Using e-learning and the theory of planned behaviour to predict Australian primary health care nurses' behavioural intentions in Chronic Kidney Disease screening practices

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Declarations

Statement of Originality

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written statement from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers.

Statement of Contribution

By signing below I confirm that **Peter M. Sinclair** contributed to the conceptualisation, design, analysis, interpretation and writing the draft of the publication entitled:

Sinclair, P.M., Kable, A., & Levett-Jones, T. (2015). The effectiveness of e-learning on clinician behaviour and patient outcomes: A systematic review protocol. *JBI Library*, 13(1), 52-64

Professor Ashley Kable Professor Tracy Levett-Jones
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Professor Liz Sullivan Date: 13/5/19
Deputy Head of Faculty, Health and Medicine

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List of publications included as part of this thesis

Chapter 2

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Abstract

The aim of this thesis by publication was to design and evaluate an intervention that sought to improve Australian general practice nurses intention to initiate a kidney health check on people who are at risk of Chronic Kidney Disease. Five papers have been published in peer reviewed journals and the sixth paper was accepted for publication on May 8, 2019.

Opportunistic screening in the general practice setting plays an integral role in the early detection and subsequent management of chronic kidney disease. However, there are significant deficits in current screening practices, despite early identification being a national kidney health priority. Consequently, there is a need to identify strategies to improve screening practices. One potential approach is to educate general practice nurses about CKD screening. Yet, equitable access to professional development opportunities, particularly for nurses in rural and remote communities, can be challenging. E-learning presents a potential solution to this issue.

An exploratory-sequential mixed methods design with a three phase approach was used for this program of work. Phase one consisted of a systematic review which identified, appraised and synthesised the best available evidence for the effectiveness of e-learning programs on healthcare professional behaviour and patient outcomes. The review identified that e-learning was at least equivalent to traditional learning approaches and superior to no instruction at all, when evaluating the effectiveness of e-learning on teaching skills (i.e. behaviour).

Phase two of the study was informed by the Theory of Planned Behaviour and sought to identify the barriers and facilitators to opportunistic CKD screening by general practice nurses through an elicitation study. Barriers were found to be complex, multi-factorial and driven by social and organisational factors. The financial costs associated with non-claimable services, regardless of patient

benefit, were hard to justify in a private business environment. This phase assisted in the development of the intervention and its associated instruments in phase three of this program of work.

In the third and final phase of this study, a parallel group, double blind randomised controlled trial design was used to evaluate the effectiveness of an asynchronous web-based e-learning module on general practice nurses' (n = 420) behavioural intentions in relation to opportunistic screening practices for people at risk of chronic kidney disease. Participants were randomised to a targeted behavioural e-learning program (Intervention) or a knowledge based e-learning program (Active control). It also evaluated the effectiveness of an asynchronous web-based e-learning module on general practice nurses' knowledge about chronic kidney disease risk factors and screening practices. Finally, it evaluated participants' perceived satisfaction with the e-learning module. This trial was called the CKD-DETECT study.

The intervention was designed to influence the behavioural constructs of the Theory of Planned Behaviour namely attitude, subjective norm and perceived behavioural control. Data analysis determined that there were no significant differences in behavioural intention between the intervention and control groups at follow-up, when controlling for baseline values. These results were replicated in a modified intention to treat analysis.

Regression models were used to examine the relationship between the change in the Theory of Planned Behaviour constructs and intentions at follow-up for *all* participants in the CKD-DETECT study. Irrespective of study arm, completing the study had an equivalent effect on all participants. A significant change was identified for all behavioural constructs and intention (sum). These changes were not attributed to the effect of the intervention. Attitude and perceived behavioural control models accounted for approximately 35% of the explained variance in behavioural intentions, and subjective norm accounted for

approximately 33% of the variance. The inclusion of all theoretical constructs, explained 37% of the variance in intention.

Changes in CKD knowledge were assessed using a pre-test post-test evaluative design and satisfaction scores were measured on completion of the module. Participants' baseline knowledge scores were poor, with mean pre-test scores of 3.77 [SD 1.66] out of ten. Post test scores revealed a significant improvement (mean difference 1.81, [95% CI: 1.53 – 2.09] $p < .01$), however overall final scores remained inadequate.

The CKD-DETECT trial used a purpose developed satisfaction instrument which evaluated participants' satisfaction with undertaking the e-learning module/s and their instructional design elements, particularly course design delivery. Participants in the CKD-DETECT trial rated their satisfaction with the design of the e-learning modules used as high.

This program of work was the first study to identify the barriers and facilitators of screening and evaluate an intervention specifically designed to target participants' attitudinal, normative and control barriers to chronic kidney disease screening. While this program of work achieved its stated aims, it produced mixed results. The results provide a persuasive argument for further investment and work in improving knowledge and behavioural intention to initiate opportunistic screening in the general practice setting so that we can reduce disease-related morbidity and mortality, through the early detection of people with chronic kidney disease.

Glossary

Acronym	Full description
APNA	Australian Primary Health Care Nurses Association
CKD	Chronic Kidney Disease
CONSORT	Consolidated Standards of Reporting Trials
EFA	Exploratory Factor Analysis
e-learning	Electronic Learning
GP	General Practice
GPN	General Practice Nurse
HCP	Health Care Professional
HREC	Human Research Ethics Committee
I-CV	Items Content Validity
KE-I	Knowledge Evaluation Instrument
LSAe-L	Learner Satisfaction with Asynchronous e-Learning (Instrument)
PPI	Potential Problematic Items
RN	Registered Nurse
RCT	Randomised Controlled Trial
RA	Research Assistant
SME	Subject Matter Expert
S-CV	Survey(Scale) Content Validity
TPB	Theory of Planned Behaviour
TPB-CKDISI	Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Questionnaire
UON	University of Newcastle

Chapter 1: Overview

1.1 Introduction

This thesis by publication, presents a multi-phase program of work, including the Chronic Kidney Disease DETECT (CKD-DETECT) effectiveness trial, that evaluated the impact of an e-learning program on general practice nurses (GPNs) intention to initiate opportunistic chronic kidney disease (CKD) screening (i.e. a 'Kidney Health Check') in Australia. In this introductory chapter of this program of work, the burden of CKD in Australia and challenges in detecting this largely asymptomatic disease are discussed. The development and context of E-learning are then outlined. E-learning is proposed as a potential solution to improving opportunistic CKD screening by GPNs in the Australian general practice setting. One approach to evaluating e-learning interventions is proposed. Aims and research questions are presented. The program of work is underpinned by pragmatism and an exploratory, sequential mixed methods design is used. The Theory of Planned Behaviour informs the theoretical framework. The chapter concludes with an overview of the structure of the thesis and published papers contained within them.

1.2 Background

1.2.1 Chronic Kidney Disease: A silent disease

The burden of CKD on the Australian health system is growing (ANZDATA, 2017). The need for renal replacement therapy for people with end-stage kidney disease, the terminal phase of CKD, increased by 75% between 2002 and 2015 (ANZDATA, 2017). This rise has contributed to an increase in healthcare expenditure in Australia with the total disease expenditure related to CKD, end-stage kidney disease and their associated therapies estimated to increase by 37% by 2020 compared to cardiovascular disease (Tucker *et al.*, 2014). However,

these cost estimates do not include individual out-of-pocket expenses and personal impact of CKD on peoples' lives.

CKD is a largely asymptomatic and insidious disease with 10% of Australians demonstrating clinical evidence of its presence (Australian Bureau of Statistics, 2013). The presence of CKD generally remains asymptomatic until signs of electrolyte disturbances and fluid overload develop, and at this stage clinical interventions may not delay progress of the disease (Hewitt & Elder, 2014). People whose kidney disease goes undetected have higher comparative mortality compared to those whose disease is detected (Smart & Titus, 2011).

Opportunistic screening and early detection and management of CKD by primary health care providers is an essential part of reducing mortality and the burden on the health system and individuals affected by it (Mathew & Corso 2009; Tracey *et al.,* 2013). However, in Australia, it has been reported that there are significant deficits in screening practices and evidence-based management of risk factors for CKD in the general practice setting (Razavian *et al.,* 2011; Manski-Nankervis *et al.,* 2018). Consequently, there is a need to identify ways in which opportunistic screening in the primary care setting can be improved.

General practice nurses (GPNs) are ideally placed to lead screening programs and collaborate with general practitioners in the early detection and management of CKD (Tracey *et al*., 2013). However, it is not known whether registered nurses working in primary care settings in Australia possess the requisite knowledge and skills to lead or participate in CKD screening programs. The increasing number of people with CKD will require nurses to possess a minimum set of skills and adequate knowledge to assist in its early detection. However, geographical isolation often provides significant challenges for Australian health care professionals who seek professional development opportunities (Curran *et al.,* 2006; Sinclair and Levett-Jones, 2011). E-learning programs are a useful strategy to overcome many geographical

challenges. E-learning programs can offer flexible and tailored training materials to all health professionals irrespective of location (Booth *et al.,* 2009; Sinclair *et al.,* 2011).

1.2.2 E-learning in continuing health professional education

Technological innovation has impacted social change in recent years and has been the prime driver of educational transformation (Garrison, 2011). Members of today's healthcare workforce have a professional responsibility to maintain competency in practice through achieving a minimum number of hours of continuing professional development each year (Sinclair *et al.,* 2013). Individuals seeking continuing health professional development opportunities usually source these independently according to their learning needs (Mills *et al.,* 2011). However, some encounter difficulties accessing ongoing professional development opportunities. Some professionals have limited face-to-face education opportunities (Lenthall *et al.,* 2011; Bennett *et al.,* 2014) due to geographic isolation, not being enrolled in a formal program of study, being time poor, and the overall lack of targeted short programs (Doorenbos *et al.,* 2011). E-learning is a potential solution for overcoming these challenges.

The term e-learning originated in the mid-1990s as the internet began to gather momentum (Garrison, 2011). E-learning can be broadly defined as any type of education delivered in an electronic form (Clark & Mayer, 2011). Terms such as computer-assisted learning, online learning, web-based learning and e-learning are often used synonymously but all reflect knowledge transfer via an electronic device. This broad definition allows for a gamut of multimedia to be used for the purpose of constructing and delivering information and assessing learning. Multimedia typically used in e-learning ranges from the now archaic Compact Disc Read-Only Memory (CD-ROMs), to the simple Microsoft PowerPoint, or the more advanced and complex virtual worlds such as Second Life™. E-learning can be delivered in asynchronous or synchronous formats.

Asynchronous e-learning is a student-centred e-learning experience that allows learning to occur at any time that is convenient for the learner and not governed by time, place, other learners or institutions. Alternatively, synchronous e-learning allows simultaneous interaction between students and/or with educators (for example interactive online lectures via platforms such as Blackboard Collaborate or WebEx) (Garrison, 2011).

For the purpose of this PhD program of work, e-learning is defined as an educational intervention that is mediated electronically and asynchronously via the internet. The distinction between synchronous and asynchronous delivery is important within the context of the program of work. Synchronous delivery is generally characteristic of e-learning delivered within formal education courses such as university courses and programs. Healthcare professionals can access asynchronous e-learning programs through established learning networks or affiliated professional organisations in order to meet individual learning needs and objectives (Melhuish & Falloon, 2010; Sinclair *et al.,* 2014). These learning opportunities do not require a human to facilitate learning, rather the learning activities embedded in the technology are designed to act as personal tutor.

Person-to-person interactivity is an important enabler of knowledge generation (D'Souza *et al.,* 2014) and while functionalities such as web 1.0 (discussion board and email) and more recently web 2.0 (Wikis and blogs) allow for this to occur both synchronously and asynchronously, it is usually utilized in formal educational contexts only. This can be challenging for professionals seeking quality educational opportunities but who prefer not to enrol in a formal program of study or, who wish to address a specific learning need. Alternatively, asynchronous e-learning is a more individualised approach that affords the opportunity to engage in learning at a time and location that is convenient and thus, enables the learner to balance professional development with personal and work commitments (Sinclair et al., 2014).

1.2.3 Evaluation on health-related e-learning research

Health-related e-learning research has focussed on several domains including media comparative designs (Smits *et al.,* 2012; Ghoncheh *et al.,* 2014), self-efficacy (Shen *et al.,* 2013; Blackman *et al.,* 2014), user satisfaction (Liaw, 2008; Sun *et al.,* 2008), instructional design (Cook *et al.,* 2010), knowledge outcomes (Estrella *et al.,* 2012; Bennett *et al.,* 2014), clinical skills development (Kelly *et al.,* 2009; Bloomfield & Jones, 2013), and facilitators/barriers to its use (Docherty & Sandhu, 2006). However, some fundamental methodological and philosophical flaws exist in much of the e-learning research, including the use of comparative design studies. Comparison between e-learning and traditional teaching methods is methodologically flawed because comparison groups are often heterogeneous, with multiple confounders that cannot be adjusted (Friedman, 1994; Cook, 2005). As early as 1994, researchers in computer-assisted learning were citing these limitations and calling for a revised research agenda in this area (Friedman, 1994). Cook (2005; 2009) has repeated this call and noted a paucity of e-learning research related to patient or clinical practice outcomes.

E-learning is not an educational panacea and research needs to evolve beyond pre- and post-intervention and comparative designs that only evaluate knowledge increases and user satisfaction. It is time to move towards determining whether improved self-efficacy or knowledge gained through e-learning improves patient outcomes or influences clinical behaviour change and whether these changes are sustained over time.

One suitable evaluation framework that is congruent with e-learning research is Kirkpatrick's Hierarchical Model (2006) (see Table 1.1). Level one of this model relates to student reaction and how well the learner is satisfied with the education program. Level two pertains to learning and the evaluation of knowledge, level three expands on this and considers whether the education has influenced behaviour. Finally, level four evaluates the impact on outcomes

such as cost benefit or quality improvements (Galloway, 2005; Kirkpatrick & Kirkpatrick, 2006).

Kirkpatrick's model	Description in e-learning context
Level 1- Satisfaction	Learners' perceptions of value or degree of satisfaction with the e-learning experience
Level 2a - Change in attitudes or perceptions	Changes in learner's attitudes, perceptions or confidence
Level 2b - Knowledge &/or skill acquisition	Evidence of cognitive changes or improvement in skills or knowledge
Level 3 - Behavioural change	Sustained changed (in knowledge, abilities or behaviours) over time and application of learning to clinical practice
Level 4 - Benefits in patient outcomes	Improved patient outcomes and/or patient safety

Table 1.1: Kirkpatrick's model of evaluation of educational outcomes (Adapted from Kirkpatrick and Kirkpatrick (2006).

The majority of e-learning research has focused on participant experience and knowledge acquisition, outcomes that correspond with the first two levels of Kirkpatrick's model (Lahti *et al.*, 2014). To date, few studies have examined the effectiveness of internet-based e-learning programs on HCP behaviour, which aligns with level three of Kirkpatrick's model. The proposed program of work aims to address this gap.

1.3 Problem Statement

This program of work was informed by engagement with Kidney Health Australia about clinical issues, and a critique of the literature (presented in chapter two). The identified knowledge and practice gaps included:

1. A lack of evidence about whether e-learning is an effective medium to improve health care professional behaviours and patient outcomes.

2. A lack of evidence about the barriers and facilitators to opportunistic CKD screening by General Practice nurses in Australia.
3. The extent to which e-learning is an effective medium to improve General Practice nurses' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.
4. The extent to which e-learning is an effective medium to improve General Practice nurses' knowledge about CKD risk factors and screening practices.
5. A lack of understanding about the level of satisfaction of General Practice nurses with e-learning as a medium for learning about opportunistic screening practices in people at risk of CKD.

1.4 Aims of this program of work

1. To identify, appraise and synthesise the best available evidence for the effectiveness of e-learning programs on healthcare professional behaviour and patient outcomes.
2. To identify the barriers and facilitators to opportunistic CKD screening by General Practice nurses.
3. To evaluate the effectiveness of an asynchronous web-based e-learning module on General Practice nurses' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.
4. To evaluate the effectiveness of an asynchronous web-based e-learning module on General Practice nurses' knowledge about CKD risk factors and screening practices.
5. To evaluate General Practice nurses' perceived satisfaction with an asynchronous web-based e-learning module.

1.5 Theoretical perspective: Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is one of the most widely applied models of determinants of behaviour change. It has been utilised to evaluate an extensive array of health-related behaviour change interventions including breastfeeding (Giles et al., 2007), healthy eating (Kothe, Mullan, & Butow, 2012) and physical activity (Darker et al., 2010). Recently, it has been also used to evaluate the influence of e-learning interventions including medication safety (Lapkin, Levett-Jones, & Gilligan, 2014; Omura, Levett-Jones, Stone, Maguire, & Lapkin, 2015), university student health behaviours (Epton *et al*., 2014), sun safety (Cleary et al., 2014; White *et al*., 2015) and breakfast consumption (Kothe, Mullan, & Amaratunga, 2011).

The TPB asserts that the immediate antecedent of behaviour is intention (Ajzen, 1991). Intention is influenced by three predictor variables: attitude, subjective norms and perceived behavioural control. Attitudes are influenced by knowledge, values and beliefs derived from experience and reflect an individual's positive or negative beliefs about performing a given behaviour and specifically, whether they are in favour of carrying it out. Subjective norms relate to the individual's perceived social pressure from significant others (for example: general practitioners, practice managers, or other practice nurses) to undertake the target behaviour and their motivation to adhere to such pressure. Finally, perceived behavioural control represents the degree of control the individual perceives they have over the factors that facilitate or inhibit the target behaviour (Ajzen, 2002b; Francis et al., 2004). Behavioural intention can be explained mathematically as a weighted sum of the three predictor variables (see Figure 1.1).

$$BI_B = A_B + SN_B + PBC_B$$

Where
BI = Behavioural intention
$_B$ = the behaviour
A = Attitude
SN = Subjective Norm
PBC = Perceived Behavioural Control

Figure 1.1: Explaining behavioural intention (adapted from McSwain *et al.*, 2011)

Ajzen (1991, 2002) advocates that while other factors may influence behaviour, the aggregation of attitude, subjective norms and PBC affords a more reliable and valid measure of behavioural intention than any variable alone. The more positive the attitude, subjective norms and perceived behavioural control, the more likely a behavioural intention will be formed. However, an individual also needs to have the opportunity, resources and support in order to execute the specified behaviour (Ajzen, 1991). Consequently, a behavioural intention will only result in actual behaviour if the individual has volitional control. Because intention is the antecedent of behavioural decisions, it is suitable for use as a proxy for actual behaviour (McEachan et al., 2011). The relationship between intention and behaviour predicts actual behaviour more than previous behavioural models that use isolated variables, a position supported by systematic reviews in this domain (Eccles *et al.*, 2006; Godin, Bélanger-Gravel, Eccles, & Grimshaw, 2008). More recently, a meta-analysis of 237 prospective intervention outcomes from 206 studies concluded that the TPB was a strong predictor of intention and behaviour across a range of health behaviours (McEachan *et al.*, 2011). Figure 1.2 provides a diagrammatic representation of the relationship between attitude, subjective norms, perceived behavioural control, intention and actual behaviour.

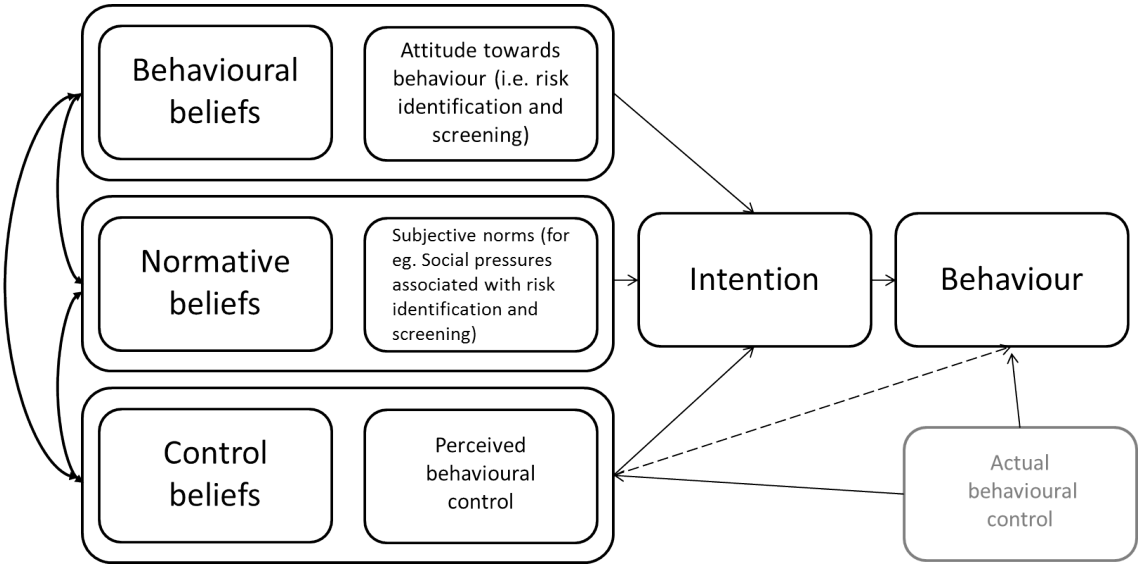

Figure 1.2: The relationship between attitudes, subjective norms, perceived behavioural control, intention and actual behaviour (Adapted from Ajzen, 2002).

By positively influencing these variables through an asynchronous e-learning intervention, it is predicted that general practice nurses' intentions to undertake a kidney health check would increase.

1.6 Research paradigm: Pragmatism

The program of work in this thesis was approached from a pragmatic worldview. A pragmatic approach centres between philosophical dogmatism and scepticism in order to identify a solution or framework to meet the aim of the research (Johnson and Onwuegbuzie 2004). The origins of Pragmatism have been traced back to American philosophers including Charles Pierce, William James and John Dewey (Teddlie, & Tashakkori, 2009). The word 'pragmatism' is derived from the Greek word *pragma*, meaning action (Pansiri, 2005).

The pragmatic researcher does not enter the paradigmatic debate attempting to resolve theoretical contradictions regarding metaphysical concepts including truth and reality. Instead, pluralistic approaches are embraced to identify 'what works' in relation to the research aims (Seaton, 2005; Teddlie, & Tashakkori,

2009). The emphasis in this study was on identifying a solution to sub-optimal CKD screening practices in general practice, and the most effective way to understand the issues and how to potentially improve them.

1.7 Research design

1.7.1 Mixed Methods

Mixed methods research is a form of inquiry that involves the combination of both qualitative and quantitative methods within a study or a body of work (Creswell and Plano Clark 2017). It extends beyond collecting both forms of data, and encompasses a pragmatic approach whereby both forms of inquiry are used together to strengthen the quality of a particular study. Consequently, a mixed methods approach is appropriate when investigating broad and complex phenomenon such as behavioural interventions (Lewin *et al.* 2009).

Approaches to mixed methods research vary and the method selected is influenced by the aims of the study. The typology of mixed methods research is classified by its time orientation and emphasis on the research approach. Time orientation can be either concurrent or sequential and refers to the timing of when the qualitative or quantitative phases occur during the study. The research approach also relates to the emphasis on the qualitative or quantitative elements of the study; for example, whether the overall study has a qualitative or quantitatively driven design or whether both paradigms have an equal emphasis. Creswell and Plano Clark (2017) suggested the inclusion of the 'level' of mixing as a further means to assist in the classification of mixed methods research. Regardless of the typology employed, the aim of the research design is to answer the research questions, hypotheses and/or aims, and a mixed methods approach can assist in a manner that mono-methods cannot (Lowenthal and Leech 2010).

Four main mixed methods approaches are referred to commonly with the literature reporting multiple variations (Creswell and Plano Clark 2017):

1. Sequential explanatory - The qualitative component proceeds a quantitative component with the qualitative data explaining the quantitative results in richer detail
2. Sequential exploratory - The qualitative component precedes a quantitative component with the qualitative data informing instrument and/or intervention design
3. Convergent (concurrent) parallel - Both the qualitative and quantitative data collection occur simultaneously, with each component afforded equal weight and the two data sets are compared after analysis and;
4. Concurrent embedded - Both the qualitative and quantitative data collection occur simultaneously, however one component is considered predominant (Curry *et al.* 2013)

This PhD program of work adopted a sequential exploratory design as it is suitable when designing, developing and evaluating new instruments and interventions (Creswell and Plano Clark 2017). This study consisted of three phases:

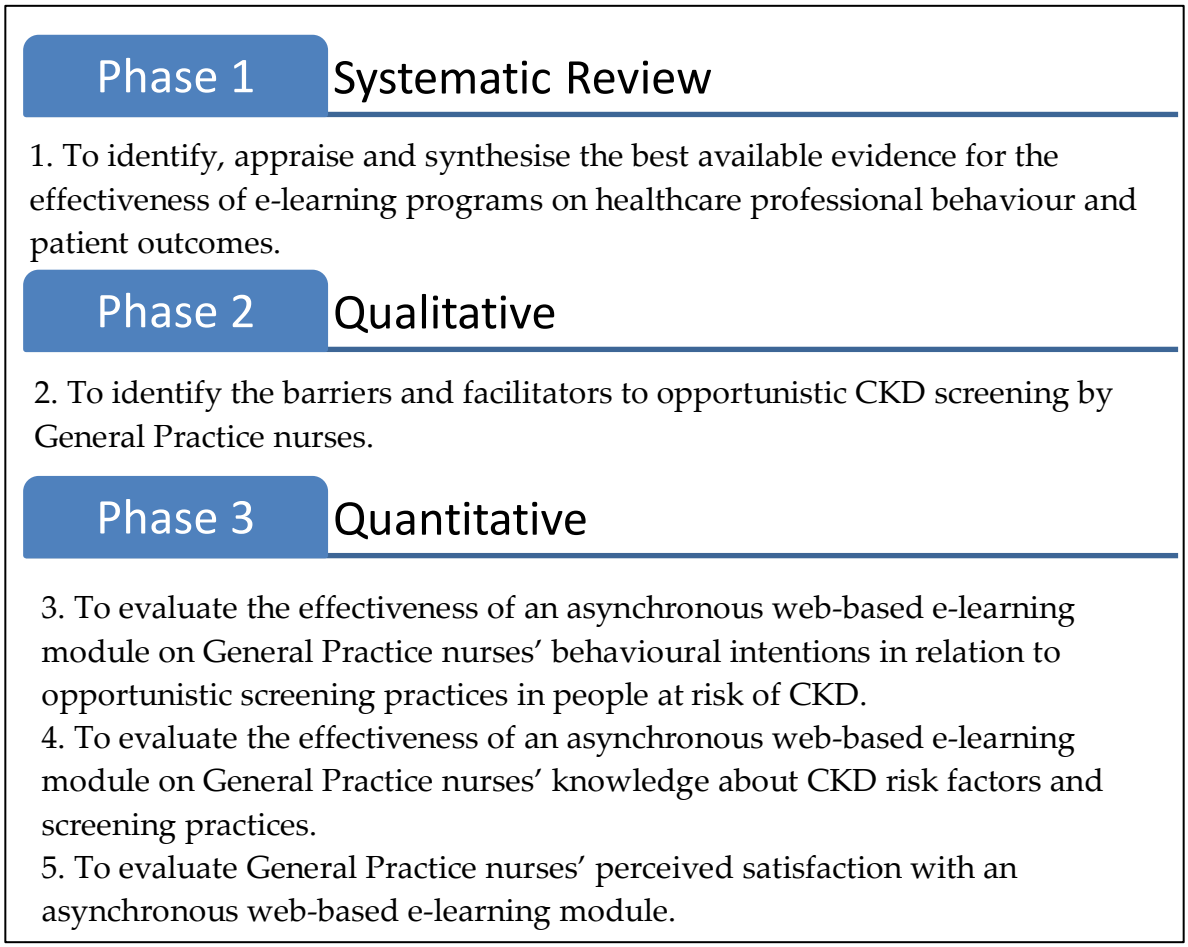

Figure 1.3: Sequential exploratory design for this program of work

This program of work includes the CKD-DETECT study - a double blind randomised controlled trial where participants were randomised to a knowledge based e-learning program (active control) or a targeted behavioural based e-learning program (intervention).

1.8 Research phases

Phase 1: Systematic review

The first phase of this research program identified, appraised and synthesised the best available evidence regarding the effectiveness of e-learning programs on health professional behaviour and patient outcomes. This subsequently informed the design and development of the main body of research reported in

this thesis. A protocol for the systematic review was developed, peer-reviewed by the Joanna Briggs Institute, and published. The systematic review was then undertaken according to the protocol and following the guidelines published by the Joanna Briggs Institute for Evidence Based Practice (2014).

Phase 2: Elicitation study and instrument development

Elicitation study

In the second phase of the study an eight-item online elicitation survey was administered to a convenience sample of 26 GPNs from both small and large general practice settings in regional New South Wales, Australia. This elicitation study was informed by the Theory of Planned Behaviour and sought to identify the barriers and facilitators to opportunistic CKD screening by participants. Each item was designed to elicit information regarding the predictor constructs of the Theory of Planned Behaviour model (behavioural (attitudinal), normative and control beliefs) as applied to opportunistic CKD screening in the General Practice setting. Items were designed to determine:

1. The most frequently perceived advantages and disadvantages of performing opportunistic screening for CKD (attitudes);
2. The most important people or groups of people who would approve or disapprove of screening for CKD in the General Practice setting (subjective norms) and,
3. The perceived barriers or facilitating factors which could make it easier or more difficult to adopt opportunistic CKD screening practices (Perceived Behavioural Control).

A directed content and frequency analysis of participant responses, as described by Hsieh and Shannon (2005) was conducted independently by two researchers. After the two researchers completed their independent review, they met to review findings and identify discrepancies. Differences were

resolved through discussion and negotiated consensus. These data enabled the construction of the Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI) as discussed in Chapter 4 as well informing the development of the intervention used in the final phase of this work.

The elicitation study provided insights into the salient beliefs and perceptions of General Practice Nurses regarding CKD screening practices. It identified seven attitudinal, five normative and seven control beliefs. These data provided new knowledge about the enablers and barriers to CKD screening, albeit in regional areas of New South Wales, Australia. These findings were used in two ways, firstly to develop the TPB-CKDISI and secondly, to design an intervention that targeted the top 75% (as suggested by Frances et al., 2004) attitudinal, normative and control beliefs identified in the elicitation study.

Instrument development

In the absence of existing validated instruments, the proposed CKD-DETECT trial required the development of three instruments to evaluate program aims three, four and five:

Instrument 1: The Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI) was developed to measure the predictor constructs of the TPB as related to opportunistic screening practices in people at risk of CKD. The TPB-CKDISI comprised of items related to: attitude (n = 7); subjective norms (n= 4); perceived behavioural control (n= 7); behavioural intentions (n = 2); and decision difficulty (n=2). Four items were reverse scored in order to minimise extreme response and acquiescence bias.

Instrument 2: A 12 item scenario-based multiple-choice instrument to assess participants' knowledge of CKD risk factors (five items) and best practice guidelines for CKD screening (seven items).

Instrument 3: The Learner Satisfaction with Asynchronous e-Learning (LSAe-L) instrument which comprised of 30 items with seven subscales. The LSAe-L instrument was created to evaluate learner satisfaction with the way e-learning is designed to facilitate learning (i.e. instructional design).

Table 1.2 demonstrates the instruments that were developed to measure the outcomes associated with each aim. Instrument development is described in detail in Chapter 4 of this thesis.

Aims	Instrument
Aim 3: **To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.**	TPB-CKDISI
Aim 4: **To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' knowledge about CKD risk factors and screening practices.**	Knowledge evaluation instrument
Aim 5: **To evaluate GPNs' perceived satisfaction with an asynchronous web-based e-learning module.**	LSAeL instrument

Table 1.2 Instruments developed and corresponding outcomes associated with each aim.

Phase 3: Intervention and active control development and evaluation for the CKD-DETECT TRIAL

In the third and final phase of this study, a parallel group, double blind randomised controlled trial design was used to evaluate:

1. The effectiveness of a targeted asynchronous web-based e-learning module on General Practice Nurses' behavioural intentions in relation to opportunistic screening practices for people at risk of CKD.

2. The effectiveness of an asynchronous web-based e-learning module on General Practice nurses' knowledge about CKD risk factors and screening practices.
3. General Practice Nurses' perceived satisfaction with an asynchronous web-based e-learning module

Participants (n = 420) were recruited for the study via social media, primary health care network newsletters and where approved, professional email lists across Australia.

Figure 1.4 illustrates the study flow chart for the control and intervention pathways. All participants, regardless of randomisation, completed the pre/post-knowledge evaluation, TPB-CKDSI and LSAeL instruments. Participants randomised to the active control arm of the study, completed module 1 only, and then repeated the post-CKD knowledge evaluation instrument. Participants who were randomised to the intervention arm and who scored ≥ 75% on the pre-CKD knowledge instrument proceeded directly to module two. Participants who scored < 75% on the pre-knowledge instrument were required to undertake module 1, and repeat the post-CKD knowledge evaluation instrument before proceeding to module 2. The rationale for this approach was based on the need to ensure participants had a requisite level of knowledge about CKD risk factors and screening prior to undertaking the intervention. During data analysis study arms were compared because both groups completed the same module one and no differences were identified between groups. Consequently, analysis for the knowledge aim was undertaken using a pre-post evaluation approach. The satisfaction aim was analysed per protocol.

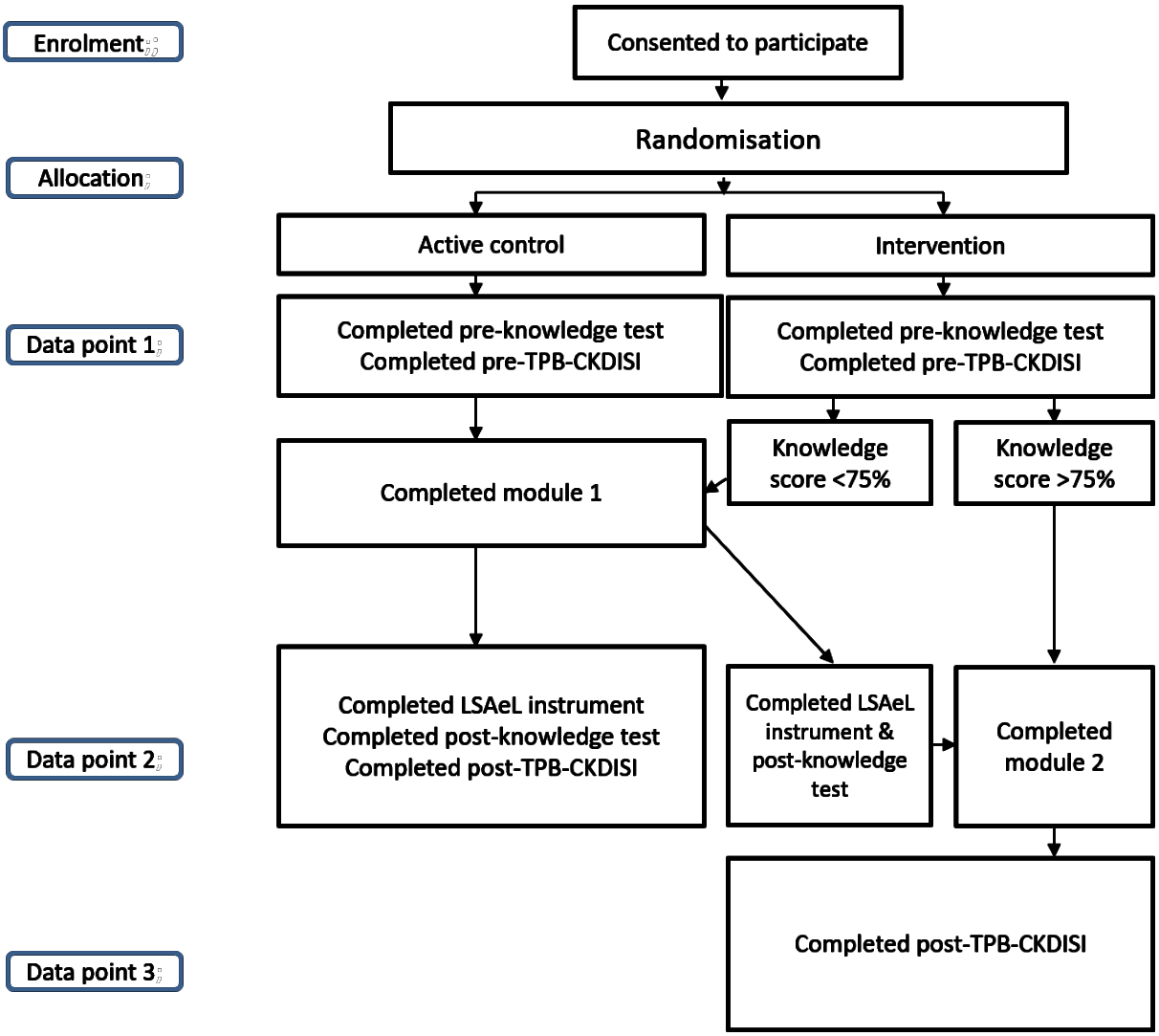

Figure 1.4: Study flow chart for the control and intervention pathways

1.9 Summary

Table 1.3 provides a summary of each phase and aims for this program of work. The research design used, the chapter and associated publications are also profiled.

Phase	Research aims	Methods	Chapter	Publication title
1	To identify, appraise and synthesise the best available evidence for the effectiveness of e-learning programs on healthcare professional behaviour	Systematic review	**2**	1. The effectiveness of e-learning on clinician behaviour and patient outcomes: A systematic review protocol
				2. The effectiveness of internet-based e-learning on healthcare professional behavior and patient outcomes: a systematic review
2	To identify the barriers and facilitators to opportunistic CKD screening by GPNs	Elicitation study	**3**	3. The barriers and facilitators to opportunistic CKD screening by general practice nurses
	Instrument development		**4**	No publication
	Development of intervention and instructional design framework		**5**	4. High engagement - High quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators
3	To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD	RCT	**6**	5. The CKD-DETECT STUDY: An RCT aimed at improving behavioural intention to initiate a Kidney Health Check in Australian practice nurses
	To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' knowledge about CKD risk factors and screening practices. To evaluate GPNs' perceived satisfaction with an asynchronous web-based e-learning module.		**7**	6. An evaluation of general practice nurses' knowledge of chronic kidney disease risk factors and screening practices following completion of a case study based asynchronous e-learning module

Table 1.3 Summary of study phases, aims, research designs, chapters and associated publications

1.10 Ethical considerations

Ethics approval for this research was obtained from the University of Newcastle Human Research Ethics Committee (HREC). All HREC approval documents are included in the Appendices including:

1. The Subject Matter Expert (SME) review of survey instruments (HREC approval: H-2015-0296) (see Appendix 1)
2. The elicitation study: Investigating practice nurses' beliefs regarding chronic kidney disease screening practices (HREC approval: H-2015-0378) (see Appendix 2)
3. The Randomised Controlled Trial: Using e-learning and the theory of planned behaviour to predict behavioural intention in Chronic Kidney Disease screening practices in Australian general practice nurses (HREC approval: H-2016-0394) (see Appendix 3)

Ethical considerations in e-learning research are situated in the wider domain of internet-based research (Esposito, 2012). Informed and voluntary consent, privacy, confidentiality, anonymity and data storage are the cornerstone ethical principles in this context (Kanuka & Anderson, 2008). The SME review of survey instruments was considered low-risk and HREC approval was expedited. A participation email request was sent with the participation statement and instructions embedded and are provided in Appendix 4. The elicitation study was also considered low-risk and HREC approval was expedited. The participant information statement is provided in Appendix 5. Participants were not required to provide any identifying information and no risks were anticipated as their participation only required them to share their beliefs at a time that was convenient for them via an online survey.

In comparison to the previous two components of this body of work, the recruitment process for the RCT required potential participants to provide personal identifying information (i.e. name and email) to the research assistant

via a weblink, a process that was necessary to register for the study. Identifying information was also required to generate continuing professional development (CPD) certificates that were generated and emailed to participants through the back end of the learning management system upon completion of the study and its surveys.

General Practice Nurses invited to participate in the CKD-DETECT trial were informed that their participation was voluntary and entirely their choice. Full disclosure of the study aims was provided. Potential participants were advised that they could withdraw from the study at any time without providing a reason. Further, they were advised that if they decided not to participate, or to withdraw from the study, their decision would not disadvantage them in any way or affect their access to the outputs (i.e. the e-learning module) of this research. The participant information statement for the RCT is presented in Appendix 6.

Informed and voluntary consent

Informed and voluntary consent was obtained from all participants prior to their involvement in the study. Informed consent is the process by which the researcher informs potential participants about the purpose and nature of the research, its aims, risks and benefits, the intervention involved and what would be expected of them if they choose to participate (Schneider *et al.* 2013). The process of acquiring informed consent requires the provision of a plain language information statement and a consent form which outlines the relevant components of the research requirements (Kanuka & Anderson, 2008). Traditional (i.e. other than online) research generally involves the signing of a paper-based consent form, with the signature confirming consent. Acquiring consent in this manner is not possible with online research, consequently electronic verification is required. Bruckman (2002) recommended that consent be obtained electronically if the following criteria are met:

1. Participants were eighteen years of age or older
2. The consent process steps potential participants through each element sequentially and
3. The risks to participants are low

This research project met all three criteria, so for the purposes of both the elicitation study and the intervention study, informed and voluntary consent was implied when the participant clicked the 'I consent to participate' button in the elicitation study and the 'Submit' button on the CKD-DETECT enrolment web page. The study enrolment page (see Appendix 7) contained the participant information statement in 'scroll box' form, outlining the purpose of the study, its aim, and what would be required of participants. The statement provided potential participants with the researcher's contact details if they had any questions relating to the study. At the end of the statement there were five declaration statements with corresponding check boxes which participants had to check in order to enrol in the study. In this way voluntary participation was assured as the participant made this choice of their own volition and free will.

Privacy and confidentiality

Confidentiality of all information was assured to all participants via the information statement. Participants' privacy was protected throughout the duration of the research project. All information acquired through the recruitment process, data collection and analysis was kept on a password protected computer only accessible by the research assistant and investigators.

Identifying data (i.e. participants' names, email addresses and study identification numbers) was stored in a separate password protected computer file only accessible by the research assistant.

Data storage

Access to the data was restricted to the research team. All data was kept on a secure password protected computer for a period of five years from the date of publication. Thereafter all data will be digitally erased following the University of Newcastle protocol for disposing of confidential data.

1.11 Contribution of the study

The asymptomatic nature of CKD increases the chances of its late detection, which is associated with higher mortality and morbidity. The early detection and management of CKD by primary health care providers is an essential part of reducing mortality and the burden on the health system and individuals affected by it (Mathew and Corso 2009; Tracey et al. 2013).

Screening practices and evidence-based management of risk factors for CKD in the general practice setting have been reported to be sub-standard (Razavian et al. 2011; Manski-Nankervis et al. 2018). Phase two identified the barriers and facilitators to CKD screening. The identification of the barriers and facilitators to CKD screening afforded the opportunity to develop and evaluate interventions to improve opportunistic screening practices. Kidney Health Australia have been providing education resources to health care professionals for over fifteen years. However, no data has been reported on the effectiveness of this education on improving knowledge or influencing behaviour.

Phase three, evaluated the effectiveness of an asynchronous web-based e-learning module on General Practice Nurses' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD. Consequently, participation in the study may improve General Practice Nurses' behavioural intention (and knowledge of CKD risk factors and screening procedures) to initiate a kidney health check. Furthermore, the CKD-DETECT trial and its subsequent results has added to the body of knowledge in both education and

kidney care domains and generated a platform on which further research in this area can be conducted.

1.12 Thesis structure

This thesis is presented as a thesis by publication. It consists of five published papers, and one publication in press.

Chapter 1: Overview

This introductory chapter outlined the structure and rationale of the thesis. The context for this study was outlined and the burden of chronic kidney disease on the Australian healthcare system was discussed. E-learning was then proposed as a way of improving practice nurses' knowledge and skills about opportunistic CKD screening practices. The phases of the program were outlined in addition to the research design used to achieve each of the study aims.

Chapter 2: Effectiveness of e-learning programs on health care professional behaviour and patient outcomes.

While there is a growing body of evidence supporting the role of e-learning in improving healthcare professionals' confidence and knowledge, it is less clear whether improved self-efficacy or knowledge gained through e-learning influences healthcare behaviour or skill development. Consequently, a systematic review was undertaken to identify, appraise and synthesise the best available evidence for the effectiveness of e-learning programs on healthcare professional behaviour and patient outcomes. **Chapter two** presents both the published protocol and review as the first and second publications of this thesis:

Sinclair, P.M., Kable, A., & Levett-Jones, T. (2015). The effectiveness of e-learning on clinician behaviour and patient outcomes: A systematic review protocol. *JBI Library*, 13(1), 52-64

Sinclair, P.M., Kable, A., Levett-Jones, T., & Booth D. (2016). The effectiveness of internet-based e-learning on healthcare professional behaviour and patient outcomes: a systematic review. *International Journal of Nursing Studies,* 57, 70-81

Chapter 3: Barriers and facilitators to opportunistic Chronic Kidney Disease screening by general practice nurses: An elicitation study

Chapter three reports the findings from the second phase of the study and is the third publication of this thesis:

Sinclair, P.M., Day, J., Levett-Jones, T., & Kable, A. (2017). The barriers and facilitators to opportunistic chronic kidney disease screening by general practice nurses. *Nephrology*. 22, 776-782. doi: 10.1111/nep.12856.

An eight-item online elicitation survey informed by the Theory of Planned Behaviour was administered to a convenience sample of 26 practice nurses. The findings provided new knowledge and clarity about the barriers and facilitators to Chronic Kidney Disease screening in the general practice context. This phase of the study also informed the design and development of the intervention and the main instrument used in phase three of this study, the Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Questionnaire (TPB-CKDISI).

Chapter 4: Instrument development for the CKD-DETECT trial

Chapter four reports the development of the three instruments used to evaluate the outcome measures of the CKD-DETECT trial:

1. The Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI)
2. A CKD risk factor and screening knowledge evaluation instrument
3. The Learner Satisfaction with Asynchronous e-Learning (LSAe-L) instrument

Chapter 5: Development of the intervention for the CKD-DETECT trial

Chapter five presents the fourth publication of this thesis:

Sinclair, P.M., Levett-Jones, T., Morris, A., Carter, B., Bennett, P.N., & Kable, A.K (2017). High engagement - High quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators. *Nursing & Health Sciences.* 19(1), 126-137

This paper describes the development of the intervention for the proposed RCT, in addition to the framework for the design and development of high engagement - high quality e-learning programs.

Chapter 6: Phase three: Part A - THE CKD-DETECT study: A Randomised Controlled Trial

Chapter six presents the results of aim three of this thesis: To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD. Additionally it reports the results of the two associated hypotheses that were tested using a double blind randomised controlled trial where participants were randomised to a knowledge based e-learning program (active control) or a targeted behavioural based e-learning program (intervention). The findings are reported in the fifth publication for this thesis:

Sinclair, P.M., Kable, A., Levett-Jones, T., Holder, C., & Oldmeadow, C. (2019). The CKD-DETECT STUDY: An RCT aimed at improving behavioural intention to initiate a Kidney Health Check in Australian practice nurses. *Journal of Clinical Nursing.* 28(15/16), 2745-2759.

Chapter 7: Phase three: Part B - THE CKD-DETECT study: Knowledge and satisfaction evaluation

Chapter seven presents the results of the secondary aims of the CKD-DETECT STUDY which evaluated participant knowledge of CKD risk factors and evidence-based screening in addition to satisfaction with the e-learning module/s. The findings are reported in the sixth publication intended for this thesis, which is currently in press in the Australian Journal of Primary Health:

Sinclair, P.M., Kable, A., Levett-Jones, T., Holder, C., & Oldmeadow, C. (in press). An evaluation of general practice nurses' knowledge of chronic kidney disease risk factors and screening practices following completion of a case study based asynchronous e-learning module. *Australian Journal of Primary Health*. Accepted May 8, 2019

Chapter 8: Discussion, recommendations and conclusion

The final and concluding chapter of this thesis reviews each of the research aims and hypotheses and provides a critical discussion of the key results reported. The significance and contribution of this program of work to new knowledge is also presented. The chapter concludes with recommendations for primary care providers, policy makers, education providers and future research.

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Chapter 2: Effectiveness of e-learning programs on Health Care Professional behaviour and patient outcomes

E-learning is an educational approach that is at least as effective as traditional forms of learning (i.e. face to face learning) in terms of knowledge generation (Lahti, Hätönen, & Välimäki, 2014). However, there is a paucity of literature that demonstrates the effectiveness of e-learning for changing healthcare professionals' (HCPs') behaviours. As discussed in Chapter 1, the majority of e-learning research has focussed on user experience, attitudes and knowledge acquisition, outcomes that correspond with the lower level evaluation of educational outcomes. Given that opportunistic CKD screening is a clinical practice behaviour, it is important that any intervention developed for this area targets behaviour change as a whole, rather than knowledge, confidence or attitude alone. Consequently, there was a need to review the current literature *to identify and appraise studies that evaluated the effectiveness of e-learning on HCP behaviours and patient outcomes,* the top two levels of educational outcomes (Kirkpatrick, 1994).

This chapter presents the following publications:

Sinclair, P.M., Kable, A., & Levett-Jones, T. (2015). The effectiveness of e-learning on clinician behaviour and patient outcomes: A systematic review protocol. *JBI Library*, 13(1), 52-64

Sinclair, P.M., Kable, A., Levett-Jones, T., & Booth D. (2016). The effectiveness of internet-based e-learning on healthcare professional behavior and patient outcomes: a systematic review. *International Journal of Nursing Studies,* 57, 70-81

2.1 Publication impact

At the time of thesis submission, the systematic review protocol had been cited 32 times and the systematic review cited 77 times.

2.2 Publication copyright

No formal license is required from Wolters Kluwer for the reproduction of publication one. Permission to reproduce publication two in this thesis has been obtained (See Appendix 8).

Publication one: The effectiveness of Internet-based e-learning on clinician behaviour and patient outcomes: a systematic review protocol

The effectiveness of internet-based e-learning on clinician behavior and patient outcomes: a systematic review protocol

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Review question/objective

The objective of this systematic review is to identify, appraise and synthesize the best available evidence for the effectiveness of internet-based e-learning programs on health care professional behavior and patient outcomes.

Background

Technological innovation has not only impacted social change in recent years but has been the prime driver of educational transformation.[1] The newest consumers of post-secondary education, the so-called 'digital natives', have come to expect education to be delivered in a way that offers increased usability and convenience.[2] Health care professionals (HCPs) in the clinical setting, particularly those in rural and remote communities, are no different.[3-5] Today's health workforce has a professional responsibility to maintain competency in practice through achieving a minimum number of hours of continuing professional development.[6] Consequently, HCPs seeking professional development opportunities are reliant on sourcing these independently according to individual learning needs.[7] However, difficulties exist in some health professionals' access to ongoing professional development opportunities, particularly those with limited access face-to-face education[8,9] due to geographical isolation or for those not enrolled in a formal program of study.[10,11] These issues challenge traditional methods of teaching delivery; electronic learning (e-learning) is at the nexus of overcoming these challenges.

The term e-learning originated in the mid-1990s as the internet began to gather momentum.[1] Electronic learning can be broadly defined as any type of educational media that is delivered in an electronic

form.[12] Terms such as computer-assisted learning, online learning, web-based learning and e-learning are often used synonymously but all reflect knowledge transfer via an electronic device. This broad definition allows for a gamut of multimedia to be used for the purpose of constructing and assessing knowledge. Multimedia typically used in e-learning range from the now archaic Compact Disc Read-Only Memory (CD-ROMs), to the simple Microsoft PowerPoint, or the more advanced and complex virtual worlds such a second life. Electronic learning can be delivered in asynchronous or synchronous formats, with the latter (for example interactive online lectures via platforms such as BlackboardCollaborate or WebEx) more commonly used in formal educational settings according to set timetables of study.[1]

Person-to-person interactivity is an important enabler of knowledge generation and while functionalities such as web 1.0 (discussion board and email) and more recently web 2.0 (Wikis and blogs) allow for this to occur both synchronously and asynchronously, it is usually utilized in formal educational contexts only. However, the economy of formal education does not allow for free access to courses which proves challenging for HCPs seeking quality educational opportunities who choose not to undergo a formal program of study or are just looking to meet a specific learning need. Alternatively, asynchronous e-learning is a more learner-centred approach that affords the opportunity to engage in learning at a time and location that is convenient and enables the learner to balance professional development with personal and work commitments.[13] These learning opportunities are self-directed and do not require a human to facilitate learning, rather, technology officiates/facilitates the learning process and, in the asynchronous e-learning context, the learner negotiates meaning independently.[14]

Health-related e-learning research has focused on several domains including media comparative designs[15,16], self-efficacy[17,18], user satisfaction[19,20], instructional design[21], knowledge outcomes[9,22-28], clinical skills development[17,29,30], and facilitators/barriers to its use.[31] The benefits of e-learning are well documented in terms of increased accessibility to education, efficacy, cost effectiveness, learner flexibility and interactivity.[32] However, some fundamental methodological and philosophical flaws exist in e-learning research, not least the use of comparative design studies. Comparison between e-learning and traditional teaching methods are illogical and methodologically flawed because comparison groups are heterogeneous, lack uniformity and have multiple confounders that cannot be adjusted for.[33,34] As early as 1994, researchers[34] in computer-assisted learning were citing these limitations and called for a fresh research agenda in this area. Cook[33,35] repeated this call in 2005 and again in 2009 and noted a paucity of research related to patient or clinical practice outcomes. Electronic learning is not an educational panacea and research needs to progress from pre- and post-interventional and comparative designs that evaluate knowledge increases and user satisfaction. It is time to move towards determining whether improved self-efficacy or knowledge gained through e-learning improves patient outcomes or influences clinical behavior change and whether these changes are sustained. In order to develop the empirical evidence base in e-learning, research needs to be guided by established theoretical frameworks and use validated instruments to move from assessing knowledge generation towards improving our understanding of whether e-learning improves HCP behavior and more importantly, patient outcomes.

One suitable framework that is congruent with e-learning research is Kirkpatrick's[36] four levels of evaluation. Kirkpatrick's model is hierarchically based with level one relating to student reaction and how well the learner is satisfied with the education program. Level two pertains to learning and the

evaluation of knowledge, level three expands on this and considers whether the education has influenced behavior. In the context of this review, behavior change is any practice that is intrinsically linked with the outcomes of the e-learning program undertaken. Finally, level four evaluates the impact on outcomes such as cost benefit or quality improvements.[36,37] The majority of e-learning research has focused on participant experience and knowledge acquisition, outcomes that correspond with the first two levels of Kirkpatrick's model. [38] To date, few studies have examined the effectiveness of internet-based e-learning programs on HCP behavior, which aligns with Level 3 of Kirkpatrick's model.

Studies exist that use self-reported measures of intention to change behavior,[39,40] however self-reported intention to change does not necessarily translate into actual behavior change.[41] Studies that have not used self-reported measures of behavior change have used objectively measured evaluation criteria including objective structured assessment of technical skills (OSATS) using various methods including simulation task trainers[42] and clinical simulations using standardized patients[43] scored by a panel of experts using standardized assessment tools. Carney et al.[44] used a national reporting and data system to measure the impact of a single one hour e-learning program undertaken by radiologists (*n*=31) aimed at reducing unnecessary recall during mammography screening. Carney et al. reported a null effect and attributed this to the complexities of behavior change, suggesting that longer term reinforcement of principles relating to mammography recall was required to effect behavior change. These findings also suggest that a multi-modal intervention may be required in order to reduce excessive recall rates in this area, rather than a single intervention. Contrary to Carney et al., Pape-Koehler et al.[42] and Smeekins et al.[43] reported positive findings using randomized controlled designs to test the efficacy of e-learning interventions on individual's surgical performance[42] and the detection of child abuse[43], respectively. Pape-Koehler et al. used a 2x2 factorial design to demonstrate that an e-learning intervention significantly improved novice surgeon (*n*=70) surgical performance of a laparoscopic cholecystectomy (change between pre-post test OSATS *p* 0.001) when used in isolation or in combination with a practical training session compared to practical training alone. Smeekins et al. demonstrated that a 2 hour e-learning program improved nurses' (*n*=25) ability to detect child abuse in an emergency department. The nurses in the intervention (*n*=13) group demonstrated significantly better (*p*=0.022) questioning techniques and consequently, higher quality history taking, to determine children at risk of child abuse when compared with the control group who received no training at all.

These three exemplar studies demonstrate the broad range of applications e-learning has in HCP education, as each study used different designs, had different subject areas and target health care professionals. This reflects the conceptual and practical challenges of the area of research that addresses levels three of Kirkpatrick's model. For this reason, the e-learning research agenda in health should focus on whether knowledge generated through e-learning is able to be re-contextualized into clinical practice, and influence sustained clinical behavior change and patient outcomes.

A preliminary search of PubMed, CINAHL, The Cochrane Library, The JBI Database of Systematic Reviews and Implementation Reports, ERIC and PROSPERO was conducted to determine if a systematic review on the topic of interest already existed. This search identified four systematic reviews that specifically reviewed outcome measures of knowledge and skill improvement in the domain of e-learning. Two[38,45] examined research conducted in nursing, with the other two[46,47] in orthodontics. Lahti et al.[38] systematic review examined the impact of e-learning on nurses' and nursing students' knowledge, skills and satisfaction. Lahti et al.[38] were unable to demonstrate a statistical difference

between cohorts undertaking e-learning compared to conventional teaching methods, findings that were not replicated by Du et al.[45] This may be due to the decision by Lahti et al. to include studies that utilized CR-ROM and that, despite being published in 2014, the actual review took place in 2010 and did not capture several significant studies published after this date. The systematic review by Du et al.[45] examined the efficacy of online distance education in terms of knowledge acquisition and retention, and skill performance in employed nurses and nursing students. This review identified nine randomized controlled trials (RCTs) of which five studies considered skill performance. Four of these studies demonstrated superior or equivalent improvement in skills compared to control groups. Similar findings were noted in two other systematic reviews conducted by Al-Jewair et al.[46,47] who concluded that computer-aided learning was at least as efficacious as conventional teaching methods in improving knowledge in undergraduate and postgraduate orthodontic students and educators.

These reviews included blended and fully online studies of varying instructional design quality. Seven out of the nine studies identified by Du et al. utilized interactive elements to facilitate communication between students and teachers which would confound the results of the review given that interactivity in this manner is known to improve the user experience and knowledge outcomes.[48] To date, there are no database-indexed systematic reviews that identify, appraise and synthesize the best available evidence for the effectiveness of internet-based e-learning programs on HCP behavior and patient outcomes using objectively administered evaluation criteria.

Keywords

E-learning; clinician behavior; patient outcomes

Inclusion criteria

Types of participants

This review will consider studies whose participants were HCPs in any health care context.

For the purpose of this review, a HCP will be any individual who requires a degree qualification to practice in their respective field

Types of intervention(s)

This review will consider studies that evaluated an internet-based e-learning program.

For the purposes of this review internet-based e-learning programs are defined as any asynchronous educational intervention that is mediated electronically via the internet.

Types of outcomes

This review will consider studies that include the following outcome measures:

• Impact on clinician behavior measured using objectively administered evaluation criteria

• Impact on patient outcomes measured using objectively administered evaluation criteria

For the purposes of this review, impact on clinician behavior is defined as the degree to which the intervention influenced their ability to perform the skill for which the intervention was designed. For the purposes of this review, impact on patient outcomes is defined as the degree to which patients' health care outcomes were affected (either positively or negatively) as a result of the intervention.

Types of studies

This review will consider any RCTs and quasi-RCTs. In the absence of RCTs and quasi-RCTs, other research designs such as non-randomized before and after studies and analytical and descriptive observational studies will be considered.

Search strategy

The search strategy aims to find both published and unpublished studies using a variety of databases. A three-step search strategy will be utilized in this review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Thirdly, the reference lists of all identified reports and articles will then be searched for additional studies. Studies in English published from 2004 to August, 2014 will be considered for inclusion in this review. This time frame was selected on the basis that recent systematic reviews in the domain of e-learning (Du et al.[45] and Lahti et al.[38]) identified suitable papers from the year 2004 onwards.

The databases to be searched include:

• CINAHL

• Cochrane - CENTRAL

• Embase

• ERIC

• MEDLINE

• Mosby's Index

• Scopus

Grey literature

A search for unpublished studies using Google Scholar, Mednar and Proquest will be undertaken to locate any relevant policies, government reports, dissertations, theses and conference proceedings.

Initial Search Terms

The following search terms will be used:

• Internet-based learning, computer based learning, computer assisted learning, web based learning, online learning, e-learning, distance education, internet, educational technology, information communication and technology

• Clinical assessment, psychomotor skill, behavior

• Patient outcomes

• Quantitative

• Healthcare professional

Assessment of methodological quality

Papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

Data collection

Two reviewers will extract data independently from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data synthesis

Quantitative data will, where possible be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square and also explored using subgroup analyses based on the different quantitative study designs included in this review. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate. These results will be combined to arrive at a conclusion from the research

Conflicts of interest

The authors declare no conflicts of interest exist.

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Appendix I: Appraisal instruments

MAStARI appraisal instrument

JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Was the assignment to treatment groups truly random?	☐	☐	☐	☐
2. Were participants blinded to treatment allocation?	☐	☐	☐	☐
3. Was allocation to treatment groups concealed from the allocator?	☐	☐	☐	☐
4. Were the outcomes of people who withdrew described and included in the analysis?	☐	☐	☐	☐
5. Were those assessing outcomes blind to the treatment allocation?	☐	☐	☐	☐
6. Were the control and treatment groups comparable at entry?	☐	☐	☐	☐
7. Were groups treated identically other than for the named interventions	☐	☐	☐	☐
8. Were outcomes measured in the same way for all groups?	☐	☐	☐	☐
9. Were outcomes measured in a reliable way?	☐	☐	☐	☐
10. Was appropriate statistical analysis used?	☐	☐	☐	☐
	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

JBI Critical Appraisal Checklist for Descriptive / Case Series

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Was study based on a random or pseudo-random sample?	☐	☐	☐	☐
2. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
3. Were confounding factors identified and strategies to deal with them stated?	☐	☐	☐	☐
4. Were outcomes assessed using objective criteria?	☐	☐	☐	☐
5. If comparisons are being made, was there sufficient descriptions of the groups?	☐	☐	☐	☐
6. Was follow up carried out over a sufficient time period?	☐	☐	☐	☐
7. Were the outcomes of people who withdrew described and included in the analysis?	☐	☐	☐	☐
8. Were outcomes measured in a reliable way?	☐	☐	☐	☐
9. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Appendix II: Data extraction instruments

MAStARI data extraction instrument

JBI Data Extraction Form for Experimental / Observational Studies

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Study Method

RCT ☐ Quasi-RCT ☐ Longitudinal ☐

Retrospective ☐ Observational ☐ Other ☐

Participants

Setting _____

Population _____

Sample size

Group A _____ Group B _____

Interventions

Intervention A _____

_____

Intervention B _____

_____

Authors Conclusions:

_____

_____

_____

Reviewers Conclusions:

_____

_____

_____

Study results

Dichotomous data

Outcome	Intervention ( ) number / total number	Intervention ( ) number / total number

Continuous data

Outcome	Intervention ( ) number / total number	Intervention ( ) number / total number

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Review

The effectiveness of Internet-based e-learning on clinician behaviour and patient outcomes: A systematic review

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ABSTRACT

Background: The contemporary health workforce has a professional responsibility to maintain competency in practice. However, some difficulties exist with access to ongoing professional development opportunities, particularly for staff in rural and remote areas and those not enrolled in a formal programme of study. E-learning is at the nexus of overcoming these challenges. The benefits of e-learning have been reported in terms of increased accessibility to education, improved self-efficacy, knowledge generation, cost effectiveness, learner flexibility and interactivity. What is less clear, is whether improved self-efficacy or knowledge gained through e-learning influences healthcare professional behaviour or skill development, whether these changes are sustained, and whether these changes improve patient outcomes.

Objective: To identify, appraise and synthesise the best available evidence for the effectiveness of e-learning programmes on health care professional behaviour and patient outcomes.

Design: A systematic review of randomised controlled trials was conducted to assess the effectiveness of e-learning programmes on clinician behaviour and patient outcomes. Electronic databases including CINAHL, Embase, ERIC, MEDLINE, Mosby's Index, Scopus and Cochrane – CENTRAL were searched in July 2014 and again in July 2015.

Quality assessment and data extraction: Studies were reviewed and data extracted by two independent reviewers using the Joanna Briggs Institute standardised critical appraisal and data extraction instruments.

Data synthesis: Seven trials met the inclusion criteria for the analysis. Due to substantial instructional design, subject matter, study population, and methodological variation between the identified studies, statistical pooling was not possible and a meta-analysis could not be performed. Consequently, the findings of this systematic review are presented as a narrative review.

Results: The results suggest that e-learning was at least as effective as traditional learning approaches, and superior to no instruction at all in improving health care professional behaviour. There was variation in behavioural outcomes depending on the skill being taught, and the learning approach utilised. No papers were identified that reported the effectiveness of an e-learning programme on patient outcomes.

Conclusion: This review found insufficient evidence regarding the effectiveness of e-learning on healthcare professional behaviour or patient outcomes, consequently further

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research in this area is warranted. Future randomised controlled trials should adhere to the CONSORT reporting guidelines in order to improve the quality of reporting, to allow evaluation of the effectiveness of e-learning programmes on healthcare professional behaviour and patient outcomes.

What is already known about the topic?

- The use of e-learning continues to proliferate in healthcare professional education.
- e-Learning is at least as effective as traditional learning methods for knowledge acquisition and user satisfaction, however there is a need for ongoing rigorous research to evaluate behaviour change and patient outcomes.

What this paper adds

- There continues to be a lack of rigorously designed randomised controlled trials evaluating the effectiveness of e-learning on healthcare professional behaviour and patient outcomes.
- Further research is required to determine asynchronous e-learnings effectiveness on behaviour change using objective measurement scales.
- A need exists to develop and validate alternate objective measures that are informed by sound theoretical constructs to evaluate e-learning behavioural outcomes.

1. Introduction

Technological innovation has not only impacted social change in recent years but has been the prime driver of educational transformation (Garrison, 2011). The newest consumers of post-secondary education, the so-called 'digital natives', have come to expect education to be delivered in a way that offers increased usability and convenience (Palfrey and Gasser, 2013). Health care professionals (HCPs) in the clinical setting, particularly those in rural and remote communities, have similar expectations in regards to continuing professional development (Maloney et al., 2013; Sinclair and Levett-Jones, 2011; Wellard and Bethune, 2000). Today's health workforce has a professional responsibility to maintain competency in practice through achieving a minimum number of hours of continuing professional development each year (Sinclair et al., 2013). Consequently, HCPs seeking educational opportunities are reliant on sourcing these independently according to individual learning needs (Mills et al., 2011). However, difficulties exist with some health professionals' access to ongoing professional development, particularly those with limited opportunities for face-to-face education (Bennett et al., 2014; Lenthall et al., 2011) due to geographical isolation or for those not enrolled in a formal programme of study (Curran et al., 2006; Doorenbos et al., 2011). These issues challenge traditional methods of teaching delivery; and electronic learning (e-learning) is at the nexus of overcoming these challenges.

The term e-learning originated in the mid-1990s as the Internet began to gather momentum (Garrison, 2011). Electronic learning can be broadly defined as any type of educational media that is delivered in an electronic form (Clark and Mayer, 2011). Terms such as computer-assisted learning, online learning, web-based learning and e-learning are often used synonymously but all reflect information delivery via an electronic device. This broad definition allows for a gamut of multimedia to be used for the purpose of constructing, delivering and assessing knowledge learned. Multimedia typically used in e-learning ranges from the now archaic Compact Disc Read-Only Memory (CD-ROMs), to the simple Microsoft PowerPoint, or the more advanced and complex virtual worlds such a second life. Electronic learning can be delivered in asynchronous[1] or synchronous[2] formats, with the latter (for example interactive online lectures via platforms such as BlackboardCollaborate or WebEx) more commonly used in formal educational settings with set timetables of study (Garrison, 2011).

For the purpose of this review, e-learning is defined as any educational intervention that is mediated electronically via the Internet asynchronously. The distinction between synchronous and asynchronous delivery is important within the context of this review. HCPs seeking specific knowledge are reliant on sourcing information independently via the Internet, journals, textbooks or other colleagues. Alternatively, they can access asynchronous e-learning programmes that are available through established learning networks or affiliated professional organisations in order to meet individual learning needs and objectives (Melhuish and Falloon, 2010; Sinclair and Levett-Jones, 2011; Sinclair et al., 2014). Asynchronous e-learning is a learner-centred approach that affords the opportunity to engage in learning at a time and location that is convenient and enables the learner to balance professional development with personal and work commitments (Sinclair et al., 2014). These learning opportunities are self-directed and do not require a human to facilitate learning, rather, technology officiates/facilitates the learning process and, in the asynchronous e-learning context, the learner negotiates meaning independently (Melhuish and Falloon, 2010).

The measurement of learning outcomes from health-related e-learning research has focused on several domains

[1] A student centred e-learning experience that allows learning to occur at any time that is convenient to the learner and not governed by time, place, other learners or institutions.

[2] An e-learning experience that allows simultaneous interaction between students and/or educators.

including self-efficacy (Blackman et al., 2014; Shen et al., 2013), user satisfaction (Liaw, 2008; Sun et al., 2008), knowledge outcomes (Alemagno et al., 2010; Atack and Luke, 2008; Beeckman et al., 2008; Bennett et al., 2014; Brunero and Lamont, 2010; Estrella et al., 2012; Larsen and Zahner, 2011; Tait et al., 2008), clinical skills development (Blackman et al., 2014; Bloomfield and Jones, 2013; Kelly et al., 2009), as well as instructional design (Cook et al., 2010) and facilitators/barriers to its use (Docherty and Sandhu, 2006). The benefits of e-learning are well reported in terms of increased accessibility to education, efficacy, cost effectiveness, learner flexibility and interactivity (Ehlers and Pawlowski, 2006). What is less clear is whether improved self-efficacy or knowledge gained through e-learning influences healthcare professional behaviour or skill development, whether these changes are sustained, and ultimately whether these changes have a positive impact on patient outcomes.

2. Aim

The aim of this systematic review is to identify, appraise and synthesise the best available evidence for the effectiveness of asynchronous e-learning programmes on healthcare professional behaviour and patient outcomes.

3. Methods

This paper reports a systematic review and is structured in accord with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009).

3.1. Search strategy and selection criteria

The review protocol (Sinclair et al., 2015) aimed to identify both published and unpublished studies using a variety of databases. A three-step search strategy was utilised. An initial limited search of MEDLINE and CINAHL was undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe identified articles. A second search, using all identified keywords and index terms was then undertaken across all included databases. Finally, the reference lists of all identified reports and articles were searched for additional studies. Studies in English published from 2004 to July 2015 were considered for inclusion in the review. This time frame was selected on the basis that recent systematic reviews in the domain of e-learning (Du et al., 2013; Lahti et al., 2014) only identified suitable papers from the year 2004 onwards. A search for unpublished studies using Google Scholar, Mednar and Proquest was undertaken to locate any relevant dissertations, theses or conference proceedings. Quantitative terms used for identifying randomised controlled trials were informed by the Cochrane Highly Sensitive Search Strategy for Medline (Higgins and Green, 2008) and adapted for each database searched to maximise identification of relevant studies. The search was first conducted in July 2014 and again in July 2015. The search strategy was devised by the primary author in conjunction with the faculty librarian.

The databases of CINAHL, Cochrane – Other Reviews, Cochrane Trials, Cochrane Review, Embase, ERIC, JBI, Medline, Mosby's Index, and Scopus were searched using the following search terms: (Internet/computer/web based learning OR computer assisted learning OR online learning OR e-learning OR distance education OR Internet OR educational technology OR information communication and technology) AND (clinical assessment OR patient behaviour) AND health professionals (various terms) AND quantitative terms (random*, RCTs OR before and after stud* OR intervention* OR experimental OR quantitative stud*). The database search results are available as additional online material.

3.2. Inclusion/exclusion criteria

All identified papers were assessed against the inclusion and exclusion criteria as outlined in Sinclair et al. (2015). This review considered studies that evaluated any asynchronous educational intervention that was mediated electronically via the Internet. Participants were Health Care Professionals (HCPs), working in any health care context. A HCP was considered to be any individual who requires a degree qualification, or was working towards one, to practice in their respective field. The identification of Randomised Controlled Trials (RCTs) and quasi-RCTs was the primary focus. In the absence of RCTs and quasi-RCTs, other research designs such as non-randomised before and after studies and analytical and descriptive observational studies were considered.

This review only considered studies that evaluated the intervention's impact on clinician behaviour or patient outcomes using objectively administered evaluation criteria. For the purposes of this review, impact on clinician behaviour was defined as the degree to which the intervention influenced their ability to perform the skill for which the intervention was designed. The impact on patient outcomes was defined as the degree to which patients' health care outcomes were affected (either positively or negatively) as a result of the intervention.

Papers were excluded if the studies reported findings related to user experience or knowledge increase exclusively; experiences or attitudes of educators regarding e-learning; mobile learning interventions or the evaluation of blended learning interventions exclusively or; interventions that utilised any form of learner–teacher or learner–learner interaction.

3.3. Appraisal of methodological quality

Papers selected for retrieval were appraised by two independent reviewers for methodological validity (eligibility) prior to inclusion in the review using the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument standardised critical appraisal instrument[3] (JBI-MAStARI, see Table 1). This process afforded increased methodological rigour, and evaluated potential

[3] JBI critical appraisal checklist for randomised control/pseudo-randomised trial and descriptive/case series.

Table 1
MAStARI critical appraisal tool for Randomised Control/Pseudo-randomised Trial A cut-off score of six was agreed prior to appraisal, unless a paper met criteria 6–10 in full, otherwise scores below six resulted in the paper being excluded from the review on methodological grounds (see Table 2).

MAStARI critical appraisal tool question	Potential bias
1. Was the assignment to treatment group truly random?	Selection bias
2. Were participants blinded to treatment allocation?	Selection bias
3. Was allocation to treatment groups concealed from the allocator?	Selection bias
4. Were the outcomes of people who withdrew described and included in the analysis?	Attrition bias
5. Were those assessing outcomes blind to treatment allocation?	Ascertainment bias
6. Were the control and treatment groups comparable at entry?	Design bias
7. Were groups treated identically other than the named intervention	Systematic difference/contamination bias
8. Were outcomes measured in the same way for all groups?	Psychometric veracity of instruments
9. Were outcomes measured in a reliable way?	Detection/instrument/measurement bias
10. Was appropriate statistical analysis used?	Performance/detection bias

bias and threats to validity (Joanna Briggs Institute, 2014). Both reviewers were trained in the use of the appraisal tools prior to this process. A minimum quality threshold criterion was established and agreed between the two reviewers prior to review, and higher weighting was placed on criteria six to ten. Any disagreements that arose between the reviewers were resolved through discussion. Criteria such as participant blinding and allocation concealment were considered less applicable due to the nature of the educational research being reviewed.

3.4. Data extraction

Data were reviewed by two independent reviewers from included papers using the JBI-MAStARI data extraction instrument. The data included details about the interventions, populations, study methods and outcomes of significance to the review question and aim.

3.5. Data synthesis

Data synthesis was conducted by the primary author and discussed regularly with the research team. Due to substantial instructional design, clinical, population, comparator and methodological variation between the identified studies, statistical pooling was not possible and a meta-analysis could not be performed. Consequently, the findings of this systematic review are presented as a narrative review.

4. Results

4.1. Search results

A total of 943 papers were identified in the initial search (see Fig. 1 – systematic review flow diagram). Duplications were identified and deleted after exporting the results into the reference management database Endnote®. A preliminary review of the titles and abstracts resulted in the identification of 22 papers for review. An additional two potential papers were identified from a manual review of the remaining papers reference lists. No additional papers were identified in the search of the grey literature. The papers for these studies were retrieved, read and assessed using the inclusion and exclusion criteria leaving 12 papers, which were then assessed for quality using the JBI MAStARI appraisal tool. Five papers were excluded on methodological grounds (see Table 3) leaving a total of seven papers for the review. The key features of the studies included in this review are summarised in Table 4.

4.2. Characteristics of included studies

Papers included in the final review originated from six countries, Germany, United States of America (2), Spain, Turkey, Holland and the United Kingdom, and were published between 2010 and 2013. Five studies were randomised controlled trials utilising pre-post experimental designs (Cantarero-Villanueva et al., 2012; Durmaz et al., 2012; Gordon et al., 2011; Pape-Koehler et al., 2013; Smeekens et al., 2011), one was a randomised controlled trial utilising a post only experimental design (Elgie et al., 2010). The type of randomisation varied between all studies. Finally, Bandla et al. (2012) reported a quasi-experimental prospectively controlled study. All studies utilised parallel designs with the exception of one that employed a 2×2 factorial design (Pape-Koehler et al., 2013).

There was substantial variation in the methodological quality of the seven studies included in this review (see Table 2). No studies fulfilled all the criteria to be recognised as a high-quality study. The main threats to the internal validity of included studies were from selection and attrition bias. Selection bias was anticipated by the authors prior to the search due to the practical limitations associated with educational research. Attrition bias was evident in most studies and only two studies reported intention to treat analyses (Durmaz et al., 2012; Elgie et al., 2010).

4.3. Outcome measures

Although the papers included in this systematic review report multiple outcome measures including knowledge increase and satisfaction with e-learning, the focus of this systematic review is on healthcare professional behaviour change and patient outcomes, therefore only results in this area will be discussed.

All studies reported designs which utilised objectively administered evaluation criteria to measure a diverse range of clinical skills in sleep medicine, palpation and ultrasound, pre/post-operative care (patient admission

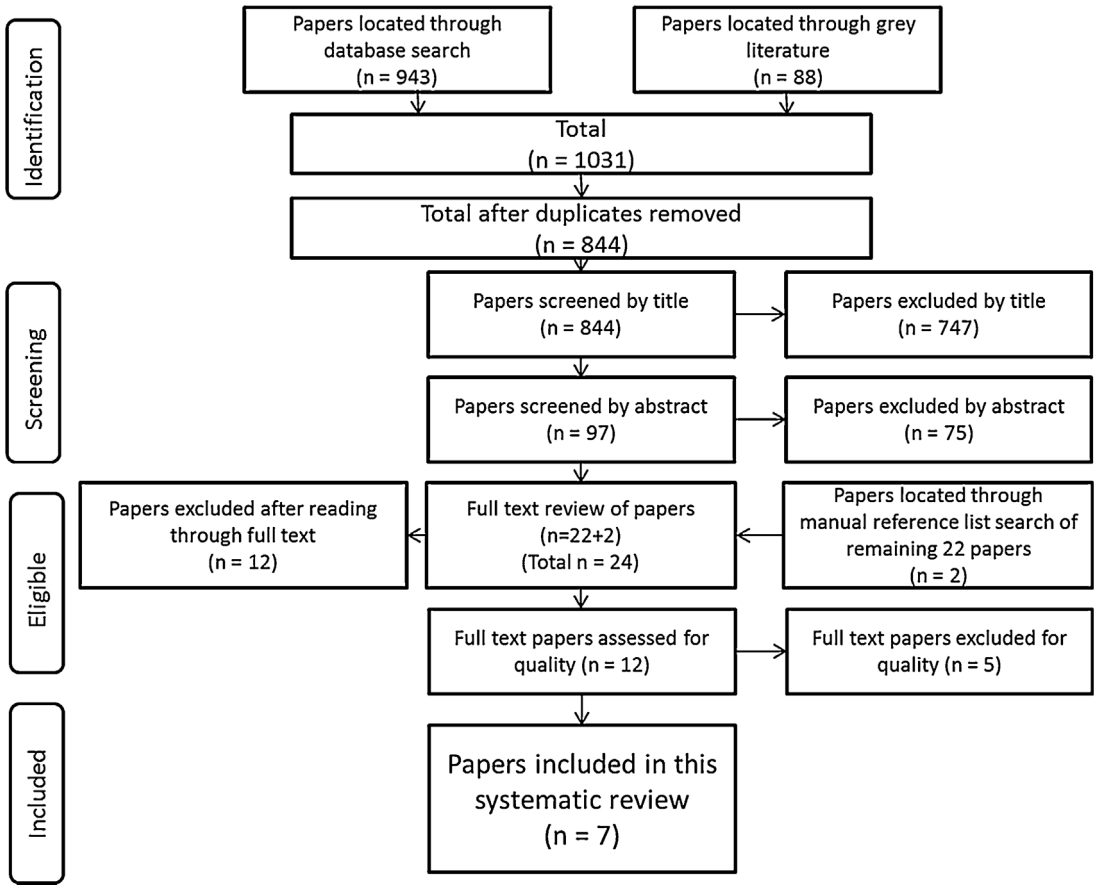

Fig. 1. Systematic review flow diagram.
Adapted from Moher et al. (2009).

and deep breathing and coughing exercises), emergency preparedness, child abuse screening, and laparoscopic cholecystectomy. All studies, with the exception of Gordon et al. (2011) who used an online prescribing assessment module, utilised simulation-type scenarios with objective evaluation criteria as a basis to measure outcomes. Elgie et al. (2010) and Smeekens et al. (2011) used a simulated on-site emergency scenario and standardised patient simulation respectively plus evaluation criteria to measure outcomes in their studies. Three studies utilised Objective Structured Clinical Examination (OSCE) (Bandla et al., 2012; Cantarero-Villanueva et al., 2012; Durmaz et al., 2012); and one utilised an Objective Structured Assessment of Technical Skills (OSAT) (Pape-Koehler et al., 2013). Only two studies to reported assessment of inter-rater reliability (Elgie et al., 2010; Pape-Koehler et al., 2013). Smeekens et al. (2011) utilised a panel of subject matter experts but did not report any assessment of inter-rater reliability. No other studies reported evidence of the psychometric integrity of the tools used in measuring study outcomes. All seven studies reported healthcare professional behaviour change in terms of ability to perform a targeted clinical skill for which the intervention was designed. The search strategy did not identify any

Table 2
Results of methodological appraisal.

MAStARI question	Q1	Q2	Q3	Q4	Q5	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Score**
Authors											
Bandla et al. (2012)	N	N	U	N	U	Y	Y	Y	Y	Y	5
Cantarero-Villanueva et al. (2012)	Y	Y	U	N	U	Y	N	Y	Y	Y	6
Durmaz et al. (2012)	Y	N	N	Y	U	Y	N	Y	Y	Y	6
Elgie et al. (2010)	N	N	N	Y	Y	N	Y	Y	Y	Y	6
Gordon et al. (2011)	Y	N	Y	U	Y	Y	Y	Y	Y	Y	8
Pape-Koehler et al. (2013)	N	Y	Y	U	Y	Y	Y	Y	Y	Y	8
Smeekens et al. (2011)	Y	U	U	N	Y	Y	Y	Y	Y	Y	7

Y = yes, N = no, U = unclear, NA = not applicable response for each question.

appropriate studies that met the inclusion criteria that reported patient outcomes.

4.4. Participant characteristics

Inclusion/exclusion criteria and sample and power calculations were only reported in three studies (Cantarero-Villanueva et al., 2012; Gordon et al., 2011; Pape-Koehler et al., 2013). The failure to report sample size or power calculations, may indicate that some studies were not sufficiently powered to detect intervention effects on the target outcomes, possibly increasing the risk of type II statistical error. Participant numbers ranged from 38 (Smeekens et al., 2011) to 190 (Bandla et al., 2012). One study used a combination of undergraduate medical students and early career doctors (Pape-Koehler et al., 2013). Studies by Bandla et al. (2012) and Gordon et al. (2011) included only undergraduate medical students and early career doctors respectively. Smeekens et al. (2011) and Elgie et al. (2010) participants consisted of registered nurses, however Elgie et al.'s (2010) sample population consisted of nurses with varied licensure with registered nurses comprising of 95% of the total population ($n = 39$). Finally, Cantarero-Villanueva et al. (2012) and Durmaz et al. (2012) participants consisted of physical therapy undergraduate students and second year undergraduate nursing students respectively.

4.5. Excluded studies

Prior to studies being assessed by the JBI-MAStARI appraisal tool the main rationale for exclusion was either that studies use subjective assessment criteria to measure skill-based outcomes or that the intervention contained teacher-learner or learner–learner interaction throughout the intervention. A list of the studies excluded after methodological appraisal are included in Table 3. Five papers were excluded due to poor reporting of methodological quality; these papers were generally characterised by reporting that did not follow the Consolidated Standards of Reporting Trials (CONSORT) statement for the reporting of randomised controlled trials, with the exception of studies that did not conduct RCT (Marshall et al., 2011; Postgate et al., 2009).

4.6. Effectiveness of e-learning on health care professional behaviour

All studies reported the outcomes of e-learning effectiveness on specific participant target skills. The findings suggested that e-learning was at least as equivalent to learning approaches or superior to no instruction at all. Durmaz et al. (2012) study reported that e-learning was more effective ($p = 0.04$) than skill laboratories alone for second year undergraduate nursing students in teaching preoperative patient admission skills. However, in the same cohort's post intervention deep breathing and coughing exercises, e-learning was not found to be more effective than clinical laboratory instruction ($p = .867$). Pape-Koehler et al. (2013) 2×2 factorial design reported that e-learning was more effective than no training or practical instruction alone ($p < 0.001$). The effectiveness of e-learning compared to no training at all was demonstrated in three studies (Elgie et al., 2010; Gordon et al., 2011;

Table 3
Summary of papers excluded on methodological grounds.

Author (year) country	Intervention content area	Design participants	Outcome measures
1. Chiu et al. (2009) Taiwan	**Intervention**: **Group 1**: e-learning **Group 2**: instructor led video **Content area**: neurological assessment	**Design**: Pre-post intervention RCT **Participants**: Registered nurses in Neurology ($n = 129$)	Score verification unit to measure the use of Chinese version of the National Institute of Health Stroke Scale
2. Hutton et al. (2010) England	**Intervention**: e-learning **Group 1**: e-learning **Group 2**: practical laboratory based activity **Content area**: medication dosage	**Design**: A multi-stage cross-over design. **Participants**: Early 3rd year nursing students ($n = 50$) Initial convenience sample and then purposive	OSCE to medication skills
3. Latha et al. (2011) India	**Group 1**: e-learning **Group 2**: classroom instruction **Content area**: cranial nerve assessment	**Design**: Pre-post intervention quasi-experimental design **Participants**: UG nursing students ($n = 64$)	Observational checklist to measure Cranial nerve assessment skill
4. Marshall et al. (2011) Ireland	**Intervention**: e-learning **Content area**: ordering radiological examinations	**Design**: Pre-post intervention design (no control) **Participants**: Final year medical students ($n = 177$)	Clinical vignettes evaluated by set marking criteria to measure improvement in quality of radiological examination orders
5. Postgate et al. (2009) U.K.	**Group 1**:e-learning – Gastro-intestinal (GI) trainees ($n = 14$) **Group 2**: e-learning – Medical students ($n = 14$) **Content area**: endoscopy lesion recognition	**Design**: Pre-post test evaluation study **Participants**: Medical students & GI trainees ($n = 28$)	60 question lesion recognition test module to measure change in performance among participants with different experience levels (module construct validity) – assess change in performance after intervention (module content validity)

Table 4
Summary of included papers in systematic review papers ($n = 7$).

Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
1. Bandla et al. (2012) U.S.A. 2C	**Group 1**: 4 module PPT based e-learning converted with Microsoft Producer ($n = 97$) **Group** 2: 2.5 h classroom instruction ($n = 93$) **Content area**: Sleep medicine	**Design**: Pre-post intervention. Alternate group allocation **Participants**: ($n = 190$) medical students	Post only OSCE[a] to measure sleep history assessment skills	OSCE (max score: 35 mean/SD) **Group 1**: 23.9/3.1 **Group 2**: 23.3/3.3 p value: not reported	- Same ppt was used as primary instruction for both groups - No guiding instructional design framework - No subject matter expert review of content quality - No discussion re: OSCE inter-rater reliability - Inclusion/exclusion criteria not reported - No sample size or power calculation reported - Potential confounding of results due to student exposure to content during clinical placement
2. Cantarero-Villanueva et al. (2012) Spain 1C	**Group 1**: 6 h f2f (2 h theory + 4 h practical) + 20 h of e-learning ($n = 23$) **Group 2**: 6 h f2f (2 h theory + 4 h practical) + documents/books ($n = 21$) **Content area**: Physical therapy	**Design**: Single blinded pre-post intervention RCT **Participants**: Undergraduate (UG) Physical therapy students ($n = 44$)	Post OSCE to measure palpation and ultrasound of lumbo-pelvic region	Global OSCE (max score: 9 – mean/SD) **Group 1**: 8.40/1.29 $p < 0.001$ **Group 2**: 6.66/2.24	- Blended learning intervention - external website, no discussion regarding guiding instructional design framework - Variation in time intervention accessed (61.6% used for 1 h/day for duration of intervention) - Reported sample size and power calculation - Exclusion criteria reported (previous training) (two experienced staff – no discussion re: inter-rater reliability)
3. Durmaz et al. (2012) Turkey 1C	**Group 1**: e-learning ($n = 41$) **Group 2**: Skill laboratories ($n = 41$) **Content area**: Pre/post op management	**Design**: Pre-post intervention RCT via random numbers table **Participants**: Second-year UG nursing students ($n = 82$)	Post OSCE to measure pre-operative patient admission (skill 1) and post-operative deep breathing and coughing exercise skills (skill 2)	Based on ITT analysis Skill score (max score: 100 mean/SD) **Group 1**: Skill 1: 72.4/12 ($p = 0.04$) Skill 2: 67.5/13 **Group 2**: Skill 1: 66.6/13.3 Skill 2: 66.9/16 ($p = 0.867$)	- Time to complete e-learning intervention not reported - High attrition (Skill 1 $n = 33$ v 21 (control); Skill 2 $n = 36$ v 26 (control)) - No sample size or power calculation reported - Inclusion/exclusion not reported - Intervention structured according to information process theory (content evaluated) - No discussion re: OSCE inter-rater reliability
4. Elgie et al. (2010) U.S.A. 1C	**Group 1**: 15 e-learning modules ($n = 16$) **Group 2**: no intervention ($n = 26$) **Content area**: Emergency preparedness	**Design**: Post-only intervention RCT using standard randomisation table **Participants**: School nurses ($n = 52$) (RN = 95.2%)	Post On-site Mock Emergency Scenario (OMES) to measure emergency preparedness skills performance	Reported as mean %/95% CI **Group 1**: 65.5%/60.2–70.8 **Group 2**: 28.3%/22.3–34.3; ($p < 0.0001$)	- No discussion on methods but ceased analysis once 'significance' had been achieved - Inter-rater reliability tested for OMES scores - Intervention design-situated – cognitive learning theory – externally developed modules - Videotaped OMES assessed by two Paediatric Emergency Medicine physicians blinded to assessors - Convenience sample - potential selection bias - No sample size or power calculation reported - No inclusion or exclusion criteria reported

Table 4 (*Continued*)

Author Country JBI level of evidence	Intervention Content area	Design Participants	Outcome measure	Results	Comments
5. Gordon et al. (2011) U.K. 1C	**Group 1**: Three module (1–2 h) e-learning (PPT and Wondershare: self-contained flash programme) ($n = 76$) **Group 2**: no intervention ($n = 86$) **Content area**: Paediatric prescribing skills	**Design**: pre-post intervention RCT **Participants**: 'Junior' doctors ($n = 162$)	Prescribing assessment to measure prescribing skills at 1 month and 3 months using set marking criteria post intervention	Total score % **Group 1**: *Pre-test:* 67% *Post-test:* 79% *Post-test (3/12):* 79% **Group 2**: *Pre-test:* 67% ($p = 0.56$) *Post-test:* 63% ($p < 0.0001$) *Post-test (3/12):* 69% ($p < 0.0001$)	- Sample size and power calculation reported - Reported exclusion criteria - Gagne's nine events of instruction/cognitive load theory (aim to prevent overload of working memory)/quality review of content - Assessment of skill but not translated into practice
6. Pape-Koehler et al. (2013) Germany 1C	**Group 1**: e-learning (2 h) ($n = 18$) **Group 2**: practical (2 h) ($n = 17$) **Group 3**: blended (1 + 1 h) ($n = 18$) **Group 4**: no training (control) ($n = 17$) **Content area**: surgical performance – laproscopic cholecystectomy	**Design**: 2×2 factorial pre-post intervention RCT randomised by lot (draw) **Participants**: Doctors in surgical fellowship programme and final year medical students at two different universities ($n = 70$)	Pre-post OSATS[b] to measure recorded laproscopic cholecystectomy surgical performance (pelvi trainer)	Change in OSAT score **Group 1**: (4.7 ± 3.3; $p < 0.001$) **Group 2**: (2.5 ± 4.3; $p = 0.028$) **Group 3**: 4.6 ± 3.5 ($p < 0.001$) **Group 4**: (0.8 ± 2.9; $p = 0.294$)	- Inclusion criteria described - Substantial video content - Stated homogenous sample - equally distributed - Sample size and power calculation reported - Enrolment, camera assistance and evaluation blinded - OSATS (inter-rater reliability confirmed – blinded raters)
7. Smeekens et al. (2011) Holland 1C	**Group 1**: 3 externally developed programme e-learning modules (2 h minimum) ($n = 19$) **Group 2**: no training ($n = 19$) **Content area**: Child abuse in ED	**Design**: Blinded pre-post test intervention RCT **Participants**: RNs in ED ($n = 38$)	Pre and post case simulation to measure child abuse detection	Max 114 – mean/SD **combined groups 1 & 2 ($n = 25$)**: *Pre-test:* 71/21 **Group 1 ($n = 13$)**: *Pre-test:* not reported *Post-test:* 89/19 **Group 2 ($n = 12$)**: *Pre-test:* not reported *Post-test:* 71/17 (95% CI 2.9–33.3) ($p = 0.022$)	- Blinded SME panel with standardised assessment form - No sample size or power calculation reported - No explicit inclusion/exclusion reported No guiding instructional design framework discussed - High attrition, ITT not reported - **e-Learning more effective than no training at all**

[a] Objective Structured Clinical Examination.
[b] Objective Structured Assessment of Technical Skills.

Smeekens et al., 2011). Gordon et al. (2011) was the only study to include a longitudinal element in its design and reported that e-learning was superior to no intervention at all ($p < 0.0001$) and that paediatric prescribing skills outcomes were maintained three months post intervention ($p < 0.0001$). Bandla et al. (2012) reported that e-learning was as effective as classroom instruction, findings in contrast with Cantarero-Villanueva et al. (2012) who reported that e-learning was more effective than traditional learning in a blended learning context ($p < 0.001$). Results demonstrated some variation in HCP outcomes depending on the skill being taught, and the learning approach utilised.

4.7. Effectiveness of e-learning on patient outcomes

No papers were identified that met the reviews inclusion criteria that reported the effectiveness of an e-learning programme on patient outcomes.

4.8. Intervention instructional design and quality

All interventions utilised asynchronous web based e-learning interventions. However there was substantial variation in instructional design elements, module size and numbers, and time taken to complete the intervention. Four studies (Cantarero-Villanueva et al., 2012; Elgie et al., 2010; Pape-Koehler et al., 2013; Smeekens et al., 2011) used externally developed web based interventions, two converted Microsoft PowerPoint presentations to an e-learning format using proprietary based software (Bandla et al., 2012; Gordon et al., 2011) and Durmaz et al. (2012) used an internally designed web based intervention. The time taken to complete the interventions varied from 1 to 2 h (Gordon et al., 2011; Pape-Koehler et al., 2013; Smeekens et al., 2011) to 20 h (Cantarero-Villanueva et al., 2012), or was not reported (Bandla et al., 2012; Durmaz et al., 2012; Elgie et al., 2010). Learning stimuli varied across all interventions and consisted mainly of animation, video, static images, narration and text. Three studies discussed the theoretical constructs which guided intervention design. Durmaz et al. (2012) structured their intervention according to information processing theory. Elgie et al. (2010) and Gordon et al. (2011) utilised situation cognitive theory and cognitive load theory respectively. Gordon et al. (2011) was the only study which reported the instructional design framework (Gagne et al., 2005) that guided their e-learning design. Due to the use of externally designed interventions in the majority of studies, it was not possible to assess whether content quality review was conducted.

Three studies compared e-learning to no instruction at all (Elgie et al., 2010; Gordon et al., 2011; Smeekens et al., 2011), Bandla et al. (2012) and Durmaz et al. (2012) used classroom instruction and a skills laboratory as comparators respectively. Cantarero-Villanueva et al. (2012) utilised a blended learning approach whereby all participants undertook a six hour face-to-face session comprised of two hours theory and four hours practical work. The intervention group then undertook an externally designed e-learning programme while the control group had access to course related documents and books. Pape-Koehler et al.'s (2013) study consisted of four groups, group one had access to a two-hour e-learning programme, group two underwent a two-hour practical workshop, group three underwent a blended learning programme which consisted of one hour e-learning and one hour of practical workshop, and the control group received no instruction at all. The differences in these interventions demonstrate the variation in approaches used that limit the evaluation of effectiveness of e-learning on healthcare professional skill development and behaviours.

5. Discussion

This systematic review aimed to identify, appraise and synthesise the best available evidence regarding the effectiveness of e-learning programmes on clinician behaviour and patient outcomes. No studies that met the inclusion criteria were identified that reported the effectiveness of e-learning on patient outcomes. This review differs from previously reported systematic reviews (George et al., 2014; Lahti et al., 2014; McCutcheon et al., 2015) in that the inclusion criteria specified that outcome measures must be assessed using objectively administered evaluation criteria. It also included interventions that utilised asynchronous online e-learning programmes and excluded those that utilised any instructor or learner interaction. This resulted in a smaller number of studies being identified for this review compared with previous systematic reviews in this subject area (Cook et al., 2008; George et al., 2014; Lahti et al., 2014; McCutcheon et al., 2015). Previous reviews reported multiple outcome measures, including knowledge improvement and learner satisfaction, however this review focused on aims relating to the effectiveness of e-learning on HCP behavioural change and patient outcomes.

The variation in intervention design and evaluation measures of included studies meant that we were unable to make generalisable inferences about the effectiveness of e-learning on HCP behaviour. However, it is clear that there is insufficient evidence to determine whether asynchronous e-learning programmes mediated exclusively via the Internet positively impact HCP behaviour or patient outcomes. All studies in this review reported different interventions including differences in: the size of e-learning programmes, the number of modules undertaken, and the time taken to complete them. Three of the seven studies identified did not use any alternate delivery modes in the control group and two studies used a blended learning approach as part of the intervention. Many of the studies failed to describe critical instructional design elements of the interventions development, making it difficult to assess their pedagogical veracity. Only three studies (Durmaz et al., 2012; Elgie et al., 2010; Gordon et al., 2011) described the theoretical basis or instructional design elements underpinning the design of the intervention, however no in-depth discussion was provided.

There has been a growth in recent years of externally provided asynchronous e-learning programmes for the continuing professional development of HCP. Exemplars from Australia include the Australian Primary Health Care

Nurses Association's online portal (https://apna.e3learning.com.au/), the Renal Society of Australasia online nephrology education portal (http://nen.moodle.com.au/login/index.php) and the Australian National Cancer Nursing Education Project (http://www.edcan.org/). Anecdotally, the only evaluation that occurs in these environments is at a user satisfaction and knowledge level. In disciplines beyond the health domain, including teaching (Bell and Federman, 2013; Kirkwood and Price, 2014) and engineering (Lerro et al., 2012), e-learning research has predominantly focused on short term cognitive outcomes. As with health education, these disciplines have been unable to report whether improved knowledge, attitudes and self-efficacy translate into actual behaviour change (Bell and Federman, 2013). Studies that have explored the translation of learning into practice have relied on self-reported instruments of intention to apply behaviour (Kirkwood and Price, 2014) rather than measure actual behaviour.

With the rapid growth in online continuing professional development opportunities there is a need to understand the contextual elements of e-learning and their influence on behaviour change. E-learning is not an educational panacea and cannot be viewed as a one size fits all answer to all CPD learning needs. From a pedagogical and instructional design perspective, it is unlikely there will be consensus about the ideal duration, configuration or instructional design required for e-learning to achieve target learning outcomes. Learning is influenced by multiple factors and interventions will always require different modes of delivery and instructional design approaches suited to the topic area. The heterogeneity of the interventions identified in this review support this notion.

5.1. Strengths and limitations of this review

This review has several strengths and limitations. Firstly it was informed by a peer reviewed search protocol (Sinclair et al., 2015) and findings were reported using the guidelines provided in the PRISMA statement. It was conducted with specific inclusion and exclusion criteria that were developed in response to the emergence of asynchronous e-learning programmes to support HCP continuing professional development, outside formal programmes of study. It excluded studies that used subjective self-reported measurement scales, instruments that are open to reporting and social desirability biases (Van de Mortel, 2008) and not necessarily grounded in sound theoretical frameworks. Despite the use of a peer reviewed protocol and a rigorously designed search strategy, the search outcomes and subsequent findings are still at risk of selection bias and we cannot exclude the possibility that relevant studies were not identified in the search strategy. The search strategy was restricted to studies published in English language and may not have identified suitable studies written in other languages. The overall methodological quality of evidence included in this systematic review was variable, consequently statistical pooling was not possible and a meta-analysis could not be performed.

5.2. Implications for educational practice and future research

The findings of this review can assist educators and researchers involved in the development of e-learning programmes, particularly those for the use by HCP outside formal educational contexts. While e-learning affords the opportunity to disseminate knowledge, educators need to consider whether learning objectives are realistically suitable for the learning environment for which they are intended and consequently whether e-learning is the most appropriate instructional method for learning needs.

One of the enduring challenges for HCP e-learning behavioural research is demonstrating its effectiveness beyond measuring knowledge and satisfaction (Cook et al., 2008). This is particularly pertinent for asynchronous e-learning programmes that are freely available to learners outside formal education contexts. Studies included in this systematic review measured HCP behaviour using face-to-face evaluative methods such as OSCE, processes that are impractical for evaluating e-learning delivered over a wide geographical area and have limited application outside formal programmes of study. Consequently, a need exists to develop and validate alternate objective measures that are informed by sound theoretical constructs to evaluate e-learning behavioural outcomes. This requires researchers to move away from evaluating e-learning programmes using self-reported instruments of behavioural change that have no theoretical basis in their design. E-learning research needs to progress beyond the evaluation of knowledge and satisfaction, towards the utilisation of psychometrically tested instruments guided by proven theoretical models of behaviour change.

Studies that used subjectively based self-reported measures of intention to change behaviour were excluded from this review (Heitzler, 2011; Schroter et al., 2009; Stark et al., 2011). Self-reported intention to change may not translate into actual behaviour change (Davis et al., 1999). Given that the immediate antecedent of behaviour is intention and that intention is influenced by variables including attitude, perceived social pressures and behavioural control (Ajzen, 2002), an individual may have the intention to carry out a behaviour, but not necessarily possess the volitional control to enact it (Chiou, 1999). Behaviour change is a complex and multifaceted phenomenon and consideration needs to be given to the wider complexities of the targeted behaviour change in question. In order to develop the empirical evidence base in e-learning for HCP, consideration of theoretical frameworks that reflect the contextual and personal variables that influence behavioural intention and consequently, behaviour change are required.

Participant characteristics of studies identified in this review, with the exception of Elgie et al. (2010) and Smeekens et al. (2011), were predominantly undergraduate HCP students. There is limited research in the context of post-graduate continuing professional development of HCP who are not enrolled in formal programmes of study.

The methodological quality of studies included in this review was variable. Inadequate reporting of trials makes it difficult for clinicians and researchers to critically appraise their methods and results. Future RCTs need to

follow the CONSORT guidelines (Moher et al., 2012) for reporting studies and ensure their designs include appropriate randomisation to minimise potential for selection bias, include sample size and power calculations to demonstrate trials are adequately powered to detect differences between the intervention and control groups, and to utilise control groups that are exposed to some alternate form of instruction in order to be able to demonstrate the reported changes can be attributed to the intervention.

6. Conclusion

E-learning research for healthcare professionals continuing professional development to date has predominantly focussed on participant satisfaction and knowledge acquisition (Bennett et al., 2014; Curran et al., 2010; Durmaz et al., 2012; Eaton-Spiva and Day, 2011; Fleet et al., 2011). However, the conceptual and practical challenges for research that correspond with higher levels of educational evaluation such as behaviour change and the application of learning to clinical practice has meant that limited research has been conducted in this area, particularly in the post-graduate context. In the future, studies that measure clinical behaviour change and patient outcomes should be a priority for future e-learning research. In order to develop the empirical evidence base in e-learning, future research needs to incorporate more robust designs and interventions that are guided by sound instructional design principles and theoretical frameworks. Focus needs to be directed towards the development of reliable and validated instruments to objectively evaluate behavioural outcomes for interventions that are delivered in locations that make it impractical to conduct face-to-face evaluation. In doing so, e-learning research will move from assessing knowledge generation and participant experiences towards cultivating an understanding of the extent to which e-learning can influence HCP behaviour and consequently improve, patient outcomes.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ijnurstu.2016.01.011.

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Chapter 3: Barriers and facilitators to opportunistic Chronic Kidney Disease screening by general practice nurses: An elicitation study

This chapter reports the results of the elicitation study, which was used *to identify the barriers and facilitators to opportunistic Chronic Kidney Disease screening by general practice nurses.* In this chapter, the third publication of this thesis is presented:

Sinclair, P.M., Day, J., Levett-Jones, T., & Kable, A. (2017). The barriers and facilitators to opportunistic chronic kidney disease screening by general practice nurses. *Nephrology,* 22, 776-782 doi: 10.1111/nep.12856.

The elicitation study was a vital and foundational stage of the program of work as it provided insights into the salient attitudinal, normative and perceived control beliefs regarding of practice nurses regarding CKD screening practices. These data enabled the construction of the TPB-CKDISI, as well as informing the development of the intervention used in phase three of this research. Designing and developing an intervention that specifically targeted participant change using the TPB predictor variables was expected to increase the likelihood that participants would increase their behavioural intention, and increase the probability of them acting on that intention (Francis et al., 2004). In the clinical setting, practice nurse's decision-making processes and actions regarding kidney health checks are examples of intentional behaviour.

Due to publication word count restrictions some information and tables were included as online supplementary files (see Appendix 9). These are also available online at:

https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1111%2Fnep.12856&file=nep12856-sup-0001-Appendix.zip)

3.1 Publication impact

At the time of thesis submission, this paper had been cited four times.

3.2 Publication copyright

Permission to reproduce publication three in this thesis has been obtained (See Appendix 10).

Publication three: The barriers and facilitators to opportunistic CKD screening by general practice nurses.

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Original Article

Barriers and facilitators to opportunistic chronic kidney disease screening by general practice nurses

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SUMMARY AT A GLANCE

Sinclair et al identified barriers and facilitators to opportunistic CKD screening by general practice nurses from both small and large General Practice settings in regional New South Wales, Australia. The Theory of Planned Behaviour (TPB) provided the theoretical framework for the generation of data for this study.

ABSTRACT:

Aim: **Opportunistic screening in general practice (GP) is a cost-effective and viable approach to the early identification of chronic kidney disease (CKD). This study sought to identify the barriers and facilitators to CKD screening practices of GP nurses working in a regional area of New South Wales, Australia.**

Methods: **An eight-item elicitation questionnaire informed by the Theory of Planned Behaviour was administered to a convenience sample of 26 GP nurses.**

Results: **Participants identified that the advantages of CKD screening were its early detection and treatment, the reduction of disease burden, and the opportunity to increase awareness and provide disease prevention education. These positive attitudinal beliefs were offset by negative beliefs about the impost of opportunistic screening on nursing time, particularly when there were other competing clinical priorities. Participants reported that practice doctors were wary of the financial costs associated with additional non-claimable services and believed that unfunded services, regardless of patient benefit, were difficult to justify in a private business environment. Screening was enabled in GP settings with existing screening protocols or initiatives, and when patients presented with known risk factors. Barriers to screening were more frequently described and illustrated a strong focus on financial aspects of GP. Without reimbursement through the Medicare Benefits Scheme, screening was not considered an economical use of nursing time. Other competing and billable clinical services took precedence.**

Conclusion: **The findings of this study can be used to inform the development and evaluation of interventions that target opportunistic CKD screening in the GP setting.**

INTRODUCTION

The early detection and management of chronic kidney disease (CKD) by primary care providers is essential in reducing CKD related mortality and morbidity and the burden of disease on the healthcare system and people affected by this condition.[1] Opportunistic screening is considered the most cost-effective[2] and sustainable approach to the early detection of CKD in Australia.[1] Mass screening efforts reported in the literature[3,4] have proven costly and are more likely to attract people who have a vested interest in their own health.[1] In Australia, CKD screening practices in high-risk populations are currently suboptimal;[5] consequently, there is a need to identify ways in which opportunistic screening practices in the primary care setting can be improved.

Recent research has explored the management of CKD in the primary care setting [5–7] and the reporting of outcomes related to community, in-hospital and workplace screening programmes.[3,4,8] Renal health professionals recommend that opportunistic screening should occur in the general practice (GP) setting, and that education relating to screening practices for healthcare professionals (HCP) needs to be improved.[1,2] There is a need to identify the most efficient and efficacious method to deliver this education. This can be achieved by identifying the barriers and facilitators to opportunistic CKD screening in the GP context.

BACKGROUND

Extensive research has been conducted in other specialty contexts to identify factors that prevent chronic disease screening practices from occurring, particularly in the primary care setting. Time is frequently cited as the main cause for HCP inability to undertake screening.[9–12] In alcohol and nutritional screening, for example, this has been attributed to logistical issues in practice and other competing priorities facing HCP.[9,11] A recent systematic review[11] investigating the barriers to nutritional screening identified that organizational culture strongly influenced screening practices. However, a disconnection existed between HCP beliefs and attitudes regarding screening and actual practice. Green and James (2013)[11] suggested that the workplace environment was crucial to the application of screening practices; so much so, that HCP may be willing to undertake screening, but the workplace culture dictates whether it will actually happen. Studies that have explored barriers to screening for colorectal cancer,[13] gestational diabetes,[14] alcohol intake[9] and domestic violence screening[12] have identified that HCP concerns about negative patient reactions also prevent screening practices from occurring. These concerns were also identified in the only study to date that has explored the processes underpinning CKD management in a primary care setting in the UK.[6]

METHODS

Theoretical framework

The Theory of Planned Behaviour (TPB) provided the theoretical framework for the generation of data for this study. The TPB is one of the most widely applied models of determinants of behaviour change. It has been utilized to evaluate various health-related behaviour change interventions including breastfeeding,[15] healthy eating[16] and physical activity.[17] Recently, it has been also used to evaluate the influence of e-learning interventions including medication safety,[18,19] university student health behaviours,[20] sun safety[21,22] and breakfast consumption.[16] Despite its predictive potential, there has been no published research to date using the TPB in the context of investigating the barriers and facilitators of CKD screening practices in the GP setting. For a further explanation of the TPB, please see Supporting Information.

Study design

The TPB posits that an individual's behavioural beliefs govern their attitude towards the behaviour. It further considers that an individual needs to have the opportunity, resources and support in order to execute the specified behaviour. In order to reveal the salient behavioural (attitudinal), normative and control beliefs regarding CKD screening processes in the target population, an elicitation study was conducted.[25] The study design was guided by the recommendations of Francis *et al.*, (2004)[23] and is a method extensively utilized in research guided by the TPB. Ethics approval was granted for this research by the University of Newcastle Human Research Ethics Committee.

Participants and setting

The study sample consisted of GP nurses from both small and large GP settings in the Hunter New England Health and Central Coast Primary Health Network catchment areas. The catchment incorporates 27 local government areas and has a population of 1.2 million people. This 130 000 km^2 region consists of several densely populated urban and regional centres in addition to many smaller rural and remote rural communities. Participants were eligible for the study if they were currently working as a practice nurse in GP or had worked in this role within the previous year. After institutional ethics approval was granted, participants were recruited using a snowballing sampling technique. A study recruitment notification was included in the local primary health network e-newsletter in addition to an announcement in a Facebook group regularly used by local practice nurses. A sample size of between 25 and 30 participants was sought.[26,27]

Data collection

An online questionnaire with eight open-ended questions was utilized (Supporting Information). These questions were designed to elicit information regarding the predictor constructs of the TPB model (behavioural (attitudinal), normative and control beliefs)[24] as applied to opportunistic CKD screening during a nursing consultation in the GP setting. Questions were developed to determine the most frequently perceived advantages and disadvantages of performing opportunistic screening for CKD, the most important people or groups of people who would approve or disapprove of screening for CKD in the GP setting, and finally, the perceived barriers or facilitating factors which could make it easier or more difficult to adopt opportunistic CKD screening practices. Data were collected between November 2015 and March 2016 using the web-based survey tool, SurveyMonkey (SurveyMonkey Inc. Palo Alto, CA).

Data analysis

Two researchers independently conducted a directed content and frequency analysis, as described by Hsieh and Shannon (2005),[28] of participant responses. A deductive process was utilized with a priori coding specific to the TPB predictor variables. Responses were coded based on the similarity of words, phrases and/or concepts, and then listed in order of frequency and response percentage to identify the most salient beliefs. The research team met to review findings and identify discrepancies; and differences were resolved through discussion and negotiated consensus. The data from questions 3 and

6 were pooled with questions 7 and 8 to isolate challenges that participants' faced in terms of barriers and facilitators to CKD screening in their workplace.

RESULTS

Twenty-six practice nurses participated in the study. The demographic characteristics of participants are presented in Table 1.

Behavioural (attitudinal) beliefs: perceived advantages and disadvantages of screening for chronic kidney disease during a nursing consultation

Participants agreed that the early identification of CKD afforded the opportunity to manage the disease early and minimize its progression and burden on the patient. This enabled participants and their colleagues to influence patients' quality of life and reduce costs associated with chronic disease management on the healthcare system. Participants also identified that the screening process created the opportunity for the nurse to increase patient awareness of kidney health and to provide preventative advice regardless of whether kidney disease was present or not. This was particularly important for patients who presented with known risk factors for CKD. The relationship with the nurse was also identified as crucial as it created a sense of trust that enabled patients to discuss their own concerns relating to their kidney health. The most frequently identified advantages of opportunistic screening for CKD by participants are presented in Supporting Information, supported by participant verbatim quotes.

Table 1 Demographic characteristics of participants ($n = 26$)

Variable	Category	*n* (%)
Age	Less than 29 years	1 (3.85)
	30–39 years	5 (19.23)
	40–49 years	10 (38.46)
	50–59 years	9 (34.62)
	Older than 60 years	1 (3.85)
Gender	Male	1 (3.85)
	Female	25 (96.15)
Job title	Endorsed enrolled nurse	1 (3.85)
	Registered nurse	19 (73.10)
	Clinical nurse specialist	1 (3.85)
	Nurse manager	2 (7.70)
	Nurse practitioner	3 (11.50)
Years working as a nurse	1–9 years	1 (3.85)
	10–19 years	5 (19.23)
	20–29 years	8 (30.76)
	30–39 years	10 (38.46)
	40–49 years	2 (7.70)
Years working as a practice nurse	1–4 years	6 (23.10)
	5–8 years	11 (42.30)
	9–12 years	4 (15.40)
	13–16 years	2 (7.70)
	17+ years	3 (11.50)

Participants acknowledged that practice nurses were ideally positioned to undertake screening practices with participant 13 suggesting that nurses have 'more time to discuss these issues with patients than the general practitioner and can listen and engage [with] the patient'. However, some participants recognized that they had a knowledge deficit as to what constituted best practice screening for CKD.

While some participants believed there were no disadvantages to opportunistic CKD screening practices, the most frequently perceived disadvantage was the impost on consultation time and the need to manage multiple patients with competing clinical priorities. For GP nurses, the advantages of early CKD detection were balanced with what they believed to be the best use of their consultation time and the financial interests of the practice as a business. The second most frequently reported disadvantage was a concern that harm could result from opportunistic screening activities, for example, through the stress caused by the identification of a new health problem or additional cost on patients with limited financial resources. Participants raised concerns that patients attending the GP setting often focus on their presenting concern, and the introduction of new issues come as a shock. In this context, opportunistic screening may increase patient anxiety and raise issues that patients were unaware of and may not be able to emotionally deal with. Some participants also identified that they lacked the necessary knowledge and/or skills to appropriately respond to patient's questions about screening and CKD, possibly reducing their ability to educate and reassure patients about screening outcomes. The most frequently reported disadvantages of CKD screening are reported in Supporting Information with participant quotes.

Normative beliefs: individuals or groups perceived to approve and disapprove of screening for chronic kidney disease during a nursing consultation

Participants reported that they perceived general practitioners and patients to hold differing normative beliefs about who should be screening for CKD in the GP setting. Positive beliefs were most frequent and supported the inclusion of CKD screening as a component of the GP nurse role, acknowledging nursing contributions to preventative health, comprehensive patient assessment and care of patients with chronic conditions. However, when participants believed that doctors felt that screening was their responsibility only, these negative beliefs translated into constraints on the nurse's role, which prevented them from screening for CKD during consultations. Participant 15 summed this up by stating 'some general practitioners do not believe the nurse should be screening or consulting with patients as they believe that it is their role, not the nurses'. While participants valued CKD screening and considered that it had a place in their nursing consultations, they believed the authority to enact this screening was held by general practitioners. Beliefs about the exercise of medical authority and

supervision negatively impacted on nurse's role autonomy and their screening practices for CKD.

Similarly, the ability of practice nurses to enact CKD screening was, in part, determined by their perceptions of patients' normative beliefs. The notion that patients may 'disapprove' of the nurse undertaking screening practices was highlighted with the suggestion, again by participant 15, that 'some patients believe it is their doctor's role to discuss their health concerns, rather than the nurse who is only there to perform basic care'. Together with negative beliefs about screening as a nursing role, participants believed that the financial management of the practice as a business constrained their role in screening and impacted their role autonomy in some settings. They believed an absence of activity based funding, through item numbers for CKD screening in the Medical Benefit Schedule (MBS), meant that some nurses were unable to attract remuneration for the time they spent with patients for screening purposes. Without this remuneration their work was viewed as unfunded, which detracted from the financial sustainability of the practice. The most frequently reported social supports and pressures on CKD screening are reported in Supporting Information.

Control beliefs: enablers and barriers to screening for chronic kidney disease during a nursing consultation

The presence of funded population specific screening protocols or initiatives were identified by participants as business related factors that enabled opportunistic CKD screening to occur. Factors relating to the patient were the presence of known risk factors for CKD and the nurse–patient relationship. Participants highlighted that if their workplace had funded protocols or initiatives such as nurse-led chronic disease management clinics, screening was more likely to occur. In these cases, screening opportunities were directly enhanced through provision of financial reimbursement, via the MBS, for the cost of service provision. For example, according to participant 25, there are 'MBS item numbers for the 45- to 49-year-old health assessment, diabetes cycle of care and the over 75-year-old health assessment'. Participant 19 further reiterated that 'nurse-led chronic disease clinics foster screening [practices] as we always take a history, measure BP, order bloods and urine for all patients. The active promotion of the 45- to 49-year-old health assessment [also] helps with early detection'. Software used for clinical practice management also acted as a facilitator, but only for practice nurses whose workplaces operated practice-based chronic disease management clinics.

Participants reported several barriers to nurse screening for CKD, the most frequent being unfunded clinical time and funded clinical priorities. This emphasis is summed up by participant 17 who wrote 'the number one barrier is time, because in … time is money and with no specific MBS item number associated with screening activities, it does not get the time required allocated to the task'. The perception that the setting business model was 'financial return for service provision' had a major impact on the role of practice nurses in CKD screening. The impact on the patient was also identified on several levels including patient reluctance to undertake screening procedures, particularly when they were not related to the presenting complaint. The most frequently reported enablers and barriers to CKD screening are reported in Supporting Information.

DISCUSSION

Using the TPB as a guiding theoretical framework, this study has provided insights into the salient beliefs of nurses working in GP settings in regional New South Wales, Australia, regarding CKD screening practices.

Behavioural (attitudinal) beliefs

General practice nurse attitudes towards opportunistic CKD screening were positive overall and reflected their belief that they were ideally placed to undertake CKD screening during consultations, a finding that is contrary to previous primary care screening studies.[14,29] Screening was seen to be essential for improved patient awareness of CKD, kidney disease prevention, early disease detection and treatment, and reduced burden of kidney disease on patients. These beliefs are consistent with the key kidney health screening and prevention policies and guidelines at state and national levels.[30,31] These findings reflect a fundamental appreciation and understanding of preventative health strategies, and that GP nurses have a legitimate role to play across all phases of patient management in primary care. However, GP nurse beliefs relating to opportunistic CKD screening also reflect concerns about patient welfare, particularly relating to personal and financial stressors that may be associated with screening practices. Similar dilemmas have also been reported in primary healthcare-based alcohol,[9] gestational diabetes,[14] colorectal cancer[13] and domestic violence[12] screening. In the current study, it was important to GP nurses that screening imposed no financial burden on the patient, and that consideration be given to the potential impact on the patient in the eventuality of a positive CKD screening outcome. These findings are consistent with the findings of Blakeman *et al.* (2012)[6] about CKD screening in primary care settings in the UK, whereby general practitioners and practice nurses voiced concerns about possible negative patient reactions associated with the diagnosis of CKD. In the current study, participants acknowledged that CKD screening required a depth of knowledge and specific skills to ensure screening was conducted accurately and that correct patient advice was provided during the consultation. These beliefs reflect the specialist knowledge base required in the GP nurse role.[32]

Participants' beliefs about the advantages of opportunistic screening for CKD conflicted with their beliefs about the availability of time for screening during nursing consultations. They acknowledged that competing clinical demands and priorities

within the practice setting, from multiple patients presenting with conditions of varying acuity, limited the time available to undertake screening and that, in this busy setting, they often focused on the patient's presenting health issues. This tension between what GP nurses know to be beneficial and what is realistic in practice has also been reported in nutritional screening practices in primary care[11] whereby the workplace environment influences the application of practice.

Normative beliefs

Participants identified that overall, general practitioners were in favour of opportunistic CKD screening where indicated. However, some participants believed that certain general practitioners held more traditional views of nursing roles and were not in favour of delegating CKD screening to nurses or endorsing nurse screening in their practice setting. These opposing beliefs possibly account, in part, for reported inconsistencies in opportunistic CKD screening and management practices in GP.[5–7]

Participants' perceptions of general practitioner and patient beliefs about nursing consultations, who should conduct screening, the underutilization of GP nurses and about providing approval for screening activities, point to deeper normative beliefs about the exercise of personal and professional authority and power over nursing roles and activities. They also point to the pervasive impact of activity based funding on GP services and practice viability, and how this can influence the culture of individual GP settings. The issue of remuneration is consistent with previous findings relating to GP nurse screening for cervical cancer in the Australian primary care setting.[32]

Perceived behavioural control

Participants' beliefs about a lack of time for screening activities during consultations were a recurring theme. The lack of time related to the busyness of the GP setting from having multiple patients presenting to the practice at the one time, multiple general practitioners to support, the often complex and acute nature of patient presentations, and the demands of having different and competing presenting health issues at one time. Importantly however, the participants held strong beliefs about the negative impact a lack of MBS funding had on how they were able to spend their nursing time and what activities they could perform. For these nurses, a lack of a specific MBS item number for CKD screening translated into CKD screening being displaced by activities that were reimbursable. In these circumstances, nurse screening activities were controlled by general practitioner beliefs about the cost of nurse employment, potential practice income generation and the financial sustainability of the practice.

While participants identified time and lack of funding for screening services as being the principal barriers to CKD screening, the reality was that their workplace culture and relationships with general practitioners often did not afford them the opportunity to do so. While the advent of roles such as nurse practitioners have advanced the scope of practice for nurses, it is apparent from the findings of this study that interprofessional conflicts still exist in workplaces where the hierarchical structure sees nurses as subordinate to doctors. Consequently, there may be situations where GP nurses recognize the need for opportunistic screening but lack the volitional control to do. These findings are consistent with other specialty areas including cervical cancer screening,[33] oral cancer screening[34] and nutritional screening,[11] where discord between organizational cultures preclude HCP from implementing evidence-based screening practices and create a dissonance between personal beliefs and practice behaviours.

The findings of this study indicate a major disconnect between practice nurses' understanding of the benefits of CKD screening and whether screening is actually carried out because of the lack of an MBS item number. These results are of concern given the evidence that early detection of CKD is critical in reducing the disease burden and limiting its progression,[1] let alone the cost savings of early detection on health expenditure.[2] Participants suggested that the availability of an MBS item number would address this issue. Unfortunately, it appears that currently decisions about opportunistic CKD screening during nursing consultations are determined by the business orientation of GP and the perception of nurses' time being a fiscal imperative.

LIMITATIONS OF THIS STUDY AND IMPLICATIONS FOR FUTURE RESEARCH

As with most qualitative research, the generalization of these findings to the wider GP setting may be limited. This study sample was derived from GP nurses who worked in regional New South Wales, Australia and was not representative of metropolitan, rural or remote settings, nor primary health settings internationally. Additional studies are required to determine whether the findings of this study are consistent in these practice settings. The use of an online platform to collect data was a limitation as this approach did not allow for a deeper exploration of issues raised by participants. However, the aim of this study was to identify the most common salient behavioural, normative and control beliefs related to CKD screening practices rather than explore and find deeper meaning from the data. Additionally, although we anticipated that an online recruitment strategy would extend the pool of potential participants, it may have in fact restricted participants who did not have access to email or social media. Future research in this area should consider using focus groups or face-to-face interviews as alternate data collection methods.

CONCLUSION

This study revealed that participants recognized the benefits of opportunistic CKD screening particularly in the areas of

prevention, early detection and timely management of the disease. The challenges of time constraints and lack of financial reimbursements meant that opportunistic screening was not always performed. Participants identified tension between practice nurse and general practitioner roles that contributed to either confusion about who should undertake screening practices, or an explicit resistance from general practitioners who believed practice nurses should not be screening or consulting with patients. Some participants also identified a lack of knowledge related to best practice screening.

Before interventions to improve the uptake of screening practices in primary care can be designed and implemented, it is necessary to identify the barriers to change. In the current study, the barriers to CKD screening were identified as complex and multifaceted with many interrelated variables that were both socially and organizationally driven. The major barrier of time is only likely to be overcome if an MBS item number for chronic disease screening is implemented or if practices can learn from other practices that have successfully implemented chronic disease screening programmes with minimal cost to the practice. The early detection of CKD reduces disease-related morbidity and mortality. Consequently, there is a moral imperative that GP settings identify strategies to improve opportunistic screening. This will be most likely achieved if the organizational culture of GP respects a more collaborative approach to patient care and GP can be reimbursed for nurse-led CKD screening activities.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

General Practice Nursing in Australia
The Theory of planned behaviour

Online Supplementary file 3. Open ended questions utilised in the online elicitation survey and associated constructed measured
Table 2A: Behavioural (attitudinal) beliefs - Most frequently reported advantages of screening for Chronic Kidney Disease in nursing consultations ($n = 26$), B: Behavioural (attitudinal beliefs) - Most frequently reported disadvantages of screening for Chronic Kidney Disease ($n = 26$)
Table 3A: Normative beliefs - Most frequently reported individuals or groups perceived to approve of screening for Chronic Kidney Disease ($n = 24$), B: Normative beliefs - Most frequently reported individuals or groups perceived to disapprove of screening for Chronic Kidney Disease ($n = 24$)
Table 4: Perceived behavioural control - Most frequently reported factors that enable or prevent screening for Chronic Kidney Disease in the general practice setting ($n = 26$)

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Chapter 4: Instrument development for the CKD-DETECT trial

This chapter reports the development of the three instruments used to evaluate the outcome measures of the CKD-DETECT trial.

1. *Instrument 1*: The Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI) was developed to measure the predictor constructs of the TPB as related to opportunistic screening practices in people at risk of CKD. This instrument evaluated aim three of the thesis: The effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.
2. *Instrument 2*: A 12 item scenario-based multiple-choice knowledge evaluation instrument to assess participants' knowledge of CKD risk factors and best practice guidelines for CKD screening. This instrument evaluated aim four of the thesis: The effectiveness of an asynchronous web-based e-learning module on GPNs' knowledge about CKD risk factors and screening practices.
3. *Instrument 3*: The Learner Satisfaction with Asynchronous e-Learning (LSAe-L) instrument which served to evaluate aim five of this thesis: GPNs' perceived satisfaction with an asynchronous web-based e-learning module.

4.1 Instrument development

All instruments were informed by the eight step process in scale development recommended by DeVellis (2012):

1. Determine construct to be measured;
2. Generate the item pool;
3. Determine measurement format;
4. Initial expert panel review draft instrument;

5. Consider inclusion of validation items;
6. Administer items to administrative sample;
7. Item evaluation; and
8. Optimisation of scale length.

4.1 Instrument validity

Given the time restrictions associated with this program of work, face and content validity of the instruments were evaluated prior to the intervention phase of the study. Face validity refers to whether the items within an instrument measure the construct they are intended to measure (Hardesty & Bearden, 2004). Alternatively, content validity relates to the accuracy of an instrument to evaluate or represent the entirety of the construct (e.g. learner satisfaction or knowledge) it purports to measure (Nunnaly & Bernstein, 1994).

4.2 Content validity

Content validity suggests that the survey tool reflects and considers all of the constructs being measured, where the construct is considered the underlying theme or subject matter being assessed (Lavrakas, 2008). Approaches to appraise content validity can be categorised as either judgemental or statistical (Sireci, 1998). The judgemental content validity approach utilises a panel of subject matter experts (SME) to evaluate and rate the representativeness and relevance of test items in the construct being evaluated. Alternatively, statistical methods analyse test item data from the instrument to determine the degree of content validity (Sireci, 1998).

To determine the representativeness and relevance of the three survey instruments and their individual items in this study, content validity was assessed using the two-stage judgemental approach described by Lynn (1986) and Polit and Beck (2006). The judgemental quantification approach initially required the full identification of the content domain, item generation and their integration into a draft instrument. The

second stage utilised a panel of Subject Matter Experts (SME) to evaluate individual test Items Content Validity (I-CV) and the survey instruments entire content validity (S-CV) (Lynn, 1986). For the review of instruments used in the study, each panel of SME consisted of 5-10 experts in their respective fields. While appearing an arbitrary number this range, according to Lynn (1986), provides a means of avoiding chance agreement. The SME were provided with a face and content validity rating instrument (see Appendix 11) and asked to rate each item using a four point ordinal scale for relevance, clarity and conciseness, and ambiguity. A four point scale whereby 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant, was chosen to avoid any neutral or ambiguous midpoints (Polit & Beck, 2006). If an item was rated 1 or 2, the SME were asked to provide feedback for this decision, and the item was then revised or discarded accordingly.

The I-CV was calculated as the number of SME awarding a rating of 3 or 4, dichotomising the rating into relevant and not relevant, and divided by the number of SME (Polit & Beck, 2006). In keeping with Lynn's (1986) suggestion, if the panel consisted of 5 SME, all must have been in agreeance about the I-CV for their rating to be considered a reasonable representation of the universe of possible ratings. Items were revised or discarded if the I-CV was lower than 0.78 (Lynn, 1986). The S-CV was determined by universal agreement (S-CV/UA) by the panel of SME, which was calculated by the proportion of items receiving a rating of 3 or 4 by the *entire* panel of SME (Polit & Beck, 2006).

4.3 Face validity

Face validity was measured for all instruments using the 'absolute' approach as described by Nevo (1985). At the end of each face and content validity rating instrument (see Appendix 11), the SME were asked to rate the instrument's ability to measure the construct overall using a 4 point Likert type scale.

Instrument 1: Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI)

The construction of the Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI) (see Appendix 12 for final version) required an eight-stage approach. Its development was undertaken using the guidelines for the construction of TPB questionnaires suggested by Francis et al. (2004) and Ajzen (2002). The TPB-CKDISI predictor items were informed by the data collected during the elicitation study reported in chapter three and developed to assess each of the emergent themes from its content analysis. The instrument included one clinical vignette, which enabled respondents to decide on their course of clinical action and provide their responses to the subsequent survey items, as well as direct measures of the predictor variables attitudes, subjective norms and PBC. Two behavioural intention questions were included after the vignette with a binary response option of yes or no and a paired question to evaluate the ease with which that decision was made.

The TPB-CKDISI was reviewed by a panel of five subject matter experts (SMEs) to ensure content validity (Sireci, 1998). The panel consisted of four practice nurses and one expert in survey design. As for each instrument developed for the CKD-DETECT study, panel members were given a copy of the draft instrument and a face and content validity rating instrument (see Appendix 11) to ensure the delivery of objective and specific critique and to evaluate the Item Content Validity (I-CV) and the Survey Content Validity (S-CV) for the entire instrument (Lynn, 1986). Panel members were asked to use the rating instrument to assess content omission, overall comprehensiveness, repetition, clinical relevance and clarity. Panel members were also asked to suggest alternate wordings if any item was deemed unclear or ambiguous.

Face validity was assessed by the same panel of SMEs. The panel was asked to evaluate and provide comments where required on the suitability of the instrument,

including the preamble/instructions and individual items to assess knowledge evaluation of the key message areas/learning outcomes. A final question was asked about the overall suitability of the instrument using a 4 point Likert scale.

The final TPB-CKDISI (see Appendix 12) included 40 items, four behavioural intention questions, fourteen items assessing attitude, eight items assessing subjective norms and fourteen items assessing perceived behavioural control. While longer instruments are considered more reliable (DeVellis, 2012), pragmatic consideration was given to instrument length to maximise response rates with a survey completion time of thirteen minutes or less considered ideal to obtain a good response rate (Fan & Yan, 2010). Although assessment of instrument construct validity should be undertaken prior to being utilised in the intervention, due to the number of participants and time required to conduct a factor analysis, this was not considered feasible.

Instrument 2: The knowledge evaluation instrument

The literature does not report any reliable or validated instruments for evaluating knowledge related to CKD screening guidelines in the nursing profession. Agrawal *et al.* (2009) reported the psychometric testing of a 15-item instrument which assessed internal medicine residents' knowledge of CKD guidelines in the United States of America. While the authors concluded that their instrument was valid and reliable, it evaluated aspects of CKD outside the scope of practice for Australian GPNs including the development of clinical action plans, complication identification and medication prescription. Consequently, an instrument to evaluate GPNs' knowledge of CKD screening practices was developed for the current study.

The Kidney Health Australia - Caring for Australians with Renal Insufficiency (KHA-CARI) guidelines (Johnson *et al.* 2013) provide evidence-based recommendations for the detection of chronic kidney disease. Part one of these guidelines were used to ensure the constructive alignment between the active

control's learning objectives, content and the 12-item multiple choice knowledge evaluation instrument (KE-I). This was consistent with other instruments that have evaluated knowledge constructs in CKD education (Estrella *et al.* 2012; Tapia-Conyer *et al.* 2013).

The KE-I was reviewed by a panel of six SME for face and content validity (Sireci, 1998) as described in the previous setion. The panel consisted of one renal educator, two nurse practitioners, and three CKD Clinical Nurse Consultants. Three of the SME panel were also members from the former KHA Kidney Check Australia Taskforce education committee. After the panel had completed their review, their reports were considered by the research team. Nine items were refined based upon the feedback from the SMEs, no items were removed.

The final version of the KE-I consisted of twelve items (see Appendix 13). Five items related to the identification of CKD risk factors and the remaining seven related to evidence based screening methods for CKD.

Instrument 3: Learner Satisfaction with Asynchronous e-Learning (LSAeL) instrument

Measurement of user satisfaction is one of the most important methods of evaluating e-learning programs and one of the easiest methods for online application evaluation (Sun *et al.* 2008). User satisfaction in the context of e-learning is generally measured for quality of interface (including interactivity), system quality, reliability, support, speed of response (technical speeds) and effective feedback (Chen *et al.* 2008; Sun *et al.* 2008; Lin *et al.* 2011). Further critical factors often considered include learner information communication and technology (ICT) anxiety, perceived ease of use, and relevance to job role (Wang 2003; Sun *et al.* 2008).

A literature search was conducted to identify validated tools that assessed user satisfaction with e-learning. The databases of Medline, CINAHL, PsycINFO and Proquest were searched using the terms e-learning, ICT, instructional design,

instrument and satisfaction for the period 2000 - June, 2016. The search was supplemented by manually reviewing reference lists of relevant papers. A total of five papers (Wang 2003; Sun *et al.* 2008; Udo *et al.* 2011; de Melo Pereira *et al.* 2015; Palmer & Holt, 2009) were identified that reported validated tools that measured learner satisfaction with e-learning. However, no single paper identified a tool that would enable the measurement of satisfaction within the context of this present study. For example, Wang's (2003) measurement of learner satisfaction contained multiple items that assessed personalisation of content and interaction with other learners, variables that are not relevant or applicable to asynchronous e-learning programs. Similarly, Palmer and Holt (2005) measured participant perceived importance and satisfaction with items relating to student-student and teacher-student interactions. The instrument by Sun et al. (2008) included items that measured ICT related anxiety and technology factors such as internet connection speeds, and the instrument by de Melo Pereira et al. (2015) contained items that measured participants' subsequent intention to use e-learning. While variables such as ICT anxiety and internet speeds influence satisfaction, they are factors outside the control of the developers and do not accurately represent user satisfaction with the actual e-learning module itself; rather they represent part of the user experience of e-learning overall. Consequently, the decision was made to develop the LSAeL-I to evaluate participants' perceived satisfaction with their experience of undertaking the e-learning module/s and their instructional design elements, particularly course design delivery.

Theoretical framework, item generation and measurement format

For the purpose of developing the LSAeL instrument, asynchronous e-learning was defined as any educational intervention that is mediated electronically via the internet or on a local computer or network which is devoid of any student-student or teacher-student interaction, whereby the program alone facilitates knowledge generation (Sinclair, Kable, Levett-Jones, & Booth, 2016). Learner satisfaction was

defined as the user's perceptions of satisfaction with instructional design features of the e-learning program (Kats, 2013). The instructional design principles described by Sinclair et al. (2017) and informed by Gagne, Wager, Golas, Keller, and Russell (2005) for the development of high-quality, high engagement asynchronous e-learning programs were used as the theoretical basis for the creation of the LSAe-L instrument (See Figure 4.1). The instrument was designed from a pragmatic perspective that theorised that while there are many factors related to satisfaction with e-learning reported in the literature, many are beyond the control of the developer.

Domain 1: Gain attention
Domain 2: Describe the goal
Domain 3: Stimulate recall of prior knowledge
Domain 4: Present the material to be learned
Domain 5: Provide guidance for learning
Domain 6: Elicit performance "practice"
Domain 7: Provide informative feedback
Domain 8: Assess performance
Domain 9: Enhance retention and knowledge

Figure 4.1: a priori domains of instructional design principles (Gagne et al. 2005)

Items were developed for each of the nine *a priori* domains for the instrument. The initial item pool comprised of 32 core items with eight of those items containing 18 sub-items, resulting in a total of 50 discrete items. A 5-point Likert type scale with anchors ranging from strongly disagree to strongly agree was selected because it has been commonly used in satisfaction instrument measurements (Wang 2003; Sun *et al.* 2008; de Melo Pereira *et al.* 2015) and is suitable for measuring perceptions (DeVellis, 2012). Positively and negatively worded items were included to preclude potential agreement bias. The primary and secondary research supervisors then reviewed and made recommendations about the refinement of items.

The draft LSAeL-I was reviewed by a panel of five SME for I-CV and S-CV. The panel consisted of one academic with extensive experience in survey design, two independent e-learning instructional design experts and two e-learning content development experts from external organisations. As per the previous two instruments, each panel member was given a copy of a draft LSAeL-I and the face and content validity rating instrument. The SME panel were provided with an electronic copy of the draft LSAeL scale and an instrument to rate the relevance of each individual item in addition to its clarity and conciseness of wording.

Results

The expert panel unanimously agreed that the instrument accurately evaluated learner satisfaction with asynchronous e-learning programs instructional design elements with the original draft S-CV (relevance) being 0.975 (See Appendix 14 for pre and post expert panel scoring). The minimum I-CV was 0.60 and the maximum, 1.00. The mean modified Kappa was 0.96. Two potentially problematic items (PPI) were identified (i.e. modified Kappa ≤ 0.59), item 2 was removed from the instrument and item 3 was refined and re-evaluated by the panel. While the expert panel demonstrated strong agreement regarding item relevance, five PPI were identified as being poorly constructed in terms of clarity and conciseness.

The S-CV (clarity) of the LSAel overall was 0.92 with a minimum I-CV was 0.40 and maximum, 1.00. The mean modified kappa coefficient was 0.89 and 84.4% of items (n=27) were rated as excellent, 12.5% (n=4) were rated as weak, with the remaining item (#14) rated as poor for clarity. Item 14 was reworded based on the expert panel suggestions, and the stem and sub questions were removed and reordered to become item 13 in the revised draft.

A follow up meeting with the expert panel resulted in the refinement of the remaining four PPI that were identified as having questionable relevance and/or clarity. The meeting resulted in the removal of one further item (#29) on the basis of poor clarity whereby discussion could not achieve any resolution or alternative

wording. The refined instrument was returned to the expert panel and 100% universal agreement was achieved. The final items and sub items were then converted to discrete items (i.e. no stem with sub items) and re-ordered under the nine ID domains, resulting in a 35 item instrument (eg: Gain attention (Q1-4) contained two discrete items with two further stem items with seven associated sub-items; these were then converted to nine discrete items for the final instrument).

Exploratory factor analysis

The 35-item instrument underwent pilot testing using module 1 in a purposive sample drawn from a cohort of 622 undergraduate students enrolled in a second year nursing course at a regional university in New South Wales. The testing was part of another study not associated with this program of work.

One item, which was a negatively worded validation item, and had inconsistent distribution compared to the other items. As a result, it was removed from the instrument and not included in further analyses. The exploratory factor analysis (EFA) generated eight eigenvalues greater than one, Horn's parallel level analyses generally agreed with the Kaiser's eigenvalue findings. Subsequently, seven to nine factor solutions were generated and explored. The nine-factor solution demonstrated three cases of cross loading and was discarded. There were no cross loadings in the seven or eight factor solutions. After detailed examination of specific items and factor loadings and identifying that items 19 and 24 were solitary items in the eight-factor solution, the seven-factor solution was identified as the best plausible fit with the data accounting for 86.1% of the total variance. Items 10, 19, 21 and 33 had factor loadings < 0.4 and were removed, item 32 loaded weakly (0.42) into factor five and the decision was made to refine the item in future instrument iterations as there was scope to improve the clarity of its wording.

The final version

The engagement of the expert panel resulted in the removal of 15 items on the basis that the learner was not in a position to reliably answer items about accuracy, quality and evidence levels of content. The decision to remove these items strengthened the ability of the instrument to evaluate measures pertaining to instructional design particularly given that some of the existing e-learning satisfaction instruments have items that measure other constructs. The factor analysis resulted in a further five items being removed. After piloting the instrument and associated factor analysis, a 30-item instrument was used for the CKD-DETECT trial (See Appendix 15). Overall, results demonstrated that the LSAeL-I has good content, face and construct validity

Demographic data

A demographic instrument was developed that included 13 items measuring age, gender, geographic location, job title, nursing history[1] and previous exposure to kidney health related continuing professional development opportunities (see Appendix 16)

[1] Including years of nursing experience and years working in general practice

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Chapter 5: Development of the intervention for the CKD-DETECT trial

This chapter describes the development and content of the learning components of the active control and intervention for the CKD-DETECT trial. It also presents a framework for the design and development of authentic high engagement - high quality e-learning programs through the presentation of the fourth publication of this thesis:

Sinclair, P.M., Levett-Jones, T., Morris, A., Carter, B., Bennett, P.N., & Kable, A.K (2017). High engagement - High quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators. *Nursing & Health Sciences.* 19(1), 126-137

5.1 Publication impact

At the time of thesis submission this paper has been cited five times.

5.2 Publication copyright

Permission to reproduce publications fourth in this thesis has been obtained (See Appendix 17).

5.3 Developing the intervention and active control e-learning modules

In order to modify an individual's intention to perform a specific behaviour it is important to first elicit:

1. Whether they are in favour of carrying it out (attitude)
2. The social pressures that influence whether they will or will not carry it out (subjective norm) and;
3. Whether the individual has the volitional control to carry out the behaviour in question (perceived behavioural control)

Interventions that specifically target these factors are more likely to improve behavioural intention (Francis et al., 2004) and in turn, change behaviour (Kok et al., 2016). In the context of the intervention used for the CKD-DETECT study, general practice nurses (GPNs) decision making processes and actions regarding the initiation of kidney health checks were the target behaviours.

The CKD-DETECT study comprised of two arms.

The active control: Module ONE

For the active control group, module one was designed and developed to meet two key learning outcomes derived from the Kidney Health Australia - Caring for Australians with Renal Insufficiency Guidelines (Johnson et al., 2013):

1. To identify the major risk factors for developing CKD and;
2. To describe the best practice screening method for early CKD

Module 1 (See Appendix 18), used a case study approach and introduced participants to Mr John Anderson, a 62-year-old man who presented to his general practice. Module 1 consisted of 16 core screens with each page containing various multimedia and interactive links depending on the content being delivered.

The intervention: Module TWO

For module two (See Appendix 19), the intervention arm, there were two learning outcomes:

1. To identify the challenges that prevent CKD screening in the workplace and;
2. To identify and reflect upon potential solutions to improve CKD screening in the workplace

The elicitation study (presented in Chapter 3) suggested that participants were familiar with who should be targeted for opportunistic screening and how to conduct a kidney health check. It concluded that the barriers to CKD screening were influenced by many inter-related variables that were socially and organisationally

driven. The intervention was developed using the premise that GPNs may overcome the barriers to CKD screening if they role model/adopt strategies employed by other practices that have effectively implemented chronic disease screening programs at minimal cost to the practice.

Module two profiled two general practices that had implemented award-winning processes to successfully screen people with recognised risk factors for CKD. After participants identified salient challenges they faced, programming logic was used to present them with strategies they could use which specifically targeted the TPB predictor variables identified from the elicitation study (See Table 5.1). These can be cross referenced with the illustration of the intervention presented in Appendix 19.

Barrier	TPB target variables	Content/Materials
1. Without an MBS item number for CKD screening, it is just not cost effective to screen for CKD	ATT, PBC	Video of how case study practices approach this – Nurse practitioners and practice principles speak on the topic area
2. I'm unsure what the best approach is to improving practice (let alone CKD screening) in my workplace	PBC	Video and animations on change processes including collaborative approaches and how to develop organisational buy in
3. I can't collaborate with some of the 'traditional' doctors in my workplace who think that initiating screening is outside nurses' scope of practice.	PBC	Videos from the case study practices talking about strategies to work with 'traditional' doctors
4. We don't have any ways to find people who are at risk of CKD efficiently?	PBC	Multiple links to animations, videos and how to guides on the efficient use of practice management software
5. Staff in my workplace don't know what the risk factors for CKD are or how to screen for it	PBC	Multiple links to CKD education resources including smart phone applications, e-learning modules, posters and handbooks
6. I can't seem to remember to check for people who are at risk of CKD	PBC	Videos with practical hints on remembering as part of patient assessment as well as link to posters for treatment rooms
7. I am too busy to screen for CKD, there are more important priorities	ATT, PBC	Videos of practice nurses speaking to this myth and a link to the federal government practice incentives program gor continual improvement projects and how this could be utilised to the benefit of the practice
8. I am not confident enough to bring up the need for a Kidney Health Check with the GP	PBC	Video with practical suggestions on how to start a conversation with GPs in addition to a link to a live Facebook post about managing conversations with GPs
9. CKD screening is not part of the Practice Nurses role	ATT, SN, PBC	Two short videos responding to this statement

Table 5.1: Mapping the barriers to CKD screening to the TPB predictor variables to the intervention (module two) content (Att: Attitude; SN: Subjective Norms; PBC: Perceived Behavioural Control)

Module two consisted of 26 screens with various multimedia including animations, videos and links to resources and applications to assist participants in overcoming the barriers. The first seven screens of the intervention targeted attitudinal variables including awareness, prevention, the benefits of early CKD detection and decreasing disease burden. Subjective norms were targeted throughout the intervention with particular focus through the use of two award-winning general practices. Factors that influence perceived behavioural control were predominantly addressed during the core barriers section (See Table 5.1). In this section, particularly barriers one and seven also focused on attitudinal variables including impost on time and benefits of early detection. Upon completion of the study and its surveys, all participants were emailed a continuing professional development certificate and were entered into a draw to win one of three AU$100.00 gift vouchers.

Prior to the design of the intervention, a reference group was engaged to critique and provide advice throughout its development. The group consisted of GPNs and Nurse Practitioners who were specialists in the content field, and e-learning instructional design experts. Kidney Health Australia (KHA) representatives were consulted before and during the project to ensure a consistent 'Kidney Health' message was delivered. After the development phase had concluded, five members from the Primary Care Education Advisory Committee for KHA (PEAK) were asked to undertake both modules and review them using the Learning Object Review Instrument (LORI 1.5) (Nesbit, Belfer, & Leacock, 2003). LORI 1.5 (See Appendix 20) provided a framework to evaluate key domains including the veracity and accuracy of content, ease of navigation, and whether the e-learning program adhered to internationally accepted technical standards. Minimal changes were required after the review.

The total time expected for completion was between 60 and 90 minutes depending to which study arm the participants were randomised. This time would vary depending on the level of user engagement with each module. Participant compliance with undertaking the modules was not measured specifically, however the post surveys could not be accessed until the participant had completed their allocated arm in full. Both modules strictly adhered to international web standards in order to avoid technical issues and maximise usability across all computers and mobile devices (Sinclair *et al.* 2017).

Publication four: High engagement - High quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators.

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Education Article

High engagement, high quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators

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Abstract E-learning involves the transfer of skills and knowledge via technology so that learners can access meaningful and authentic educational materials. While learner engagement is important, in the context of healthcare education, pedagogy must not be sacrificed for edu-tainment style instructional design. Consequently, health professional educators need to be competent in the use of current web-based educational technologies so that learners are able to access relevant and engaging e-learning materials without restriction. The increasing popularity of asynchronous e-learning programs developed for use outside of formal education institutions has made this need more relevant. In these contexts, educators must balance design and functionality to deliver relevant, cost-effective, sustainable, and accessible programs that overcome scheduling and geographic barriers for learners.

This paper presents 10 guiding design principles and their application in the development of an e-learning program for general practice nurses focused on behavior change. Consideration of these principles will assist educators to develop high quality, pedagogically sound, engaging, and interactive e-learning resources.

Key words education, e-learning, information communication and technology, instructional design, kidney, nursing.

INTRODUCTION

E-learning has become an integral and ubiquitous component of health professional education. It has many benefits, including the accommodation of multiple learning styles, asynchronicity, and instructional design flexibility (Gerkin *et al.,* 2009). Increased access to education, cost-effectiveness, and interactivity are also frequently cited advantages of e-learning (Ehlers & Pawlowski, 2006). Despite these benefits, and the potential that recent advances in computer-based instruction offer, there is great variation in e-learning quality. Indeed, too often, purported e-learning programs are no more than document repositories with limited interactivity (Sinclair *et al.,* 2016b).

Health professional educators should be competent in the use of current web-based educational technologies so that learners are able to access relevant and engaging e-learning materials without restriction. Educators must also maintain a balance between the design and implementation of quality resources, ensuring cost-effectiveness, sustainability, and accessibility, irrespective of time or the geographical location of learners (Button *et al.,* 2014). Consequently, in order to develop and deliver engaging and pedagogically sound e-learning programs, they must be informed by evidence-based instructional design principles.

This paper presents 10 guiding principles for educators who want to develop empirically informed, engaging, and effective asynchronous e-learning programs (see Table 1). An exemplar e-learning program, CKD DETECT, designed to improve opportunistic chronic kidney disease (CKD) screening practices in the Australian primary care setting, is presented to demonstrate the application of each principle. The e-learning program was developed in response to sub-optimal CKD screening practices in Australia (Razavian *et al.,* 2011), in conjunction with a call for improvement in CKD education (Mathew & Corso, 2009). The program's target audience is general practice nurses, as they are ideally positioned to lead general practice-based screening programs (Tracey *et al.,* 2010).

While it would be naive to suggest that there is a single linear approach or model for instructional design that will suit all e-learning development needs, the principles identified in this paper can be used as a guide for health professional educators who aim to develop pedagogically sound, high quality, asynchronous e-learning programs. Fundamental to these principles is the premise that e-learning development should predominantly focus on the process of learning rather than the process of instruction (Gagne *et al.,* 2005).

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Table 1. Instructional design principles

1	Consider learner capabilities and existing knowledge
2	Consider the programing to be utilized
3	Provide learning guidance
4	Identify learning outcomes and ensure content will deliver
5	Conceptualize and create meaningful and engaging content
6	Present the stimulus material
7	Consider how you will capture and maintain the learner's attention
8	Design objective performance assessments and feedback
9	Incorporate elements to enhance retention, transfer, and behavior change
10	Incorporate peer review of content and resource evaluation measures

CONSIDER LEARNER CAPABILITIES AND EXISTING KNOWLEDGE

Educators who plan to implement e-learning resources must consider the capabilities of the target audience for whom the resource is being designed. Despite the increased use of e-learning in health professional education, not all learners will be competent or confident in its use (Levett-Jones *et al.,* 2009). There is a need to consider learners' experiences, attitudes, and preferences with regard to e-learning, as well as whether they have reliable Internet and computer access (Sinclair *et al.,* 2011). Variations in bandwidth and streaming capabilities of the learner's Internet connection can also affect the delivery of the resource and impact learner satisfaction with the experience. Consideration of learners' technical ability and their need for preparatory activities can prevent disappointing user experiences that can result in disengagement from e-learning resources.

New information should always be linked to and build on existing knowledge (Knowles, 1980). E-learning designers should recognize that learners may possess prerequisite knowledge and that to repeat already known content will create a barrier to engaging with new content. This challenge can be navigated in one of three ways. Firstly, a case study approach could be utilized that requires the learner to identify appropriate clinical assessments or actions, and then provides immediate feedback on their responses. Depending on the accuracy of the answers, learners can either bypass selected modules if they choose, or be directed to extension materials prior to progressing to the next module of the program. The second option is to deliver a pre-quiz to identify the learner's current level of knowledge. Depending on the grade attained, learners can then be directed either to a foundational or to more advanced learning modules. These approaches ensure that all participants will have the same baseline level of knowledge before proceeding to the additional content required to meet the new learning outcomes of the program. A third option developers may wish to consider is the use of a "choose your own learning pathway" approach, whereby users can select which modules they choose to undertake. This approach promotes engagement with program content and is consistent with "just-in-time" teaching that is becoming more prevalent in today's learning environment (Boese, 2016).

Box 1: Learner capabilities and existing knowledge considerations in the development of CKD DETECT
CKD DETECT was designed to be intuitive in nature so that learners are able to easily navigate through each step of the program (Section 4 discusses this in more detail). The program also administers a 12 item pre-quiz to assess the learner's level of knowledge regarding CKD risk factors and best practice screening methods. A grade of 80% was set as a minimum knowledge requirement, and attaining a grade equal or higher enables the learner to bypass the knowledge-based module (module one) and proceed to the more practically focused module (module two). Module two profiles general practice settings that have successfully implemented easily replicable screening programs . Further information regarding the learning outcomes for module two is available in Boxes 4 and 7.

CONSIDER THE PROGRAMING TO BE UTILIZED

Educators should be fluent with the e-learning authoring software and programing resources they intend to use, and whether they are appropriate to the desired outcomes of the learning experience (Watkins, 2005). Asynchronous e-learning design requires an understanding of educational pedagogies, multimedia content, resource publication, electronic technologies, and international web standards (Brown & Voltz, 2011). While experience in these areas is beneficial, it is not essential, and with appropriate guidance and support, designing e-learning resources does not have to be difficult or time consuming. As the Internet has developed, proprietary technologies, including Internet browsers and animation plugins, have become available. Traditionally, many stand-alone e-learning programs have been developed using Adobe Flash (Adobe Systems, San Jose, California, USA) or Microsoft Silverlight (Microsoft Corporation, Redmond, Washington, USA), multimedia platforms that can be used to create rich, animated, and interactive media. These approaches have made it relatively easy and cost-effective for subject matter experts to develop their own e-learning resources. The benefit of having full control over e-learning content design and development is that it allows for seamless integration of current clinically relevant content as it becomes available, without the need to rely on third party developers to assist with updates.

Advancements in smart phone and tablet technologies has rendered some e-learning programs, particularly those developed using Flash or Silverlight software, inaccessible on mobile devices that do not support these platforms, including the Apple iPhone and iPad. However, major technology firms, including browsers such as Mozilla (Mozilla Foundation, Mountain View, California, USA) and Google Chrome (Google, Mountain View, California, USA), have taken steps to limit or completely prevent the use of Adobe Flash because hackers are actively exploiting vulnerabilities within (Burgess, 16 May 2016). These types of issues need to be considered during the design of e-learning resources.

Programing behind e-learning resources can provide device independent access if educators and web designers use

international web standards. These established international standards provide a worldwide framework of open technologies that only requirement an Internet connection and the browser on a computer, tablet, or smart phone (W3C, 2012). Unlike installations of new software, most Internet browsers can also be kept up to date once installed, without the user needing "administrator access" to a computer, which can be a common problem in clinical settings. An additional benefit of using a browser-only approach when developing e-learning resources is the ability to update the content and have the changes immediately reflected worldwide (Mikkonen & Taivalsaari, 2011).

The requirement for international standards compliance is incontrovertible and is considered to be best practice in e-learning development, as it maximizes accessibility and compatibility across all computers and mobile devices (Leacock & Nesbit, 2007). Adherence to the standards also assists in avoiding technical issues and maximizes usability. A combination of HyperText Markup Language (HTML) and QuestionMark Markup Language (QML) can be utilized for authoring questions (see Table 2 for an explanation of these programing languages). Alternatively, other e-learning programs, including Adobe Captivate (Adobe Systems), Smart Sparrow (Sydney, New South Wales, Australia), Articulate Storyline (Microway Pty Ltd, New York, New York, USA) or Adapt Learning (VYAS SYSTEMS, Essex, UK) could be utilized for content development. To meet best practice standards, e-learning programs should also be Sharable Content Object Reference Model (SCORM) compliant. SCORM compliance is a standards and specifications protocol that enables communication between the e-learning program and the learning management system (LMS) in which it is hosted (Gasston, 2013). Educators who do not have the skill set or access to personnel with these skills may wish to consider utilizing HTML rapid authoring e-learning tools, such as Elucidat (www.elucidat.com) or Gomo (http://www.gomolearning.com/), which offer intuitive design and development functionality, including in-built features such as online peer review via password access.

Box 2: The programming utilized in the development of CKD DETECT

CKD DETECT was developed using international web programing standards to maximize accessibility and compatibility across all computers and mobile devices. HTML was used to lay out headings, text, and links. A combination of HTML and QML were used to create questions. Cascading Style Sheets (CSS) were used to present and position visual components of the program, including icons, charts, boxes, and graphics, and JavaScript was used to provide interactivity, such as the ability to assess vital signs and calculate body mass index (see Fig. 1). The entire project was designed and delivered using Questionmark Perception (Questionmark, Trumbull, Connecticut, USA), a standards-based, assessment creation, delivery, and reporting application. Consequently, delivery is via a browser only approach. The e-learning program can be packaged using SCORM to enable it to be imported into any LMS.

PROVIDE LEARNING GUIDANCE

Asynchronous e-learning resources do not have the benefit of immediate educator or technical support and guidance, and for this reason they must be self-explanatory in nature and intuitive to use. In designing e-learning resources, the amount, timing and quality of guidance provided will influence learner engagement, achievement, and mastery, as well as overall satisfaction (Palmer & Holt, 2009). Conversely, inadequate or unclear guidance can lead to frustration, ambivalence, and disengagement (Boling *et al.,* 2012; Dziuban *et al.,* 2012). In e-learning, guidance, prompts, advanced organizers, hints, and redirection can be used to promote critical thinking, to keep the learner "on track," and to contribute to efficiency of the learning process.

Box 3: Providing learner guidance in CKD DETECT

CKD DETECT provides guidance in a number of ways. Each page contains concise but clear instructions and links to support in the form of a help page. Advanced organizers and specific icons are also provided at the top of each page to allow the learner to track their progress. A set of icons was designed exclusively for this purpose to enable learners to identify what was expected of them on each 'screen' of the e-learning program (Fig. 2).

Guidance for learning should also be supported by scaffolding (Seale & Cooper, 2010). Scaffolding refers to the provision of sufficient support and coaching to promote learning when concepts and skills are first introduced, followed by a gradual withdrawal of support as the learner progresses and begins to assume an increasingly independent role. Scaffolding allows the learner to construct new knowledge by linking current

Table 2. Programing language explanations

HTML	The primary markup language used on the web. It is interpreted by a program called a "browser," that parses (reads) the code and displays it as a web page.
QML	A markup language designed specifically for laying out questions and assessments. HTML is often used within a QML document. The QML document is turned into an interactive web page by a program such as Questionmark Perception, which then outputs HTML that can be displayed by a browser.
CSS	A style sheet language used to define the presentation of a web page (including colors, sizes, and fonts). It also is used to present different views of web pages depending on device or screen size.
Javascript	Javascript is a computer language that can be interpreted by a browser (alongside HTML and CSS). Javascript is most often used for functionality, such as dynamic page updating, animation, enhanced controls, and increased interactive elements.

Figure 1. A screen shot from CKD DETECT. [Color figure can be viewed at wileyonlinelibrary.com]

knowledge with new learning. Within the context of e-learning, scaffolding enables learners to engage with more complex learning than they would ordinarily be able to independently pursue if left unsupported (Obikwelu *et al.,* 2013).

IDENTIFY LEARNING OUTCOMES AND ENSURE CONTENT WILL DELIVER

Effective e-learning resources introduce the learner to a set of clear learning outcomes and the resource is then developed to ensure those outcomes are achieved (Gagne *et al.,* 2005). The outcomes, where possible, should situate the learning content within a broader curriculum and allow the learner to link current knowledge with what they set out to learn. Without the guidance provided by way of learning outcomes, learners are left to guess what it is they are expected to focus on. This has a direct impact on their confidence, persistence, satisfaction with, and quality of their learning experience (Palmer & Holt, 2009). Using learning outcomes to clearly outline the expectations, purpose, and rationale for the learning experience provides the learner with the opportunity to develop their confidence as they learn new material. In turn, this acquired self-efficacy can assist in driving learner motivation (Blaschke, 2012). Learning outcomes also provide a framework for the design team to ensure that the development of the e-learning resource remains focused and is not merely a compiled repository of resources.

Figure 2. Advanced organizers and icons developed for CKD DETECT. [Color figure can be viewed at wileyonlinelibrary.com]

Box 4: Ensuring content directly addresses learning outcomes in CKD DETECT

CKD DETECT was designed and developed to meet two key learning outcomes derived from the Kidney Health Australia - Caring for Australians with Renal Insufficiency Guidelines (Johnson *et al.,* 2013). A third outcome was developed from the findings of an elicitation study that identified the barriers and facilitators to opportunistic CKD screening by general practice nurses in an Australian primary care setting (Sinclair *et al.,* 2016a). This study concluded that many of the participants were familiar with risk criteria indicating who should be targeted for opportunistic screening and how screening should be undertaken. However, despite this understanding, participants did not always undertake opportunistic CKD screening. The barriers

to CKD screening were found to be complex, multifaceted, and influenced by many interrelated socially and organizationally driven variables (Sinclair *et al.,* 2016a). The major barriers for CKD screening may be overcome if general practices can adopt strategies utilized by other practices that have successfully implemented chronic disease screening programs at minimal cost to the practice. Herein lies an important caveat for the developers of e-learning programs; simply acquiring the requisite knowledge will not necessarily lead to clinical application or motivate learners to put into practice what they have learned (potential solutions to this challenge are discussed in Section 10).The learning outcomes for CKD DETECT were consistent with Australia's kidney health priority areas, thereby reinforcing the clinical and contextual relevance of the learning activity (Kidney Health Australia, 2015). Resource limitations and rationalization are a constant issue in healthcare education, and it is essential that investment in e-learning resources is justifiable. Establishing a link between learning outcomes and health priority areas is one way of providing sound justification for such an investment.

CONCEPTUALIZE AND CREATE MEANINGFUL AND ENGAGING CONTENT

When designing e-learning resources it is tempting to focus on entertainment and interactivity to the detriment of quality content and facilitated learning. Figure 3 illustrates how meaningful e-learning resources can be achieved when there is a mixture of high and low interactivity (depending on content) and when pedagogical principles inform all content-related decisions. Bloom's taxonomy is particularly useful here as this model helps the educator make informed instructional design decisions that move learners from knowledge recall to analysis and application of those facts, as well as evaluation, reflection, and critical thinking (Krathwohl, 2002).

Using a paper or digitally based storyboard approach to conceptualize the design and delivery of content is vital. It affords the opportunity to clearly outline the approach the design team wants to take and will save considerable development time. Microsoft PowerPoint (Microsoft Corporation) is an easily accessible tool that can be used to create

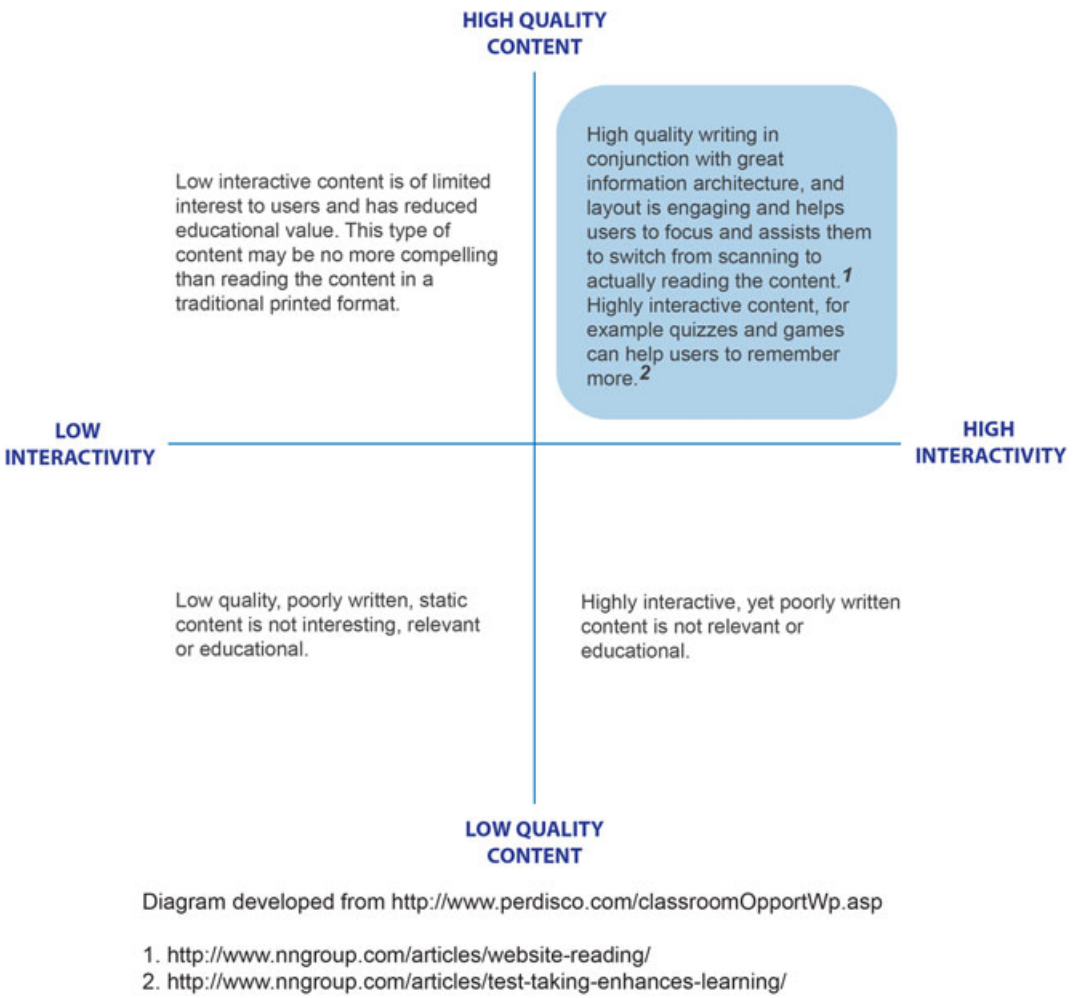

Figure 3. High quality, high interactivity e-learning resources. [Color figure can be viewed at wileyonlinelibrary.com]

storyboards and offers the benefit of being able to drag and rearrange storyboard frames if required. Ideally, each storyboard frame should include the following details (see Fig. 4):

- Frame (screen) title and number
- Branching (i.e. link to next screen/s) and/or additional resources option
- Visual descriptors/sketch/multimedia/content section
- Interactivity and programing notes
- Narrative/scripts notes
- Comments section

Box 5: Utilizing interactivity to create meaningful and engaging content in CKD DETECT
E-learning interactivity allows the learner to be actively engaged rather than a passive recipient of information. CKD DETECT uses a range of different levels of interactivity, from those that promote conceptual understanding and basic knowledge recall, albeit in a visually stimulating way (see Fig. 5: The Glomerulus video), to those that require learners to examine and interpret pathology results (see Fig. 6: Blood results and CKD trajectory). To illustrate, one of the learning activities in CKD DETECT requires nurses to recognize the significance of physical assessment data. This design requires them to identify risk factors for CKD, utilize clinical decision-making skills, and draw conclusions about the patient's clinical condition.

PRESENT THE STIMULUS MATERIAL

The way in which the stimulus materials are presented is a key element of e-learning design success. New stimulus material must be directly aligned with the achievement of learning outcomes and serve to illustrate essential aspects of the content. The learner's working memory – the psychological construct that influences information processing – needs to be considered carefully during the pre-design phase. Working memory is the ability to hold and process a given piece of information in one's mind. An unrelated thought or interruption is likely to cause a disruption and, consequently, a loss of information, which will impact the process of learning (Gathercole & Alloway, 2004). The ideal approach to avoid overloading working memory is to deliver content over a series of small modules rather than providing too much information in one large stand-alone program. This process, known as chunking, maximizes the chances that the learner will be able to read, process, and absorb the content presented (Martin, 2015). It also provides the development team with a framework to design clear and easy to follow content (Murphy *et al.,* 2015).

Headings, images, tables, videos, color, graphics, bold print, and italics, should be used to emphasize key points and facilitate perception of essential features. Video and audio resources should be in MP4 and MP3 file format, respectively, in order to meet best practice standards and ensure content is available across all devices. Video and audio content should also include a written transcript to mitigate any potential audio playback problems or for learners who are in a "quiet zone" and do not have headphones. Transcripts

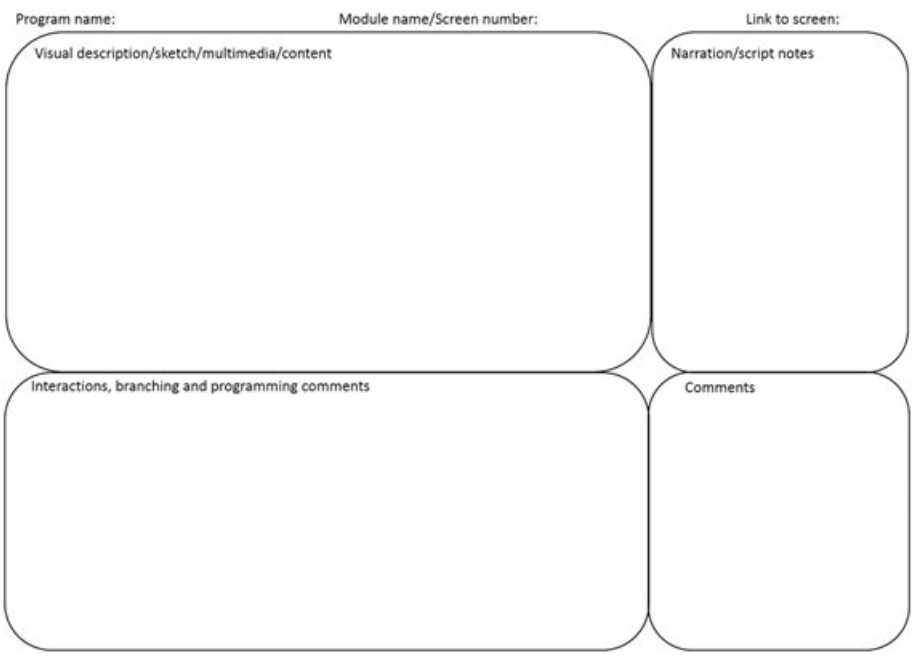

Figure 4. Storyboard exemplar.

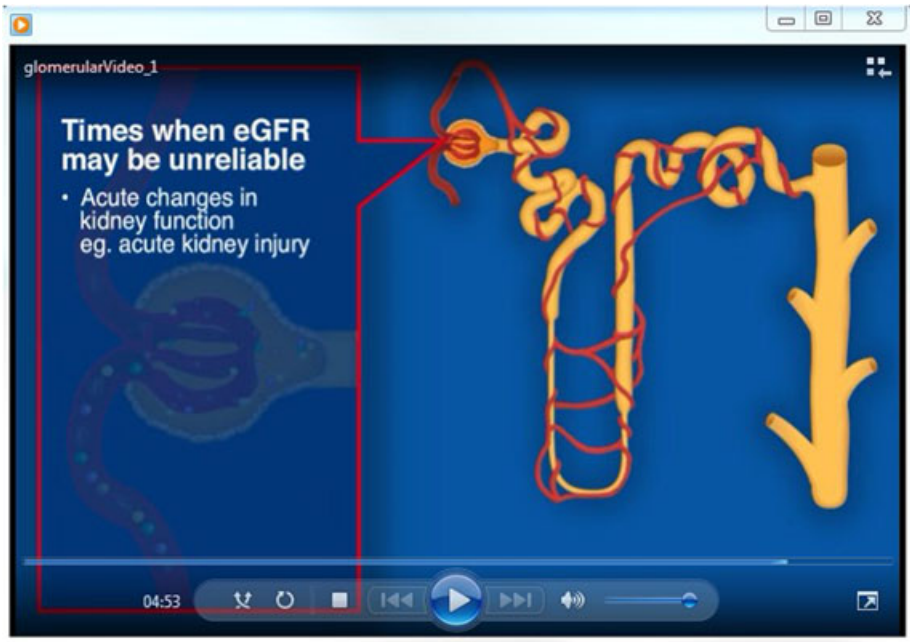

Figure 5. The glomerulus video. [Color figure can be viewed at wileyonlinelibrary.com]

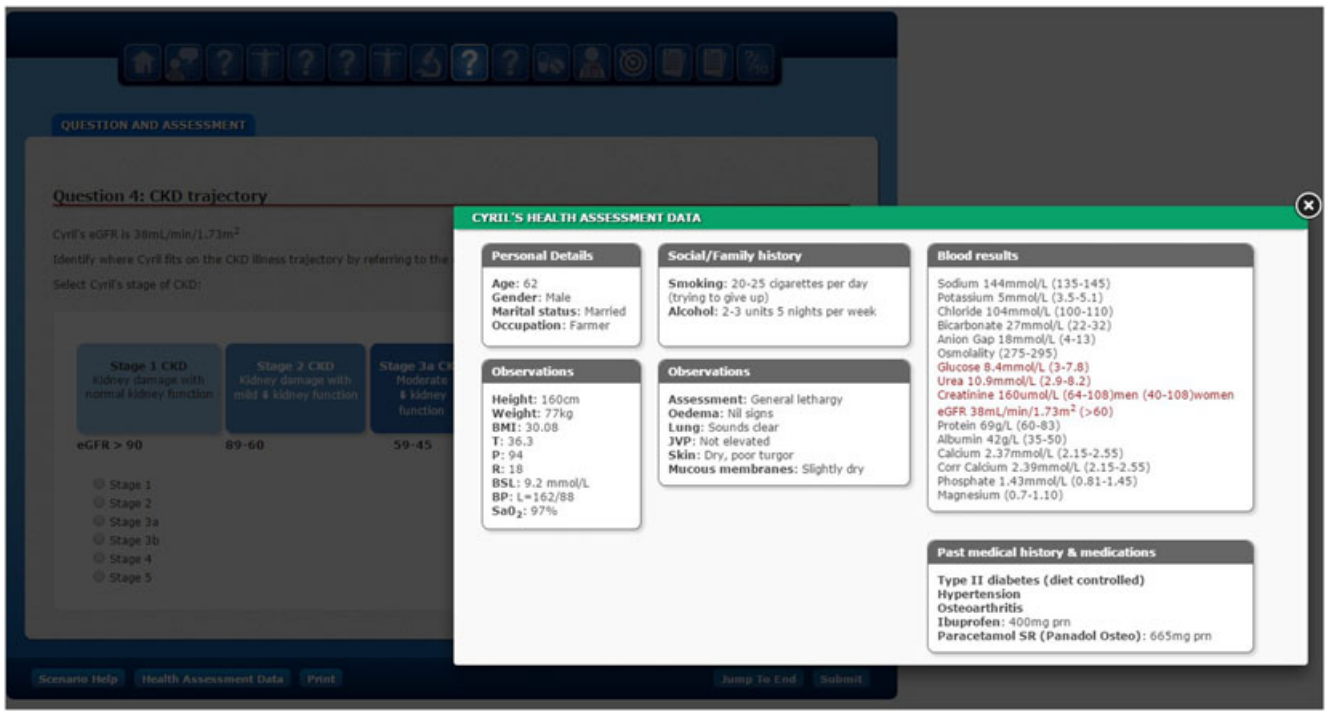

Figure 6. Blood results and Question 4 chronic kidney disease (CKD) trajectory. [Color figure can be viewed at wileyonlinelibrary.com]

may also assist learners, particularly those from a non-English speaking background, to understand terminology and be able to seek further information if required. The use of underlining should be restricted to hyperlinks to minimize possible confusion. Color pallets should be carefully considered in order to provide contrast and color combinations that allow people who are color-blind (or low vision in other educational contexts) to access the content, while making the resource attractive to retain the learner's attention (Mbipom & Harper, 2011).

Box 6: Presenting the stimulus material in CKD DETECT
Figures 1, 5 and 6 demonstrate the considered use of heading code and color pallets to maximize learner comfort. All file formats meet best practice standards, including MP4 for video files and MP3 for audio files. Transcripts were made available for all relevant content.

Considered use of heading code in the HTML is important because most screen readers used by learners with visual impairments use HTML heading levels to summarize the document and mark out sections. In a similar way to the more familiar Microsoft Word application, web pages designate heading levels so that Heading 1 (or <h1> in HTML) is larger than Heading 2 and so on. Guidelines exist that specify how these headings should be used to maximize accessibility (University of Washington, 2013). On the modern web, font size is easily controllable from the user perspective – both at system and browser level. However, the use of well-styled headings will allow larger and smaller text to remain relatively similarly sized even if the learner increases or decreases the font size to their comfort level. The default font sizes should be within accepted ranges and be tested across all major platforms, devices, and browsers.

CONSIDER HOW YOU WILL CAPTURE AND MAINTAIN THE LEARNER'S ATTENTION

As with all adult education initiatives, there needs to be an explicit reason or motivation for undertaking a learning activity (Knowles, 1980). There are many ways of providing the rationale for the e-learning activity and to capture the learner's attention. Gagne *et al.* (2005) advocate the use of novelty, such as animation, humor, demonstration of an unexpected event, or provision of a relevant patient safety statistic or a meaningful scenario to facilitate engagment. A brief 60–90 s video from a prominent authority figure can also be effective in gaining learner attention and establishing the context and benefits of the resource. The emphasis here is on "brief," although the optimal length for video in e-learning will vary depending on the content, its purpose, and presentation. No firm evidence exists to support the ideal length of e-learning video content; however, for an e-learning introduction, the maxim should be "the shorter the better," with the video not lasting more than 90 s (Perry, 2005). An exception is the use of video content that demonstrates a particular skill.

Learner engagement is heightened when the learning is transferable to real world situations. This is facilitated by delivering authentic activities that enable learners to recognize the relevance of their learning to clinical practice (Brown & Voltz, 2011). In health professional education, the introduction of the "person" who is or will be the recipient of care, through the use of text, video, or audio files, promotes a person-centered approach and enhances learner motivation. Beginning with a person's life history allows health professionals to view their practice as more than interactions linked to episodes of care but rather as meaningful engagement with a person during a time in their illness (or life) journey. Unfolding stories are known to provide adult learners with a powerful and effective way to retain information (Prusak *et al.,* 2005). Patient stories enable exploration of reality from different perspectives and create an emotional resonance (Stone & Levett-Jones, 2014). Learners are more likely to exert effort if they find the scenarios compelling and meaningful (Gee, 2003).

Box 7: Capturing and maintaining learner attention in CKD DETECT
CKD DETECT sought to gain the learner's attention in a number of ways. Firstly, a short 90 s introductory video, presented by a practice nurse, provides the stimulus for the e-learning program. It includes an emotional plea and explains how practice nurses can significantly influence patient outcomes through evidence-based screening practices. This is followed by a video of a patient on hemodialysis who was not screened early enough to regress their kidney disease. In this short video, the patient explains the impact that late discovery of kidney disease has had on their lives. The learner is then presented with a pre-test to evaluate their existing knowledge regarding CKD risk factors and opportunistic screening processes to determine, as previously discussed, whether they need to complete the knowledge focused module before proceeding to the more practically focused module. Module one introduces the learner to Mr John Anderson, a 62-year-old man who presents to their general practice. They are given insight into John's life history through a series of images overlaid with a narrated audio file. This is reinforced by the provision of "John's Story" and an outline of his medical history. The learner continues in their usual role as a practice nurse who meets John at their local practice. This is followed with factual information about the prevalence and epidemiology of CKD. In this way, learners are left in no doubt about the significance of this learning to their current and future clinical practice. Module two presents learners with real-life case studies of award-winning general practices who have implemented processes to successfully screen people with recognized risk factors for CKD. The module is based on the premise of having conversations that matter and suggests strategies to improve volitional control of screening practices in their local general practice surgery. This module is pragmatically focused on change management at an organizational level.

DESIGN OBJECTIVE PERFORMANCE ASSESSMENTS AND FEEDBACK

Assessment should be frequently undertaken throughout the e-learning program using a range of questions designed to assess the learner's achievement of the learning outcomes. These can be formatted from traditional multiple choice, multiple response, numeric, or select styles through to graphically rich drag and drop interfaces. Questions can be used to facilitate new learning, and extensive feedback on correct and incorrect responses should be provided to further assist in actively engaging learners.

The provision of feedback allows learners to gauge their performance; it also reinforces learning, corrects misconceptions, and inspires confidence in the learner's understanding of the content (Hatziapostolou & Paraskakis, 2010). In e-learning, feedback is traditionally provided as notification of "correct" or "incorrect" responses; however, this does little to remediate knowledge deficits. Feedback in e-learning should consider all possible answers and be delivered to provide guidance, direction, encouragement, and further information. The timing of feedback is essential; the immediacy that can be provided by e-learning programs embeds learning at the time of delivery and prevents learner frustration (Shute, 2008). Assessment feedback needs to be clear, specific, and meaningful to facilitate further learning (Killen, 2005). Immediate feedback is more effective than delayed feedback in terms of both retaining correct information and correcting wrong answers (Dihoff *et al.,* 2004). It also affords greater knowledge retention, confidence, and the ability to identify and comprehend why responses may have been incorrect in the first instance. E-learning developers should consider providing tailored and specific feedback for each question, including common mistakes and learning caveats to facilitate further learning. Allowing multiple opportunities to reattempt questions also encourages learners to persist in learning without fear of failure.

Box 8: Performance assessment and specific feedback in CKD DETECT

CKD DETECT uses a range of multiple choice, multiple response, and drag and drop interfaces to both assess understanding of content and facilitate new learning. We utilized very specific feedback that linked both correct and incorrect answers to best practice guidelines regarding the detection of CKD. To illustrate, one formative question in module one asked users to identify what investigations should be ordered after identifying that John possessed several risk factors for CKD. One of the multiple-choice distractors was a bladder scan. Rather than identifying it purely as incorrect, the learner was directed to the indications of a bladder scan and in what situations this would be an appropriate investigation to undertake. If the learner identified the correct investigations, their feedback would reiterate where the evidence for this investigation originated.

INCORPORATE ELEMENTS TO ENHANCE RETENTION, TRANSFER, AND BEHAVIOR CHANGE

Once the learner has worked their way through an e-learning resource and achieved the pre-determined learning outcomes, preventing knowledge degradation over time and enhancing the learner's ability to transfer their learning to new situations is vital. This is particularly relevant in health professional education where the goal is often clinical transfer and application. There should be provision for recall of learning, either by reattempting the e-learning resource at spaced intervals throughout future weeks and months (Gagne *et al.,* 2005), or in other ways, such as online tests or quizzes, or directing the learner to further reading, such as guidelines or journal articles.

E-learning is not an educational panacea and will not achieve all educational outcomes. No evidence-based guidelines exist regarding ideal e-learning program size, duration, configuration, or instructional design approach (Cook *et al.,* 2010a; Cook *et al.,* 2010b). If the outcome is to increase knowledge and participant self-efficacy, e-learning has been demonstrated to be at least as effective as face-to-face learning (Cook *et al.,* 2008). What is less clear is whether e-learning can influence sustained behavior change. If behavior change is a desired outcome, further consideration is required by the development team to ensure content adequately addresses variables that affect participant volitional control. Behavior change is a complex and multifaceted phenomenon. If an e-learning program is focused on skill development or behavior change, educators must first recognize that the learner may not be able to undertake the learned behavior or skill of their own volition, if external variables, such as attitudes, perceived social pressures, and behavioral control, prevent them from doing so (Ajzen, 1991). Consequently, research may be required prior to the development of e-learning resources to identify any contextual or personal variables that may impede behavioral change.

Self-reported evaluation tools that measure confidence to perform a target behavior do not necessarily guarantee actual behavior change (Sinclair *et al.,* 2016b). These evaluation tools are inadequate because they do not determine whether the individual possesses the volitional control to carry out a desired practice (Chiou, 1999). Consequently, e-learning interventions that focus on behavior change or skills development should be developed within a theoretical framework that considers the tenets of behavior change (Webb *et al.,* 2010). E-learning developers should develop reliable and validated instruments to objectively evaluate behavioral outcomes for asynchronous e-learning programs where it is impractical to conduct face-to-face evaluation.

With the growth of externally provided asynchronous e-learning programs, minimal attention has been directed to the rigorous evaluation of clinical skills and health professional behavior. The majority of e-learning research to date has focused on user satisfaction, knowledge improvement, or self-efficacy relating to clinical skills using subjective self-reported measures (Lahti *et al.,* 2014). Few studies have examined the effectiveness of e-learning programs on health care professional (HCP) behavior using objectively administered evaluation criteria (Sinclair *et al.,* 2016a); however, those that have considered effectiveness used Objective Structured Clinical Examination (OSCE) (Cantarero-Villanueva *et al.,* 2012) or Objective Structured Assessment of Technical Skills (OSAT) (Pape-Koehler *et al.,* 2013). These processes are impractical for evaluating clinical skills and behavior change in the asynchronous e-learning environment. Consequently, psychometrically tested alternate objective measures informed by sound theoretical constructs are required to evaluate e-learning outcomes associated with behavior change (Sinclair *et al.,* 2016b).

Box 9: Utilizing evidence to create content to facilitate behavior change in CKD DETECT
CKD DETECT was informed by the findings of an elicitation study that identified the barriers and facilitators to opportunistic CKD screening by Australian-based general practice nurses. The findings of the study allowed the program's content to be tailored specifically to address the identified barriers. This is a substantial step forward from the traditional approach of delivering education that is focused on improving knowledge with the hope that knowledge will increase confidence and subsequently increase the probability that participants will engage in the target behavior or practice. Developing an e-learning program that focuses on delivering solutions based on existing real world practice may assist with behavior change; however, this is yet to be supported by empirical evidence and further research in this area is required.

INCORPORATE PEER REVIEW OF CONTENT AND RESOURCE EVALUATION MEASURES

Evaluation of the impact of any educational initiative is important but never more so than when implementing e-learning resources which require a significant investment of time and expertise (Marshall, 2005). During "face-to face" education, educators can observe students level of engagement and involvement and utilize objective evaluation measures to assess clinical practice; however, this opportunity is not available in an asynchronous online environment. Consequently, evaluation should be the final important design element considered by e-learning developers (Gagne *et al.,* 2005; Ossiannilsson & Landgren, 2012).

The evaluation process should occur at two stages: prior to implementation, peer review of the learning resource should be conducted, and on completion of the e-learning program, evaluation of achievement of the learning outcomes should be conducted. The development team should consider engaging a reference group to critique and provide advice on the design and content throughout the project. Preferably, the reference group will be comprised of experts in the content field, e-learning instructional design, and evaluation methodology. A separate, and ideally blinded, peer review process should also be undertaken after the program has been developed. Peer review is well established as a primary mechanism for quality control in the discipline of health education. However it has also been criticized as being an arbitrary and subjective process prone to bias (Smith, 2006). Because of the potentially subjective nature of peer review processes, e-learning resources should be rigorously evaluated by a group from the intended target audience, as well as by subject matter and instructional design experts. Peer reviewers should be instructed to complete the program and scrutinize aspects such as accuracy of content, navigation, interactivity, format, usability, and currency (Ruiz *et al.,* 2007). The review process can be strengthened by utilizing objective evaluation instruments, such as the Learning Object Review Instrument (LORI) (Nesbit *et al.,* 2003), as a framework to evaluate key domains from the veracity and accuracy of content and ease of navigation to whether the e-learning program adheres to internationally accepted technical standards.

Education effectiveness from an end user perspective is traditionally evaluated using the domains of learner satisfaction, knowledge gain, and behavioral change. These three constructs align with levels one (Satisfaction), two (Knowledge), and three (Behavior change) of Kirkpatrick's (1994) evaluation model of educational outcomes. To date, e-learning programs and their associated evaluation have predominantly focused on participant satisfaction and knowledge acquisition. This can be largely attributed to the conceptual and practical challenges of e-learning research that corresponds with higher levels of educational evaluation, such as behavior change (Sinclair *et al.,* 2016b). The degree of satisfaction and improvement in knowledge are important constructs to measure in asynchronous learning, particularly when also evaluating behavioral or skill change. Data should also be collected about learner participation, performance, and number of attempts required to accurately answer questions, and items should be embedded to identify level of engagement and problematic questions and/or activities. These data can be used to inform future iterations and isolate issues that may not have been initially identified by the development team. If evaluation conducted in conjunction with the program is unable to demonstrate a statistically significant change in behavior then these data will assist in determining whether this may have been a result of the program or mode of delivery being ineffective. Learner satisfaction surveys can also be used to elicit feedback from a user's perspective. Satisfaction, although frequently dismissed as being subjective and of little value, is still an important indicator of engaged and meaningful learning experiences (Shea *et al.,* 2003).

Box 10: Utilizing peer review and evaluating user satisfaction in CKD DETECT
CKD DETECT undertook a rigorous peer review process by content and design experts. Changes were incorporated at both content and instructional levels throughout this process. The absence of a suitable learner satisfaction instrument necessitated the design and development of the Learner Satisfaction with Asynchronous e-Learning (LSAeL) scale. The development and psychometric testing of this scale will be reported elsewhere.

CONCLUSION

This paper combines instructional design and pedagogical principles to present key elements of e-learning instructional design to inform the development of e-learning resources. Ten key design principles have been presented using descriptions and illustrations from a recently developed e-learning education program that aimed to improve opportunistic CKD screening practices in Australian general practice nurses. We propose that when e-learning resources follow the design principles described in this paper, the learning will be output focused, maximize the potential for learner engagement and the

achievement of targeted learning outcomes, and provide learners with the skills and capacity to change their behavior in the clinical practice setting.

Contributions

Manuscript development: PS, TLJ, PB, AM, BC, AK
CKD detect design & development: PS, AM, BC
Tables & Figures: PS, AM, BC

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Chapter 6: Phase three: Part A – The CKD-DETECT study: A Randomised Controlled Trial

This, and the following chapter reports the results of the CKD-DETECT study, a parallel group, double blinded randomised control trial. Due to the amount of data generated, the results were reported in two separate papers. Chapter six reports the results of aim three of this thesis, along with two associated hypotheses:

Aim

To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.

Primary hypothesis

Participants randomised to an asynchronous e-learning group will have an increase in behavioural intention of at least 0.3 standard deviation at the conclusion of the program, as measured by the Theory of Planned Behaviour (TPB) Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI), compared with participants randomised to an active control group.

Secondary hypothesis

The indirect theoretical constructs of the TPB (i.e. attitude, subjective norm and perceived behavioural control) will independently predict the intention of practice nurses to initiate a kidney health check on people identified as 'at risk' of CKD and/or have a conversation with the treating doctor about the need for a kidney health check.

In this chapter, the fifth publication of this thesis is presented:

Sinclair, P.M., Kable, A., Levett-Jones, T., Holder, C., & Oldmeadow, C. (2019). The CKD-DETECT STUDY: An RCT aimed at improving behavioural intention to

initiate a Kidney Health Check in Australian practice nurses. *Journal of Clinical Nursing.* https://doi.org/10.1111/jocn.14882

6.1 Publication impact

At the time of thesis submission this paper has only just been published

6.2 Publication copyright

Permission to reproduce publication five in this thesis has been obtained (See Appendix 21).

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ORIGINAL ARTICLE

Journal of Clinical Nursing WILEY

The CKD-DETECT study: An RCT aimed at improving intention to initiate a kidney health check in Australian practice nurses

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Abstract

Background: The burden of Chronic Kidney Disease (CKD) on the Australian health system is growing. Efforts to reverse this trend have not been successful. This paper evaluates the effectiveness of a targeted asynchronous web based e-learning module on general practice nurses' behavioural intentions in relation to opportunistic screening practices for people at risk of CKD.

Design: Double blinded pre-post interventional randomised control design.

Methods: Participants were nurses working in general practice settings in Australia. Participants were randomised to a knowledge based active control or targeted behavioural based intervention which were delivered using asynchronous e-learning modules. The intervention was designed to influence the behavioural constructs of the theory of planned behaviour (TPB): attitude, subjective norm and perceived behavioural control (PBC).

Results: Of the 420 participants, we analysed the primary and secondary outcomes for 212 (50.47%) who had complete follow up data. There were no significant differences (p 0.424, [d] 0.04) in behavioural intention between the intervention and control groups at follow-up, when controlling for baseline values. However, regression models assessing the relationship between the change in the TPB constructs and behavioural intention at follow-up for all participants, regardless of study arm, demonstrated a significant change in intention to initiate a kidney health check. Although these changes could not be attributed to the effect of the intervention. Attitude (r2 = 0.3525, p 0.0004) and PBC (r2 = 0.3510, p 0.0005) models accounted for approximately 35% of the explained variance in behavioural intentions and social norm (r2 = 0.3297, p 0.0171) accounted for approximately 33% of the variance. When all TPB constructs were included in the model, 37% of the variance in intention was explained.

Conclusion: A targeted behavioural online intervention was no more effective than a knowledge based online program to improve primary health care nurses' intention to initiate a kidney health check in people at risk of chronic kidney disease.

Registration: The trial was registered with the Australian and New Zealand Clinical Trials Registry (Trial ID: ACTRN12617001360303)

Protocol: The trial protocol is hosted with the Australian and New Zealand Clinical Trials Registry at http://www.ANZCTR.org.au/ACTRN12617001360303.aspx

Relevance to clinical practice: Collaborative efforts are required by all staff working in general practice to develop models of care to improve screening practices for chronic kidney disease. Future research should focus on interventions that improve collaboration between health care professionals in the primary care setting and public health campaigns to increase awareness of risks of CKD and the importance of screening in the primary care setting.

KEYWORDS
behaviour, general practice, kidney, nursing, online learning, primary health care, randomised control trial, screening, theory of planned behaviour

1 | INTRODUCTION

The burden of chronic kidney disease (CKD) on the Australian health system is growing. Renal replacement therapy for people with End Stage Kidney Disease (ESKD), the terminal phase of CKD, increased by nearly 47% between 2006–2016 (ANZDATA Registry, 2018). This equates to an increase of 37% in total expenditure for CKD, ESKD and their associated therapies, compared to a 14% increase for cardiovascular disease by 2020 (Tucker, Kingsley, Morton, Scanlan, & Dalbo, 2014). These financial estimates do not include the individual cost and personal impact of CKD on peoples' lives.

Chronic kidney disease generally remains asymptomatic until symptoms such as electrolyte disturbances and fluid overload develop, at which stage clinical interventions may not delay the progression of the disease (Hewitt & Elder, 2014). People whose kidney disease remains undetected have higher mortality rates compared to those who are detected early (Smart & Titus, 2011).

Community (Tracey, Cossich, Bennett, Wright, & Ockerby, 2013), in-hospital (Hewitt & Elder, 2014) and workplace (Mathew et al., 2010) CKD screening programmes have proven effective in increasing its early detection; however, they are costly to implement and unsustainable. In contrast, opportunistic screening in the primary healthcare setting is a more cost-effective and sustainable method for early CKD detection (Howard et al., 2006; Mathew & Corso, 2009). Opportunistic CKD screening is a relatively simple process and consists of identifying people at risk and then initiating a kidney health check (KHC) which includes measuring blood pressure, taking a urine sample for an albumin-creatinine ratio, and a blood test to determine the individuals estimated glomerular filtration rate (Johnson et al., 2013).

This paper reports the results of a parallel group, double-blinded randomised control trial that evaluated the effectiveness of a tailored behavioural e-learning intervention compared to a knowledge-based e-learning control in changing the intention of GPNs to initiate KHCs in Australian general practice settings.

What does this paper contribute to the wider global clinical community?

- This paper demonstrated that a targeted behavioural e-learning intervention was no more effective, in changing practice nurses behavioural intention to initiate a kidney health check, than compared to a knowledge-based e-learning program.
- Future research should evaluate collaborative models of care in general practice aimed at improving screening practices for chronic kidney disease.
- Policymakers should consider introducing funding measures for integrated chronic disease screening by general practice nurses.

2 | BACKGROUND

Primary care plays an integral role in the early detection of people with CKD. Opportunistic screening and the early detection of CKD by primary care providers is an essential strategy in reducing mortality and the burden on the health system (Mathew & Corso, 2009; Tracey et al., 2013). However, CKD screening for high-risk populations is sub-optimal and there are significant deficits in general practitioners' adherence to screening practices and evidence-guidelines (Razavian et al., 2011). Consequently, there is a clinical and moral imperative to identify, implement and evaluate methods by which opportunistic screening in the primary healthcare setting can be improved. General practice nurses (GPNs) are ideally placed to initiate KHCs and collaborate with general practitioners (GPs) in the early detection and management of CKD (Tracey et al., 2013). However, it is not known whether nurses working in primary health settings in Australia already possess the requisite knowledge and skills to undertake these checks. The increasing number of people with CKD means that nurses must achieve and maintain a minimum knowledge level and have the intention to assist in its early detection.

2.1 | The theory of planned behaviour

The theory of planned behaviour (TPB), an extension of the Theory of Reasoned Action, provides a theoretical framework to objectively measure behavioural intentions as a valid proxy for actual behaviour

FIGURE 1 Explaining the theory of planned behaviour (Ajzen, 1991, 2011; Godin et al., 2008)

Behavioural intention can be explained mathematically as a sum of the three predictor variables: $BI_B = A_B + SN_B + PBC_B$ Where BI = Behavioural intention; $_B$ = the behaviour; A = Attitude; SN = Subjective Norm; PBC = Perceived Behavioural Control	
Attitude towards behaviour (AB)	Beliefs influenced by knowledge, experience and values which reflect participants' positive or negative perceptions about performing a target behaviour, in this case opportunistic CKD screening;
Subjective norms (SN)	Participants' perceptions of social pressure about performing the target behaviour, and their motivation to conform to such pressure;
Perceived behavioural control (PBC)	The degree of control the participant perceives they have, over the factors that promote or prevent the target behaviour. So while participants may have the intention to initiate CKD screening they also need to have the opportunity, resources and support in order to act on that intention.

change (Eccles et al., 2006; McEachan, Conner, Taylor, & Lawton, 2011). According to the TPB, the immediate antecedent of behaviour is intention, which is influenced by three predictor variables: behavioural beliefs (attitudinal), subjective norms (SN) and perceived behavioural control (PBC; See Figure 1).

The relationship between intention and behaviour predicts actual behaviour more so than previous behavioural models that used isolated variables, a position supported by systematic reviews in this domain (Eccles et al., 2006; Godin, Belanger-Gravel, Eccles, & Grimshaw, 2008). Changing behaviour requires the ability to change salient beliefs related to that behaviour. In order to identify why a particular behaviour is or is not performed, it is vital to first identify the extent to which the behaviour is influenced by SN, attitudes and PBC (Ajzen, 1985). Consequently, interventions that directly manipulate variables known to influence intentions to perform a specific behaviour are significantly more likely to change actual behaviour (Webb, Joseph, Yardley, & Michie, 2010).

2.2 | The CKD-DETECT study

The CKD-DETECT study evaluated the effectiveness of a tailored behavioural asynchronous web-based e-learning module (Module two) compared to a case study (knowledge) based module (Module one), on practice nurses' behavioural intentions to perform opportunistic screening practices for people at risk of CKD (see Data S3 for a pictorial guide to the two modules).

The study consisted of three aims:

1. To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD.
2. To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' knowledge about CKD risk factors and screening practices.
3. To evaluate GPNs' perceived satisfaction with an asynchronous web-based e-learning module.

This paper reports the findings of study aim one and its associated hypotheses. Findings related to aims two and three are reported elsewhere (paper currently under review).

To inform the development of the intervention an elicitation study was conducted to identify the barriers and facilitators to opportunistic CKD screening by general practice nurses (Sinclair, Day, Levett-Jones, & Kable, 2017). The barriers to CKD screening were found to be complex and multi-dimensional and influenced by a combination of social and organisational variables. A constructivist approach (Davidson-Shivers, Rasmussen, & Lowenthal, 2018) was adopted for the design of the intervention which was reported in detail by Sinclair, Levett-Jones, Morris, Carter, Bennett and Kable (2017). The intervention was developed with the premise that GPNs may overcome the barriers to CKD screening if they role model or adopt strategies employed by other practices that have effectively implemented chronic disease screening programmes previously. The intervention focussed on empowering participants by equipping them with strategies while simultaneously targeting salient beliefs regarding opportunistic CKD screening. Participants in

the intervention identified the specific challenges they faced, and programming logic provided a range of practical strategies drawn from two general practices. The two general practices operated under different business models and had both successfully implemented chronic disease screening programmes at minimal cost to the practice.

The intervention initially consisted of a single learning outcome. However, during the development phase, a second outcome was added to allow participants the opportunity to position potential solutions suggested in the module, to barriers based on existing challenges they faced in their workplace. Consequently, the learning outcomes for the intervention module were as follows:

1. Identify the challenges that prevent CKD screening in your workplace and;
2. Identify and reflect upon potential solutions to improve CKD screening in your workplace

The intervention consisted of 26 "screens" with various multimedia including animations, videos and links to resources and applications to assist participants in overcoming the barriers. The first seven pages of the intervention targeted attitudinal variables including awareness, prevention, the benefits of early CKD detection and decreasing disease burden. Subjective norms were targeted throughout the intervention with particular focus on the profiled general practices. Factors that influence perceived behavioural control were predominantly addressed during the core barriers section.

The active control was designed and developed to meet two key learning outcomes derived from the Kidney Health Australia—Caring for Australians with Renal Insufficiency Guidelines (Johnson et al., 2013):

1. Identify the major risk factors for developing chronic kidney disease and;
2. Describe the best practice screening method for early chronic kidney disease

It used a case study approach and introduced participants to Mr John Anderson, a 62-year-old who presented to their general practice. It consisted of a total of 16 core pages with each page containing various multimedia and interactive links depending on the content being delivered.

3 | METHODS

A parallel group double-blinded randomised controlled trial was used to compare outcomes of a tailored e-learning behavioural intervention to a knowledge-based e-learning module as an active control. The trial was registered with the Australian and New Zealand Clinical Trials Registry (Trial ID: ACTRN12617001360303). The trial protocol is hosted with the Australian and New Zealand Clinical Trials Registry at http://www.ANZCTR.org.au/ACTRN12617001360303.aspx. No variations were made to the trial design or outcomes after trial commencement. This paper is reported using the Consolidated Standards of Reporting Trials (CONSORT) guidelines (Moher et al., 2012), see Data S1.

3.1 | Primary hypothesis

Participants randomised to an asynchronous e-learning group will have an increase in behavioural intention of at least 0.3 standard deviation at the conclusion of the programme, as measured by the Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI), compared with participants randomised to an active control group.

3.2 | Secondary hypothesis

The indirect theoretical constructs of the TPB (i.e., attitude, SN and PBC) will independently predict the intention of practice nurses to initiate a KHC on people identified as "at risk" of CKD and/or have a conversation with the treating doctor about the need for a KHC.

3.3 | Additional study aims

The study also sought to: evaluate GPNs' perceived satisfaction with an asynchronous web-based e-learning module; and evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' nurses' knowledge about CKD risk factors and screening practices. These outcomes will be reported elsewhere.

3.4 | Measurement instruments

All instruments were assessed for face and content validity by a panel of experts from the nursing, primary care and research fields. Prior to launching the study, they were pilot tested by several primary care and renal nurses who assessed the overall structure and content. Minor modifications were made based on feedback from the panel.

3.4.1 | The TPB-CKDISI

The Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument (TPB-CKDISI) was developed to measure the predictor constructs of the TPB (see Data S2). Its construction was informed by the guidelines for the development of TPB questionnaires suggested by Francis et al. (2004) and Ajzen (2002). For the purposes of this study, the target behaviour was opportunistic screening for CKD which was defined as performing a KHC (i.e., Blood pressure, urinary albumin-creatinine ratio and a blood test for creatinine to determine estimated glomerular filtration rate) on high-risk individuals in the general practice setting, without symptoms of kidney disease (Mathew & Corso, 2009). Items were derived from salient beliefs relating to GPNs' screening for CKD (See Table 1) identified in an elicitation study conducted prior to this study (Sinclair, Day, et al., 2017).

TABLE 1 Salient beliefs used for the theory of planned behaviour instrument [Adapted from Sinclair, Day, et al. (2017)]

Attitude	Subjective norm	Perceived behavioural control
Early detection & treatment	Approval of GPs & patients	Existing screening protocols
Reduction of disease burden	Activity-based funding models (MBS[a] items)	Presence of known risk factors
↑ awareness of CKD	Medically defined roles	Relationship with patient
↑ prevention of CKD	The business[a]	Unfunded time versus competing funded priorities[a]
Imposition on time & competing clinical priorities[a]		Lack of MBS item [illegible][a]
Threat of patient harm (Stress and financial)[a]		Impact on patient[a]
Knowledge &/or skill deficit[a]		Practice business rules[a]

Note: MBS, Medicare benefits schedule.
[a]Negative beliefs.

Theory of planned behaviour questionnaires have the potential to be protracted and complex in nature (Darker & French, 2009). Consequently, a pragmatic decision was made to use one simple yet real world, clinical vignette to guide the instrument:

> Bill Smythe is a 62 year old man with a history of hypertension. He smokes a packet of cigarettes a day, his alcohol intake is 6 units per week and his BMI is 32 kg/m^2. Bill presents to your practice and tells you he is feeling lethargic and has shortness of breath on exertion.

This scenario was written in this manner to illustrate a presentation that could be associated with a number of potential outcomes. Participants were then asked two direct behavioural intention questions with a binary yes/no response, and to report the degree of difficulty with which the decision was made. Subsequent survey items were direct measures of the TPB predictor constructs attitudes, PBC and SN (Ajzen, 1991). A Behavioural intention score was calculated as the total of the binary response multiplied by the degree of difficulty. The TPB-CKDISI comprised of items related to: attitude (n = 7); subjective norms (n = 4); perceived behavioural control (n = 7); behavioural intentions (n = 2); and decision difficulty (n = 2). Four items were reverse scored in order to minimise extreme response and acquiescence bias. A 13-item demographic survey accompanied the TPB-CKDISI. Items assessing the three TPB predictor variables were constructed to measure the interaction between two components, (i) participant's beliefs, and (ii) their corresponding positive/negative judgements. The TPB-CKDISI's internal consistency was considered acceptable if the subscales Cronbach's alphas were >0.70 (DeVellis, 2012).

Attitudes were assessed using seven paired questions, establishing firstly a measure of behavioural belief strength and then an outcome evaluation about the belief. For example, item five: performing a KHC improves patient awareness of CKD was paired with item six: improving the awareness of CKD in patients considered at risk of CKD is [...] to me. Response scales were formatted as either unipolar (1 (strongly disagree) to 7 (strongly agree)) or bipolar (−3 (not very important) to +3 (very important)) depending on whether the construct being measured is unidirectional (i.e., probability) or bidirectional (i.e., evaluation). Higher scores were representative of a stronger intention to perform opportunistic kidney health screening practices. The total attitude score was calculated by multiplying each behavioural belief item by its corresponding outcome evaluation item and summing the resulting products together. One item was negatively worded and reversed scored as a result. Total scores could range from −147 to 147.

Subjective norms: consisted of an interaction between four injunctive items and four corresponding motivation to comply items. Response scales and scoring were calculated in the same manner as attitudes, with the exception of one question which used a response scale related to approval, for example: item 25—General Practitioners where I work would (1 (Always approve) to 7 (Never approve)) of me initiating KHCs; item 26: General Practitioners expectations about me initiating KHCs is (−3 (Very unimportant) to +3 (Very Important)) to me. No negatively worded questions were presented and total scores ranged from −84 to 84.

Perceived behavioural control was assessed using seven paired questions, of which three were negatively worded and reverse scored. PBC consisted of an interaction between the strength of a participant's control beliefs with their corresponding perceived power to influence behaviour, for example: item 39—Being able to initiate a KHC when I determine the need for it, is part of the role of a Practice Nurse was paired with item 40. Initiating a KHC is [...] for me Response scales were formatted as either unipolar (1 [strongly disagree] to 7 [strongly agree]) or bipolar (−3 [very difficult] to +3 [very easy]), with total scores ranging from −147 to 147. The total PBC score was calculated by multiplying each control belief item by its corresponding power to influence item and summing the resulting product together.

3.5 | Scoring of outcomes

Behavioural intentions (BI): Two items directly assessed participant's BI to (a) independently initiate a KHC; and (b) have a conversation with a General Practitioner about initiating a KHC. For analysis, BI was assessed using the two direct measures in addition to the sum of the two direct measures to provide an overall direct behavioural intention score (named BI sum). A fourth measure assessed predictor constructs of the TPB: attitude, SN and PBC. Participants responded yes or no in response to the question asking if they would perform the behaviour given the scenario presented to them. For each item participants were also asked to rate, on a seven-point Likert scale (ranging from very difficult to very easy), how difficult

they would find performing each of the behaviours. To determine participant's direct behavioural intentions their yes/no responses were multiplied by their corresponding level of difficulty.

One participant had a missing Attitude Score, as a result of one missing behavioural belief item response. The missing behavioural belief response was imputed using the average of other subjects with similar attitude belief responses (Andridge & Little, 2010). A behavioural belief response that was within 2 units of the participant's response was considered similar.

3.6 | Sample size calculation

Sample size calculation was performed using STATA version 14 (StataCorp). Based on a priori power calculations, 110 participants per group were needed to detect a medium effect size (effect size [*d*] 0.3) with 80% power and 5% type I error rate. This calculation assumed a baseline/completion correlation of 0.6.

3.6.1 | Study sample

The study sample consisted of general practice nurses currently working in Australian general practice. Approximately 63% of Australian general practices employ a practice nurse (Australian Medicare Local Alliance, 2012). A practice nurse is any nurse practitioner, registered (equivalent of baccalaureate qualified) or enrolled nurse (equivalent of licensed practical nurse) who is employed by a general practice service.

3.7 | Participants, recruitment, randomisation and treatment allocation

Participants were recruited via social media (Facebook and Twitter) and primary healthcare network newsletters and where approved, email lists across Australia between October 2017–April 2018. Each announcement contained a link to the study website which contained a series of statements for potential participants to click as part of the inclusion/exclusion and consent process. The core inclusion criterion was that participants were nurses who had worked in an Australian general practice setting within 12 months of enrolling. An inability to read English was the only exclusion criterion. Potential participants clicked the submit button to register for the study and were then allocated to study groups (1:1) by an independent research assistant using a web-based randomisation schedule. The randomisation schedule used a permuted block randomisation with blocks of randomly varying size, stratified by rurality and years of experience (<10 years or 10+ years). Group allocation was concealed from those conducting data analysis to avoid ascertainment bias. An email was then sent to participants with a hyperlink, depending on their randomisation, to either the active control arm or the intervention arm. Baseline outcome and demographic data were not collected prior to randomisation, as this was logistically and practically difficult. Participants were blinded to treatment allocation to avoid selection bias. Reminder emails were sent out on three separate occasions during the recruitment period. All participants who completed the programme received a continuing professional development certificate and were entered into a draw for one of three AU$100.00 gift cards.

3.8 | Ethics and procedure

The institutions human research ethics committee provided ethical approval for the study (H-2016-0394). Consent was recorded after participants clicked the submit button. Participants randomised to the intervention group completed two online survey instruments, the pre-CKD knowledge instrument and the pre-TPB-CKDISI. Participants scoring <75% (*n* = 102/105) on the preknowledge instrument undertook module one (A knowledge-based e-learning module) and repeated the CKD knowledge questionnaire on completion. They then proceeded to module two, regardless of knowledge score. Participants scoring ≥75% (*n* = 3/105) on the preknowledge instrument proceeded directly to module two. On completion of module two, participants completed two online survey instruments, the post-TPB-CKDISI and the LSAe-L instrument. Participants in the active control group completed the same instruments as the intervention group, the Pre-CKD knowledge questionnaire and the TPB-CKDISI. They then, regardless of scores, undertook module one only. On completion, participants completed the post-CKD knowledge instrument, the Post-TPB-CKDISI and the LSAe-L instrument. Data were collected from October 2017–May 2018 when sufficient participants had completed the study.

3.9 | Data analysis

Data analysis was conducted using SAS 9.4 (SAS Institute Inc.). A *p*-value of ≤0.05 was considered to be statistically significant. Participant demographic characteristics were summarised by mean (standard deviation), median (interquartile range) and frequency (percentage) separately for the intervention and control groups. A separate Analysis of Covariance (ANCOVA) was conducted for each of the outcome variables, to determine whether there were any differences in these outcomes between the intervention and control group. The ANCOVA models consisted of the completion value as the dependent variable and the baseline and intervention group variables as the independent variables. Baseline-adjusted differences between groups are presented, together with 95% confidence intervals, and *p*-values. Cohen's *d* is also provided to give a standardised effect size of the difference between the two groups. A Cohen's *d* value of <0.2, was considered a small effect size, 0.2–0.5 a medium effect and 0.5–0.8 as a large effect size (Sawilowsky, 2009). Linear regression was used to assess the relationship between baseline BI and the three indirect TPB constructs (the secondary aim). Changes in the TPB constructs (between baseline and completion) were also assessed for association with the BI at completion using linear regression. These regression models also included factors predicted to be associated with intention (intervention group, age, rurality, nursing years, primary health nursing years and bulk billing practices). Prior to creating the BI outcome variable, we established that a significant moderate positive linear

relationship existed between the two BI outcomes. Cronbach's alphas were calculated for all instrument subscales.

3.9.1 | Population

The first population of interest was those that were randomised and completed both the baseline and final outcome surveys (the completers' population). The second population, a modified intention to treat population (MITT), included participants that were randomised and completed and baseline demographic and outcome data.

3.9.2 | Missing data

Our primary analysis was of the completers' population. For the MITT population, we compared participant demographics between those with missing completion data using *t* tests and Chi-Square tests for categorical variables. Missing completion data were then imputed in 30 completed datasets using chained regression equations. ANCOVA regression models were used to estimate the treatment effect in each imputed dataset, and results were pooled across imputed datasets using Rubin's method (Rubin, 1987). Baseline outcomes and demographic variables

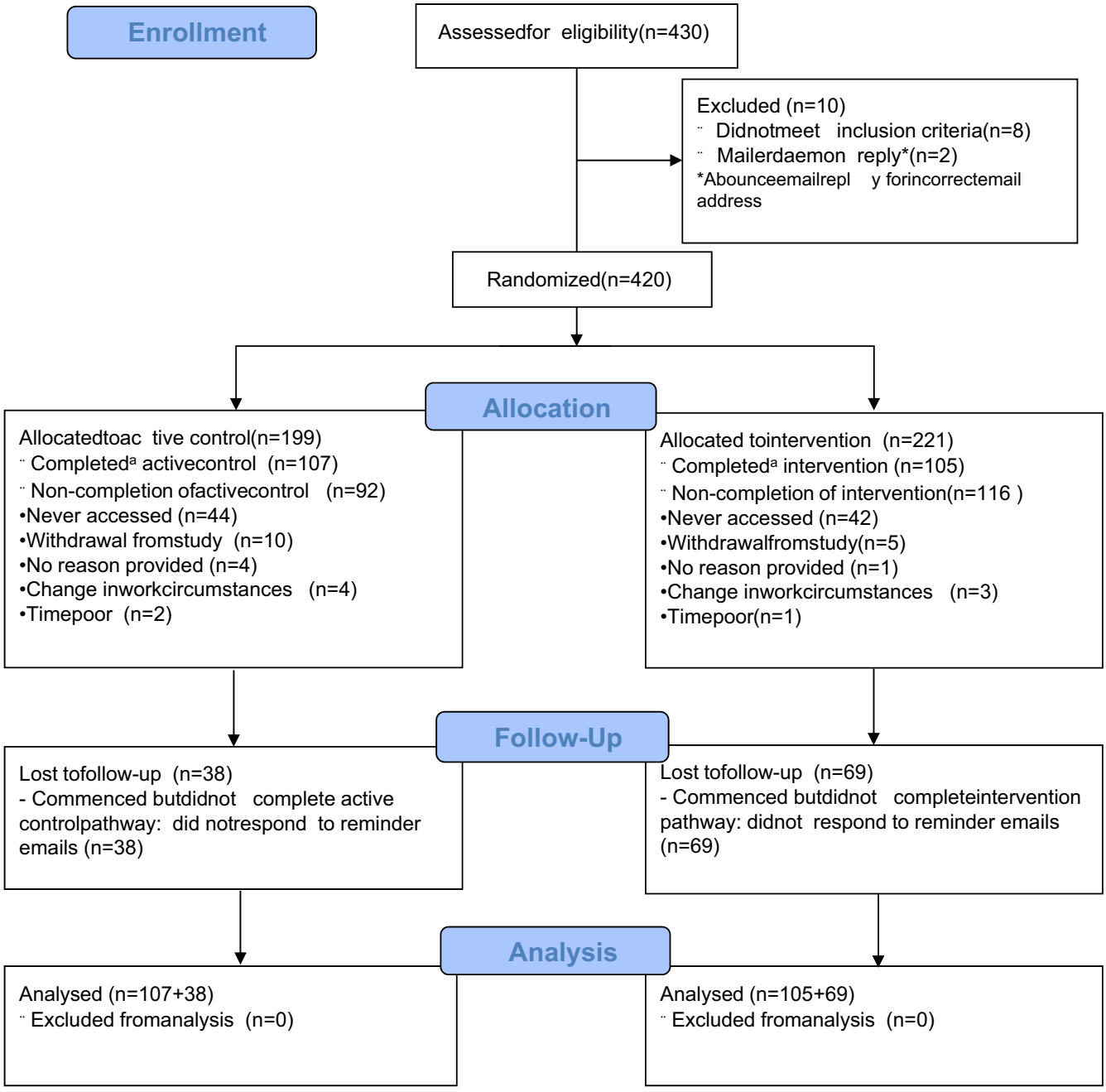

FIGURE 2 Study flow chart [adapted from Moher et al. (2012)]. [a]Completed = all pre- and postinstruments completed

TABLE 2 Participant characteristics

Participant characteristics	Control (*n* = 107)	Intervention (*n* = 105)	Total (*N* = 212)
Age (years)			
n	107	[illegible]	[illegible]
Mean (*SD*)	47.08 (12.28)	46.95 (10.88)	47.02 (11.58)
Median (Q1, Q3)	49 (37, 56)	48 (38, 56)	49 (38, 56)
Gender			
Male	1 (0.9%)	2 (1.9%)	3 (1.4%)
Female	106 (99%)	103 (98%)	209 (99%)
Language			
English	96 (90%)	101 (96%)	197 (93%)
Other	11 (10%)	4 (3.8%)	15 (7.1%)
Job title			
Enrolled nurse	2 (1.9%)	5 (4.8%)	7 (3.3%)
Endorsed enrolled nurse	13 (12%)	6 (5.7%)	19 (9.0%)
Registered nurse	86 (80%)	91 (87%)	177 (83%)
Nurse practitioner	4 (3.7%)	2 (1.9%)	6 (2.8%)
Other	2 (1.9%)	1 (1.0%)	3 (1.4%)
Number of primary health nurses			
n	107	[illegible]	[illegible]
Mean (*SD*)	3.8 (4.78)	6.1 (20.11)	4.94 (14.56)
Median (Q1, Q3)	2 (1, 5)	3 (2, 4)	3 (2, 4)
Number of GPs			
n	107	[illegible]	[illegible]
Mean (*SD*)	7.33 (5.84)	7.7 (5.26)	7.51 (5.55)
Median (Q1, Q3)	6 (3, 10)	7 (4, 10)	6 (4, 10)
Number of patients registered in practice			
n	107	103	[illegible]
Mean (*SD*)	4,811.14 (6,378.91)	12,297.3 (50,966.28)	8,482.92 (36,089.05)
Median (Q1, Q3)	2000 (600, 6,000)	4,500 (1,000, 9,000)	3,000 (1,000, 7,000)
Hours per week			
n	107	[illegible]	[illegible]
Mean (*SD*)	30.59 (10.2)	28 (10.47)	29.31 (10.39)
Median (Q1, Q3)	32 (24, 38)	28 (21, 37)	30 (23, 38)
Years nursing			
n	107	[illegible]	[illegible]
Mean (*SD*)	23.78 (30.71)	22.95 (14.87)	23.37 (24.15)
Median (Q1, Q3)	22 (7, 33)	23 (12, 32)	22.5 (8.5, 32.5)
Primary health nurse years			
n	107	[illegible]	[illegible]
Mean (*SD*)	7.94 (8.38)	7.99 (7.96)	7.96 (8.16)
Median (Q1, Q3)	5 (2, 11)	5 (2, 10)	5 (2, 11)
Rurality			
Major cities/inner regional	84 (79%)	81 (77%)	165 (78%)
Outer regional/remote	23 (21%)	24 (23%)	47 (22%)
Bulk billed			
[illegible]	61 (57%)	72 (69%)	133 (63%)

(Continues)

TABLE 2 (Continued)

Participant characteristics	Control (n = 107)	Intervention (n = 105)	Total (N = 212)
Yes	46 (43%)	33 (31%)	79 (37%)
Prior CKD education			
[illegible]	64 (60%)	57 (54%)	121 (57%)
Yes	43 (40%)	48 (46%)	91 (43%)
[illegible]			
Face to Face			
[illegible]	83 (78%)	78 (74%)	161 (76%)
Yes	24 (22%)	27 (26%)	51 (24%)
E-learning education			
[illegible]	85 (79%)	91 (87%)	176 (83%)
Yes	22 (21%)	14 (13%)	36 (17%)
Journal article education			
[illegible]	68 (64%)	67 (64%)	135 (64%)
Yes	39 (36%)	38 (36%)	77 (36%)
Pharmacy rep education			
[illegible]	82 (77%)	84 (80%)	166 (78%)
Yes	25 (23%)	21 (20%)	46 (22%)
Webcast			
[illegible]	100 (93%)	96 (91%)	196 (92%)
Yes	7 (6.5%)	9 (8.6%)	16 (7.5%)
Other education			
[illegible]	97 (91%)	97 (92%)	194 (92%)
Yes	10 (9.3%)	8 (7.6%)	18 (8.5%)

that were found to be statistically significantly associated with missing completion outcomes were included as auxiliary variables in the multiple imputations of completion outcomes.

4 | RESULTS

Figure 2 demonstrates the flow of participants through the trial. Of the 420 participants registering for the study, 199 were randomised into the control group, and 221 to the intervention group. Of those 420, 86 never accessed the survey link, 15 withdrew and 319 accessed the survey link. Of the 15 withdrawn, eight of those participants had demographic data and baseline data. Of the 319 participants that accessed the survey, 301 had complete baseline data, 212 had complete data. Participants who withdrew from the study did not complete any of the postinstruments. Consequently, 212 participants were analysed in the completers group and 309 in the MITT group.

4.1 | Participant characteristics

Table 2 presents the characteristics of participants that completed both surveys by intervention and control group. Consistent with the demographics of nurses in Australia, the majority of respondents were female. Both groups had similar distributions between demographic variables. Forty-three per cent of participants had accessed prior CKD education, and the two main modes were face to face workshops and journal articles. Fifty-seven per cent of participants had no previous CKD education.

4.2 | Primary hypothesis

There was a significant positive linear relationship between BI outcome one (initiate a KHC) and BI outcome two (initiate KHC conversation; r^2 0.54 [$p < 0.0001$] preintervention and r^2 0.48 [$p < 0.0001$] postintervention). Table 3 presents the means of the baseline and completion outcomes, the estimated intervention effect size derived utilising ANCOVA with a 95% C.I., the respective p-value and the Cohen's d value for the completers group. As the means and medians were close in values, only the mean is reported. There were no significant differences between the intervention and control groups on completion. Both groups appear to have had similar increases in outcomes assessed from baseline to completion. The lack of effect size was confirmed with all Cohen's d values <0.2. The internal reliability of the TPB-CKDISI was satisfactory with Cronbach's alphas for subscales Attitude (0.868), SN (0.800), and PBC (0.860) demonstrating the predictive power to explain variance in intention.

TABLE 3 Mean scores of direct and indirect theory of planned behaviour measures at baseline and follow-up of completers population ($n = 212$)

	Baseline		Follow-up				
	Control mean (*SD*) ($n = 107$)	Intervention mean (*SD*) ($n = 105$)	Control mean (*SD*) ($n = 107$)	Intervention mean (*SD*) ($n = 105$)	Intervention effect size (95% CI)	*p*	Cohen's *d*
Direct B.I. Outcome 1: Initiate kidney check	4.64 (2.47)	4.14 (2.6)	5.92 (1.43)	6.02 (1.11)	0.21 (−0.11, 0.53)	[illegible]	[illegible]
Direct B.I. Outcome 2: Kidney check conversation	4.43 (2.47)	3.59 (2.73)	5.25 (1.7)	4.98 (1.65)	0.01 (−0.38, 0.41)	[illegible]	[illegible]
B.I. Sum	9.07 (4.25)	7.73 (4.61)	11.17 (2.83)	11 (2.25)	0.24 (−0.35, 0.84)	[illegible]	[illegible]
Predictor constructs							
Attitude	92.84 (28.32)	89.6 (32.98)	101.73 (31.81)	97.8 (30.28)	−1.73 (−8, 4.53)	[illegible]	0.13
Subjective norm	36.79 (24.24)	37.43 (20.31)	41.62 (25.1)	39 (20.78)	−3.1 (−7.36, 1.15)	[illegible]	[illegible]
PBC	47.36 (41.95)	41.3 (40.26)	59.06 (45.13)	58.73 (38.19)	4.43 (−2.8, 11.66)	[illegible]	[illegible]

4.3 | Sensitivity data

The MITT dataset consisted of the 309 participants that had valid baseline outcome data (i.e., had completed all baseline surveys). Table 4 reports the intervention effect size for the MITT. Similarly to the completers group, there was no significant effect of the intervention on any of the outcomes.

4.4 | Exploratory analysis: Secondary hypothesis

Table 5, consists of the results of five linear regression models that were conducted to assess the relationship between baseline BI sum, and the indirect TPB domains: attitude, SN and PBC. The first model contained only the covariates: age, rurality, overall nursing years, primary health nursing years and whether their workplace bulk billed and were selected as they were the factors most to likely influence behavioural intention. It was conducted to allow for comparisons in the amount of variance that was explained by the addition of each TPB domain. For the remaining four models, the independent variables were each of the three indirect TPB domains separately, and then lastly combined. The model with only the covariates accounted for 4% of the variation in BI, while attitude, SN and PBC models accounted for approximately 12%, 8% and 24%, respectively. When all baseline constructs were included, approximately 26% of the variation in BI sum was explained.

Similarly, Table 6, assesses the relationship between BI Sum at completion and changes in the indirect TPB domains: attitude, SN and PBC, from baseline to completion. The outcome of each model was BI Sum at completion. For the remaining models, the independent variables were the change in the indirect TPB domains, separately and then combined. Each model was also adjusted for participants' BI Sum baseline scores, age, rurality, overall nursing years, primary health nursing years and whether their workplace bulk billed. Results demonstrated that when compared to the covariates only model and the other single construct models, change in attitude and PBC had the greater influence on the outcome, completion BI Sum, indicated by the higher r^2 value and lower AIC value for these models. The change in attitude and PBC models each accounted for approximately 35% of the variance, while the SN model accounted for approximately 33%. When all TPB indirect domains were included in the model, 37% of the variance was explained. Analysis using multiple imputation for the MITT population obtained similar results.

5 | DISCUSSION

This study evaluated the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD. The control and intervention groups did not differ significantly in the change from baseline for any of the study outcomes. These findings were replicated in the MITT analysis. Therefore the primary hypothesis was not supported.

TABLE 4 ANCOVA results from MITT analysis population (n = 309)

	Intervention effect size (95% CI)	p
Indirect B.I. Outcome	0.19 (−13.6, 13.98)	0.9780
Direct B.I. Outcome 1: Initiate kidney check	0.16 (−0.13, 0.44)	0.2793
Direct B.I. Outcome 2: Initiate kidney check conversation	0.04 (−0.31, 0.38)	0.8312
B.I. sum	0.22 (−0.32, 0.76)	0.4236
Attitude score	−0.8 (−7.04, 5.45)	
S.N. score	−2.06 (−6, 1.89)	0.3067
P.B.C. score	2.96 (−3.93, 9.85)	0.3996

The lack of an intervention effect was not likely to be due to poor acceptance of the e-learning intervention as user satisfaction (to be reported elsewhere) was identified as acceptable. Completing the study had an equivalent effect on all participants. Linear regression demonstrated a statistically significant change in the TPB predictor constructs in relation to the BI sum. The lack of difference between study groups may have two plausible explanations. Firstly, all participants were exposed to e-learning modules that were designed using a framework to develop high engagement-high-quality online learning experiences. The use of provocative and relevant scenarios in both modules, despite targeting specifically different phenomenon (i.e., Module 1: Knowledge & Module 2: Behaviour) may have contributed to this change. A lower fidelity control may have yielded different results. The second explanation could be related to more powerful determinants that influence behaviour. The actual act of performing a KHC requires specific clinical and behavioural decisions that will be influenced by other factors before it can be performed. At any stage these factors, some of which are beyond the volitional control of GPNs, could negatively influence direct intention. These factors include the complexity and variation in work practices, culture, fee-for-service funding models, the absence of chronic disease screening MBS item numbers, collaboration and relationships in primary care (McInnes, Peters, Bonney, & Halcomb, 2017b; Oelke, Besner, & Carter, 2014).

The expansion of the GPNs role in Australia is inhibited by the lack of MBS item numbers to cover services that can be managed by GPNs. Internationally, fee-for-service models in some countries cover wellness visits and chronic care management services that can be delivered independently by primary healthcare nurses (Ganguli, Souza, McWilliams, & Mehrotra, 2017). Despite the Australian Governments (2018) introduction of practice nurse incentive payments, some GPs do not see this as a payment for service to meet population and service demands (McInnes, Peters, Bonney, & Halcomb, 2017a). Consequently, the current Medicare system should be reviewed with consideration of payment reform and the re-introduction and expansion of claimable MBS item numbers for services that can be rendered exclusively or collaboratively by GPNs. Existing MBS items limit GPNs' scope of practice and ability to practice autonomously and may encourage some general practices to focus on income generation at the expense of preventative care and screening services.

The introduction of a dedicated MBS item number for integrated chronic disease screening for the early detection of vascular and related diseases, including CKD, is required (National Vascular Disease Prevention Alliance, 2015). An integrated approach to the detection of chronic disease recognises the interaction between risk factors and multiple chronic diseases and would be a cost-effective approach to disease-specific screening practices. In the absence of a dedicated MBS item number for chronic disease screening, more focus may be required on building collaborative working relationships between GPNs and GPs in primary care.

The secondary hypothesis examined the indirect theoretical constructs of the TPB, namely attitude, SN and PBC. We hypothesised that they would independently predict the intention of GPNs to conduct a KHC on people identified as "at risk" of CKD and/or have a conversation with the treating doctor about the need for a KHC. These were analysed as BI sum due to their positive linear relationship. The study's findings supported the secondary hypothesis.

Regression models were used to assess the relationship between the TPB predictor variables and BI Sum for all participants (n = 309) who completed the TPB-CKDISI at baseline. When all baseline TPB predictor variables were included, 26% of the variation in the BI sum was explained. The relationship between BI Sum and the changes in all predictor variables at completion was significant in all completers (n = 212) regardless of the study arm to which they were randomised. When the relationship between the changes in predictor variables was included in the regression model, approximately 37% of the variance was explained. Attitude (p = 0.0004), subjective norm (p = 0.0171) and perceived behavioural control (p = 0.0005) accounted for 35%, 33% and 35% of the variance in BI Sum, respectively, and were all significant predictors of intention. The lack of significant differences between groups suggests that exposure to the study, regardless of study arm, positively influenced the BI of participants. This explained variance is consistent with previous reviews that have reported between 33.7% (Conner & Sparks, 2005)–40% (Godin & Kok, 1996) for predicting healthcare practitioners (HCP) clinical intentions.

This is one of few studies that has measured the utility of e-learning to influence HCP behaviour change in chronic disease screening

TABLE 5 Regression models assessing the relationship between the theory of planned behaviour constructs and BI sum at baseline (n = 309)

Model	Variable	Estimate	*SE*	*p*	r^2	AIC
1. Covariates only[a]						
Model 1 + Attitude	Attitude			<0.0001		883.574
Model 1 + SN	SN			<0.0001	0.0781	
Model 1 + PBC	PBC			<0.0001	0.2435	837.548
Model 1 + Attitude, SN and PBC	Attitude	0.0134	0.0093		0.2579	835.640
	SN	0.0163		0.1700		
	PBC			<0.0001		

[a]Covariates included intervention group, age, rurality, nursing years, primary health nursing years and bulk billed. Regression coefficients for covariates are not included in the output since they are not of interest for this aim.

TABLE 6 Regression models assessing the relationship between the change in the theory of planned behaviour constructs and BI sum at completion (n = 212)

Model[a]	Variable	Estimate	SE	*p*	r^2	AIC
1. Covariates					0.3106	333.436
Model 1 + Attitude change	Attitudes	0.0213			0.3525	322.140
Model 1 + SN change	SN			0.0171*	0.3297	329.484
Model 1 + PBC Change	PBC				0.3510	322.633
All	Attitude change	0.0132		0.0533	0.3700	320.317
	SN change	0.0117	0.0093	0.2130		
	PBC change	0.0107				

[a]Covariates for all models included Intervention Group, BI Sum at baseline, age, rurality, nursing years, primary health nursing years and bulk billed.

and is the first to use a social cognition approach in attempt to manipulate some of the factors that influence the initiation of KHCs by GPNs. This study confirms that there is insufficient evidence to support the effectiveness of wholly asynchronous e-learning programmes to influence HCPs' clinical behaviour (Sinclair, Kable, Levett-Jones, & Booth, 2016). While e-learning approaches can improve access to educational resources by GPNs, they may not be the ideal mode of delivery to influence change in clinical behaviour.

5.1 | Limitations and future research

A number of factors must be considered while interpreting the results of this study. The TPB-CKDISI was developed using the guidelines reported by Francis et al. (2004) and Ajzen (2002) for this study. The use of a self-reported instrument may have influenced the association between the BI Sum and predictor constructs secondary to social desirability and/or recall bias. The survey items for this entire study, including the knowledge and satisfaction measures not presented in this paper, numbered 157 both pre and post in total. Consequently, response burden may have influenced the findings. Using an objective behavioural measure would have strengthened this design. However, this was considered impractical and costly given the number of participants required to power the study adequately. Alternatively, the use of the TPB afforded a more practical way in which to measure behavioural intentions as an immediate antecedent to GPNs' behaviour. While participants were blinded to treatment allocation to avoid selection bias, the nature of the intervention may have meant they were able to determine to which study arm they had been randomised. Finally, the response rate and incomplete responses mean that results may not be representative of GPN's across Australia and should be interpreted with caution.

Healthcare practitioners decision-making is a complex process influenced by multiple factors. Future research should consider the environmental, workplace and cognitive processes underlying clinical decision-making with particular focus on shared decision-making. In doing so, future interventions can be developed that are more sensitive to the factors that influence HCP behaviour. Consideration should also be given to addressing and evaluating the redesign of general practice models of care to better incorporate GPNs' scope of practice and utilise their skills and knowledge. Currently, a substantial variance in GPNs' roles and responsibilities exists across workplaces (Norful, Martsolf, & Poghosyan, 2017). This variation in Australia may be due to GPs unfamiliarity with GPNs' scope of practice. This creates a tendency for nursing roles to be task orientated,

to support GPs, rather than fully utilising their knowledge and skill set (Halcomb, Salamonson, Davidson, Kaur, & Young, 2014; McInnes et al., 2017b). Given the impact of the study overall on BI sum, in particular the predictor variables of attitude and PBC, future interventions should investigate ways to improve the volitional control of GPNs to initiate a KHC. Despite being ideally positioned to lead CKD screening initiatives, it is apparent from this study that considerable barriers factors still remain that prevent them from providing this service. Considering that existing research has described a disconnect between GPs understanding of the GPNs' role and their actual scope of practice, it would be prudent to measure the effectiveness of interventions that use inter-professional education approaches to promote better collaboration and improve shared decision-making. This is all the more important given that HCP behaviours are considered habitual when conducted in a stable context and that entrenched behaviours are more difficult to change (Gardner, 2015; Godin et al., 2008).

Professional relationships between nurses and doctors in general practice have been cited as problematic (Pullon, 2008). Collaborative practice underpins the delivery of safe and effective healthcare regardless of the health setting. Future research should consider collaborative, team-based interventions that require practice nurses and general practitioners to work collaboratively to develop models of care that focus on improving chronic disease screening and management practices in the absence of current claimable Medicare item numbers.

Finally, an alternate approach to attempting to influence the intention and/or behaviour of GPNs is to consider public health campaigns to increase screening rates. Health promotion campaigns are effective strategies which positively influence health behaviour (Noar, Bell, Kelley, Barker, & Yzer, 2018). Future research could consider targeted campaigns to extend the focus from HCPs and on to the community identifying whether they possess risk factors for CKD. People with risk factors can then be encouraged to approach their primary care provider regarding the need for a KHC.

6 | CONCLUSION

With a renewed national focus on primary health care, practice nurses play a crucial role in health promotion and opportunistic screening practice in the community. This study has demonstrated that a targeted high engagement—high-quality asynchronous e-learning program was unable to change general practice nurses intention to initiate a KHC and/or have a conversation with a GP about the need for a KHC when compared to a knowledge-based e-learning program. However, the relationship between behavioural intention and the changes in all predictor variables at completion were significant overall for practice nurses in the study. This suggests that participation in the study and engagement with study materials on the topic regardless of the allocated study arm contributed to changed behavioural intention.

7 | RELEVANCE TO CLINICAL PRACTICE

The scope and autonomy with which GPNs deliver screening and health promotion services is limited by the conditions of their employment and the context of their workplace culture and practices (Hoare, Mills, & Francis, 2012).

Clinical decision-making is multifaceted process, particularly those related to screening and diagnosis (Godin et al., 2008). Behaviour change within the context of this present study was influenced by multiple factors including activity-based funding models, medically defined roles, unfunded time versus competing funded priorities, business rules and the absence of an MBS item number for chronic disease screening. These factors and personal characteristics vary widely among and between general practice settings and are known barriers to optimising the GPN role fully in primary care (Oelke et al., 2014).

In addition, GPs may not realise the full capabilities of GPNs in the primary care setting with some struggling with the opportunities collaborative practice affords (McInnes, Peters, Bonney, & Halcomb, 2015; McInnes et al., 2017b). Understanding the GPN's role and full scope of practice will promote collaboration and optimise their role in the primary care workforce to improve chronic disease outcomes for patients and providers alike (Oelke et al., 2014).

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CONFLICT OF INTEREST

The authors declare no conflict of interest in this investigator-led research.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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Chapter 7: Phase three: Part B - THE CKD-DETECT study: Knowledge and satisfaction evaluation

This chapter presents the sixth and final paper (in press) of this thesis to complete the reporting of the findings of the third phase of the study, specifically those related to research aims four and five:

4. To evaluate the effectiveness of an asynchronous web based e-learning module on GPNs' knowledge about CKD risk factors and screening practices

5. To evaluate GPNs' perceived satisfaction with an asynchronous web based e-learning module.

Sinclair, P.M., Kable, A., Levett-Jones, T., Holder, C., & Oldmeadow, C. (in press). An evaluation of general practice nurses' knowledge of chronic kidney disease risk factors and screening practices following completion of a case study based asynchronous e-learning module. *Australian Journal of Primary Health*

7.1 Publication impact

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Research

An evaluation of general practice nurses' knowledge of chronic kidney disease risk factors and screening practices following completion of a case study-based asynchronous e-learning module

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Abstract. National and international guidelines recommend opportunistic screening for chronic kidney disease to allow for early detection and management. Despite these guidelines, screening for chronic kidney disease in general practice settings is often suboptimal. This paper reports the results of a study that evaluated: (a) the effect of an asynchronous web-based e-learning module on general practice nurses' knowledge about chronic kidney disease risk factors and screening practices; and (b) general practice nurses' perceived satisfaction with the e-learning module. Changes in chronic kidney disease knowledge were assessed using a pre-test and post-test evaluative design, and satisfaction scores were measured on completion of the module. Participants' baseline knowledge scores were poor, with mean pre-test scores of 3.77 (s.d. 1.66) out of 10. Post-test scores revealed a significant improvement (mean difference 1.81, (95% CI: 1.53 – 2.09), $P < 0.01$); however, overall final scores remained inadequate. Participants highly rated their satisfaction with the design of the module. Our results suggest that an asynchronous web-based e-learning module can improve general practice nurses' knowledge about chronic kidney disease risk factors and screening practice. Efforts are required to increase practice nurses' access to educational opportunities designed to improve knowledge in this area with the aim of increasing opportunistic screening for chronic kidney disease in the general practice setting.

Additional keywords: primary care, satisfaction.

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Introduction

Chronic kidney disease (CKD) is a considerable public health problem in Australia and internationally (Johnson *et al*. 2013). Over 1.7 million Australian adults have signs of kidney disease including reduced kidney function, yet less than 10% of the population are aware that they have CKD (Chadban *et al*. 2003; Australian Bureau of Statistics 2013). The early identification and management of CKD is associated with better patient outcomes and can reduce the progression of CKD by up to 50% (Johnson 2004). The Kidney Health Australia – Caring for Australasians with Renal Impairment (KHA-CARI) guidelines recommend opportunistic screening for CKD to allow for early detection and management (Johnson *et al*. 2013). Despite these guidelines, adherence to screening practices and evidence-based management of risk factors in general practice has been reported as suboptimal (Razavian *et al*. 2012). This may be due to poor awareness of CKD risk factors, its asymptomatic nature and poor screening practices of high-risk populations in Australian general practices.

Federal government initiatives have enabled broadened roles for general practice nurses (GPNs) in chronic disease management (Australian Government Department of Human Services 2017). Consequently, GPNs, due to their role in preventing, identifying and managing chronic disease, are well positioned to assist in the early detection of people with CKD (Mathew and Corso 2009; Tracey *et al*. 2013). However, little is known about whether Australian GPNs have the requisite knowledge to identify people at risk of CKD or what constitutes evidence-based screening.

Geographic dispersion, isolation and time constraints pose substantial challenges for nurses who require timely professional

What is known about the topic?

- Chronic kidney disease is major public health problem in Australia. E-learning is a well-established, proven education medium for professional development however, its effectiveness in teaching general practice nurses about chronic kidney disease risk factors and screening techniques has not been evaluated.

What does this paper add?

- General practice nurses' baseline knowledge about chronic kidney disease risk factors and screening practices is poor. This research reports the effectiveness of e-learning and highlights the need for general practice nurses to improve their overall knowledge in this area.

development opportunities (Sinclair and Levett-Jones 2011). Supporting expanded nursing roles requires GPNs to develop their knowledge base, and e-learning is one proven educational medium that can assist professional development needs in this area (Lahti *et al*. 2014). The effectiveness of e-learning to improve knowledge-based outcomes has been well demonstrated in other nursing disciplines (Heartfield *et al*. 2013); however, there is little evidence evaluating its effectiveness in the GPN population (Edwards 2017). This paper reports the findings of a study that evaluated outcomes related to Australian GPNs' knowledge and satisfaction after completing a case study-based asynchronous e-learning module designed to improve knowledge about CKD risk factors and screening practices.

Methods

Study aims

The aim of this paper is to report the results of a study that evaluated: (a) the effect of an asynchronous web-based e-learning module to develop GPNs' knowledge about CKD risk factors and screening practices; and (b) GPNs' perceived satisfaction with the e-learning module.

This paper presents the results from one component of the CKD-DETECT study, a randomised control trial (RCT) designed to examine the effect of a tailored behavioural-based e-learning module compared with a knowledge-based module on GPNs behavioural interventions to initiate a kidney health check. Results from the behavioural intention component of the study are reported elsewhere (Sinclair *et al*. 2019).

The CKD-DETECT knowledge module

The CKD-DETECT knowledge module used an interactive case study approach whereby participants were introduced to a typical patient presentation and content about CKD risk factors and evidence-based screening practices. The module had two discrete learning outcomes: to identify the nine major risk factors for chronic kidney disease; and to describe the best practice screening method for chronic kidney disease (i.e. a kidney health check: measuring blood pressure, urine sample for an albumin–creatinine ratio and blood test to determine an individual's estimated glomerular filtration rate; Fig. 1). The module consisted of 16 core 'screens' containing various multimedia and interactive links and was designed using a high engagement–high quality framework and is profiled in detail in Sinclair *et al*. (2017).

Measurement instruments

The CKD knowledge evaluation instrument

In the absence of a validated CKD knowledge evaluation instrument for GPNs, a 12-item scenario-based multiple-choice instrument was designed using the Kidney Health Australia – Caring for Australians with Renal Insufficiency guidelines (Johnson *et al*. 2013), which provides evidence-based recommendations for the detection of CKD. The pre- and post-knowledge instrument (see Table S1 available as Supplementary Material to this paper) was designed to assess participants' knowledge of CKD risk factors (five items) and best practice guidelines for CKD screening (seven items). Responses were coded as either correct or incorrect. The sum of the correct responses resulted in the final knowledge score. Potential knowledge scores ranged from 1 to 12. Any participant with a score of 0 had their score changed to missing.

Face and content validity of the knowledge instrument were evaluated by a panel of experts from the nursing, primary care and research fields, using a combination of judgemental and statistical methods. A content validity index and a modified kappa co-efficient were used to calculate the validity of test items and the global scale and adjust for chance agreement between raters. These data were then reviewed and individual items were refined in conjunction with the expert panel feedback. No items were removed from the instrument during this process.

The Learner Satisfaction with Asynchronous e-Learning instrument

This study used the Learner Satisfaction with Asynchronous e-Learning (LSAe-L) instrument, which comprises 30 items with seven subscales. The LSAe-L instrument (see Table S2) was created to evaluate learner satisfaction with the way e-learning is designed to facilitate learning. The instrument has previously demonstrated good face, content and construct validity, with subscale Cronbach α values ranging from 0.87 to 0.96 (P. M. Sinclair, A. Kable, T. Levett-Jones, C. Holder, C. J. Oldmeadow, A. Wilson, unpubl. data).

Study procedure

Participants were randomised to either a knowledge-based active control e-learning module (Module one) or a tailored behavioural e-learning module (Module two) (Fig. 2). All participants, regardless of randomisation, undertook a 14-item demographic instrument and the pre-knowledge evaluation instrument. Participants randomised to the active control arm of the study undertook the same demographic and pre-knowledge instruments, completed Module one only, and then repeated the post-CKD knowledge evaluation instrument. Participants who were randomised to the intervention arm who scored $\geq$75% on the pre-CKD knowledge instrument proceeded directly to Module two. Participants who scored <75% on the pre-knowledge instrument undertook Module one and repeated

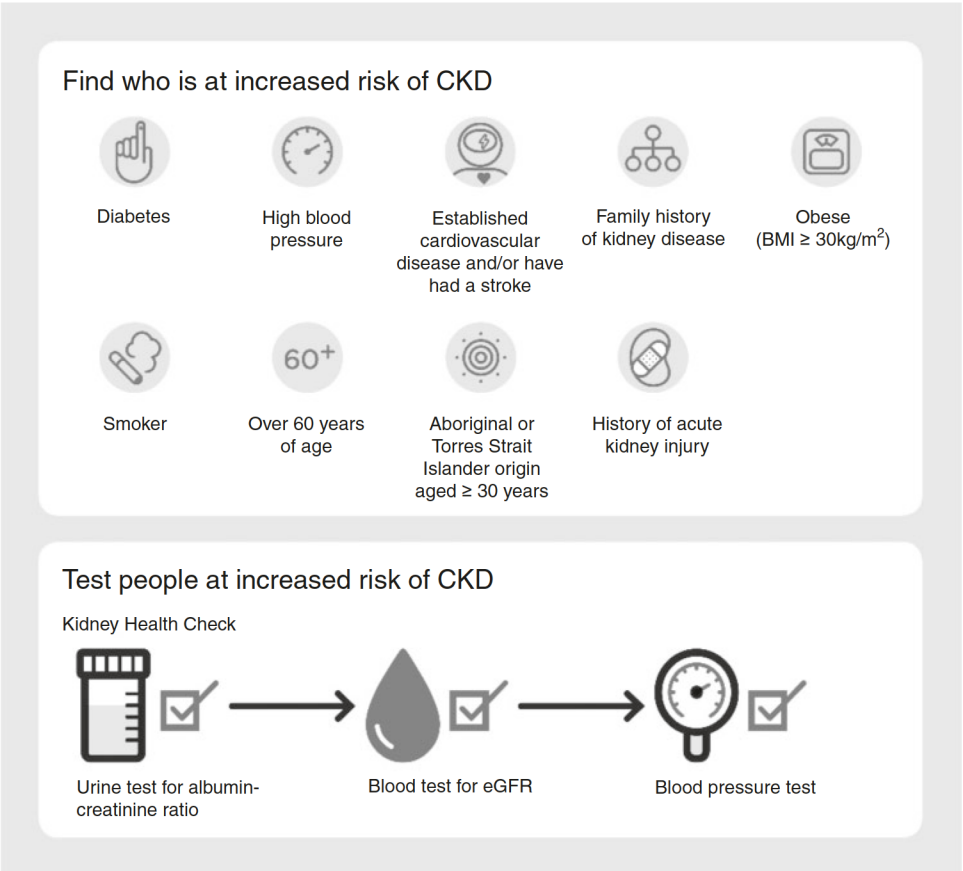

Fig. 1. Chronic kidney disease (CKD) risk factors and the kidney health check (Source: used with permission from Kidney Health Australia). BMI, body mass index; eGFR, estimated glomerular filtration rate.

the post-CKD knowledge evaluation instrument before proceeding to Module two. The rationale for this approach was based on the need to ensure participants had a requisite level of knowledge about CKD risk factors and screening before undertaking the intervention. Data analysis did not compare study arms because groups completed the same module and there were no differences between groups. Consequently, analyses for the knowledge and satisfaction aims of the study were undertaken using a pre-post evaluation design.

Sample size calculation

The sample size was powered for the primary outcome analysis of the RCT, such that a sample of 220 participants (randomised 1:1) would give the study 80% power to detect a mean standardised effect size of (Cohen's d) 0.3 (with a two-sided α of 5%). The pre-post analysis of the secondary outcomes would have 80% power to detect a within-person mean difference Cohen's d of 0.2.

Participants and recruitment

Nurses currently working in a general practice setting or who had worked in one within 12 months were eligible to participate in the study. This target population was considered to have the same scope of practice in this area that aligned with Kidney Health Australia (Kidney Health Australia 2016) recommendations and the Nursing and Midwifery Board of Australia's standards for practice (Nursing and Midwifery Board of Australia 2018). Recruitment was through multiple sources, including primary healthcare network newsletters and social media. Recruitment occurred between October 2017 and April 2018.

Data analysis

Data analysis was conducted using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Participant demographic characteristics were compared by mean, median and frequency. Data are presented as descriptive statistics; a P value of ≤ 0.05 was considered statistically significant.

Knowledge scores were calculated as the sum of all responses and expressed as a score out of 12. Paired samples t-tests were used to compare pre- and post-test knowledge scores; mean difference and 95% confidence interval and the P-values are presented. Cohen's d was used to measure effect size with a value of 0.2 considered a small effect size, 0.5 a medium effect and 0.8 a large effect size (Sawilowsky 2009). Item discrimination and difficulty indices were calculated for pre-knowledge scores and an item discrimination of ≥ 0.3 was considered acceptable (Secolsky and Denison 2017).

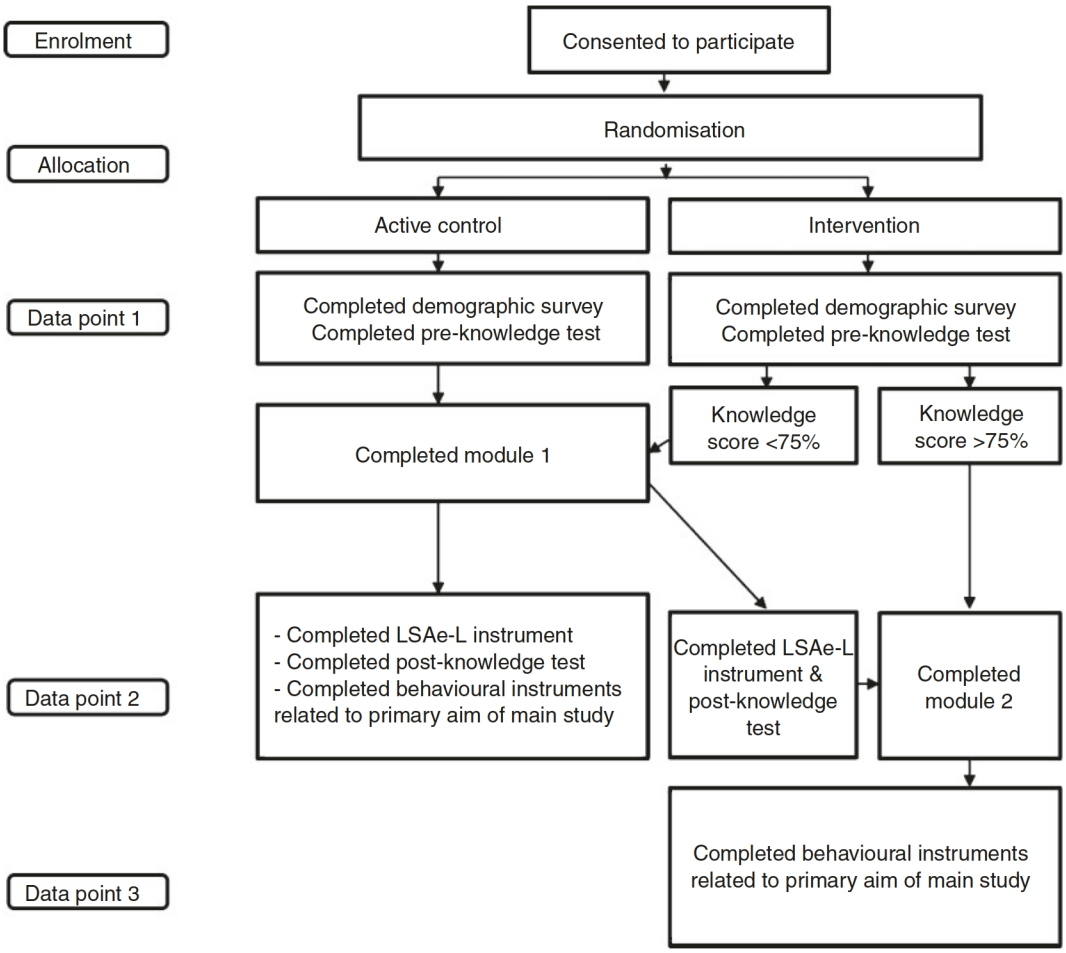

Fig. 2. Study pathway for the CKD-DETECT study (this paper reports the knowledge and satisfaction outcomes only). LSAe-L, Learner Satisfaction with Asynchronous e-Learning.

Satisfaction items were allocated a score for each item ranging from one to five based on the participant's response of strongly disagree to strongly agree. The global score for learner satisfaction was calculated as the sum of all items and ranged from 30 to 150, with higher scores representing a higher level of learner satisfaction. A mean global score of 120 or higher was considered as excellent. Cronbach's α was estimated for the satisfaction domains.

Ethics approval (H-2016–0394) was obtained from the University of Newcastle human research ethics committee before study commencement. Voluntary consent was implied after participants clicked the submit button to begin the study.

Results

Participant characteristics

Table 1 presents the characteristics of participants in the study. The average age of participants was 47 years. Participants had worked in general practice nursing on average for almost 8 years, with 78% (n = 165) coming from major or inner regional cities. Fifty-seven per cent of participants (n = 121) had never undertaken CKD education previously. Participants who had accessed CKD-related education previously predominantly did so by accessing a journal article (36%) or via face-to-face workshops (24%).

Knowledge

Satisfactory item discrimination ≥0.3 was observed in 7 of the 12 items (see Table S1). Items 3, 4 and 6 demonstrated poor discrimination, but were retained due to their direct relationship with the learning outcomes. Items 8 and 11 were discarded from analysis due to poor discrimination. A modified knowledge score was imputed by removing knowledge items 8 and 11 due to an item discrimination <0.3. The results of the modified knowledge scores, with two fewer items, were similar to those of the 12-item knowledge score. Three participants, two in the pre-quiz and one in the post-quiz, had their knowledge scores changed to missing, as a result of answering all items incorrectly. Four participants received scores >75%, and due to the study flow, were not required to undertake the post knowledge instrument. Consequently, we analysed 210 and 207 participant data in the pre- and post-surveys respectively.

Table 1. Participant characteristics
Data are presented as *n* (%) unless otherwise stated. s.d. standard deviation; CKD, chronic kidney disease

Participant characteristics		Total (*n* = 212)
Age (years)	Mean (s.d.)	47.02 (11.58)
	Median (Q1, Q3)	49 (38, 56)
Gender	Male	3 (1.4)
	Female	209 (99)
Language	English	197 (93)
	Other	15 (7.1)
Job title	Enrolled Nurse	7 (3.3)
	Endorsed Enrolled Nurse	19 (9.0)
	Registered Nurse	177 (83)
	Nurse Practitioner	6 (2.8)
	Other (Nurse Practice Managers)	3 (1.4)
Years working in nursing	Mean (s.d.)	23.37 (24.15)
	Median (Q1, Q3)	22.5 (8.5, 32.5)
Years working in general practice nursing	Mean (s.d.)	7.96 (8.16)
	Median (Q1, Q3)	5 (2, 11)
Rurality	Major cities or inner regional	165 (78)
	Outer regional or remote	47 (22)
Undertaken prior CKD education	No	121 (57)
	Yes	91 (43)
Prior CKD education mode		
Face-to-face	No	161 (76)
	Yes	51 (24)
e-Learning education	No	176 (83)
	Yes	36 (17)
Journal article education	No	135 (64)
	Yes	77 (36)
Pharmacy representative education	No	166 (78)
	Yes	46 (22)
Webcast	No	196 (92)
	Yes	16 (7.5)
Other education	No	194 (92)
	Yes	18 (8.5)

Table 2. Mean knowledge and modified knowledge scores direct at baseline (*n* = 210) and follow up (*n* = 207)
CI, confidence interval; CKD, chronic kidney disease

	Baseline Mean (s.d.) (*n* = 210)	Follow up Mean (s.d.) (*n* = 207)	Effect size (95%CI)	*P*	Cohen's d
Knowledge score (12 items)	3.85 (1.77)	5.61 (2.16)	1.87 (1.58–2.16)	<0.01	0.39
Modified knowledge score[A] (10 items)	3.77 (1.66)	5.48 (2.07)	1.81 (1.53–2.09)	<0.01	0.37
CKD risk factors (5 items)	1.57 (1.08)	2.37 (1.26)	0.84 (0.66–1.03)	<0.01	0.39
CKD screening (5 items)	2.2 (0.98)	3.11 (1.21)	0.97 (0.79–1.14)	<0.01	0.19

[A]Knowledge items 8 and 11 were removed as 2% and 5%, respectively, of the participants had accurate responses at baseline.

The pre-test mean CKD knowledge scores were 3.77 out of 10 and mean post-test scores 5.48 out of 10. This indicated a significant improvement (mean difference 1.81, $P < 0.01$) (Table 2). The effect size measured using Cohen's d indicated a small-to-medium effect size in the knowledge scores.

Satisfaction

Table 3 presents the satisfaction ratings and Cronbach α for each sub-scale and the global LSAe-L instrument (refer to Table S2 for the list of items). Participants' global satisfaction mean score was 128.74 (s.d. 16.34) and mean sub-scale scores ranged from 8.32 (s.d. 1.3) to 26.01 (s.d. 4.3). Sub- and global-scale percentages are also reported. The item response distribution showed some skewness in responses, with the majority of participants agreeing or strongly agreeing to each item. The findings suggest that overall, participants were satisfied with how the module was developed to meet each of the domains of instructional design assessed by the instrument. The internal consistency of the LSAe-L instrument was excellent, with subscale Cronbach α values ranging from 0.82 to 0.97 and the global instrument α being 0.97, suggesting that all items within each domain were measuring the same underlying construct.

Table 3. Mean participant satisfaction ratings for each sub-scale of the Learner Satisfaction with Asynchronous e-Learning instrument

Subscale	Mean (s.d.) (n = 212)	% score	Cronbach α
Gain attention (3 items)	12.7 (2.27)	84.7	0.885
Identify goals and logical presentation of content (6 items)	25.7 (3.55)	85.7	0.920
Resources and strategies to enhance content delivery (5 items)	21.46 (2.93)	85.8	0.909
Maintain attention (6 items)	26.01 (4.30)	86.7	0.967
Elicit performance 'practice' (2 items)	8.32 (1.33)	83.2	0.905
Provide informative feedback and consolidate learning (5 items)	21.67 (3.00)	86.7	0.928
Flexible navigation and knowledge transfer (3 items)	12.87 (1.83)	85.8	0.814
Global Score for Learner Satisfaction (30 items)	128.74 (16.34)	85.8	0.971

Discussion

This paper reported the results of a study that evaluated: (a) the effect of an asynchronous web-based e-learning module on general practice nurses' knowledge about CKD risk factors and screening practices; and (b) general practice nurses' perceived satisfaction with the e-learning module.

This is the first study to evaluate GPNs' knowledge of CKD risk factors and screening practices in Australia using a pre- and post-test approach following completion of an e-learning module. Although many studies have demonstrated the benefits of e-learning (Lahti *et al*. 2014), to our knowledge, there has only been one study (Estrella *et al*. 2012) that has reported the evaluation of a CKD-related learning intervention. Using an observational design, Estrella *et al.* (2012) identified that an Internet-based tool could significantly improve physician knowledge of CKD (mean improvement 27.8% (s.d. 21.3%), $P < 0.05$). The results from the CKD-DETECT study are consistent with existing evidence demonstrating that e-learning is an accessible, acceptable and effective method to increase knowledge outcomes in health professional education (Cook *et al*. 2008; Lahti *et al*. 2014).

Overall, participants' baseline knowledge about independent CKD risk factors and what constituted a kidney health check was low (mean 3.77/10). Following completion of the module, participants' knowledge scores significantly improved; however, the post scores remained below the 75% used as a benchmark knowledge score for the CKD-DETECT study. These results are concerning and demonstrated that GPNs may not have the required knowledge to identify people at risk of CKD or initiate evidence-based screening. Consequently, this should be considered as a target area for GPNs' continuing professional development.

Further educational research is required to determine whether knowledge gained from educational interventions is retained and implemented in practice. In addition, consideration should be given to the evaluation of time and learning efficiency (dosage) associated with the CKD-related learning outcomes and the comparison of e-learning with a lower fidelity method to increase GPNs' knowledge in this area.

Learner satisfaction with e-learning has traditionally been assessed for interface and system quality, reliability, technical support time, Internet speeds and the effectiveness and relevance of feedback (Wang 2003; Chen *et al*. 2008; Sun *et al*. 2008; Lin *et al*. 2011). Some studies have measured information communication and technology (ICT) access and confidence, ease of use and relevance to job role (Wang 2003; Sun *et al*. 2008). In the context of the asynchronous e-learning modules used in the CKD DETECT study, these variables are beyond the control of the program and its developers. Consequently, traditional learner satisfaction measures do not accurately represent user satisfaction with the design of the e-learning program; rather, they represent the user experience of undertaking the e-learning program overall. User satisfaction, although frequently dismissed as being subjective and of little value, is still an important indicator of engaged and meaningful learning experiences. In contrast to previous user satisfaction research (Wang 2003; Chen *et al*. 2008; Sun *et al*. 2008; Lin *et al*. 2011), the CKD-DETECT study evaluated satisfaction with the design of the program rather than variables such as: interface and system quality, reliability or Internet speeds, which are beyond the control of the program developers.

The measurement of learner satisfaction with instructional design using an *a priori* framework (see Sinclair *et al*. 2017) provides developers and educators with a better understanding of domains that can be strengthened in future versions of e-learning programs. It also provides a reliable manner by which to measure satisfaction by excluding artefacts that are not under the direct control of the developer. Participants in the CKD DETECT study rated their satisfaction with the e-learning modules highly (85.8%). The high satisfaction scores on all subscales reflect that the modules were well designed to deliver each of the criteria. The use of a new satisfaction instrument prevents comparison with other studies; however, it confirms existing research (Lahti *et al*. 2014) that reports e-learning to be an acceptable learning method, albeit using a different framework.

Limitations

The results of this study should be interpreted with consideration of its strengths and limitations. The knowledge instrument created for this study underwent extensive evaluation for content validity and was informed by current evidence-based guidelines. Despite this, some items showed poor discrimination. This may be due to the majority of participants (57%) having not accessed CKD-related education before participating in this study, and they may have had inadequate knowledge at baseline. Although their knowledge improved significantly, the overall post-score was less than 75%. The results of this study also demonstrate that participants did not have the necessary knowledge to identify risk factors for CKD or recall what tests are required for a kidney health check at baseline. Further, this study was not able to determine whether knowledge gains will be transferred into

practice or whether knowledge degradation would occur over time. Additionally, the potential of non-response bias may preclude the generalisation of results to the wider general practice nursing population. It is also acknowledged that the perceptions of self-reported satisfaction are subjective and not necessarily indicative of all aspects that may influence participants' e-learning experience.

Conclusion

This study evaluated the effectiveness of a case study-based, asynchronous e-learning module on GPNs' knowledge of CKD risk factors and screening practices. Participants' knowledge pre-scores were low, and despite a statistically significant improvement in scores at completion, post-scores were lower than the benchmark 75% that was used as the cut-off criteria to demonstrate an adequate understanding of CKD risk factors and screening practices for the CKD-DETECT study. If timely identification and management of CKD is to be achieved, then more work is required to improve GPNs' CKD-related knowledge in Australia. Further, ongoing research is required to determine whether knowledge gained from e-learning is retained and transferred to practice, as well as the effect of dosage (time and learning efficiency) on CKD-related learning outcomes in comparison to other educational modalities.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Chapter 8: Discussion, Conclusions and Recommendations

8.1 Introduction

This program of work used an exploratory sequential mixed method research design to achieve its stated aims. This design, informed by the philosophical tenets of pragmatism, enabled the exploration of qualitative data to identify the barriers and facilitators to opportunistic CKD screening which informed instrument and intervention development, and quantitative data to evaluate the effectiveness of the intervention developed (Creswell & Plano Clark, 2017).

This final chapter discusses the key findings and results of the program of work reported in this thesis. Within each section, the relevance of results is discussed in the context of the current literature. Table 8.1 provides a summary of each phase of the study, research aims, publications and their contribution to new knowledge. The limitations of the study design are also discussed. Finally, recommendations for future research, health care professional education, policy and clinical practice are presented.

Phase	Research aims	Methods	Contribution to new knowledge	Publication
1	To identify, appraise and synthesise the best available evidence for the effectiveness of e-learning programs on healthcare professional behaviour	Systematic review	- E-learning is at least equivalent to traditional learning approaches and superior to no instruction at all when evaluating the effectiveness of e-learning *when teaching skills (i.e. behaviour)* - There is a lack of rigorously designed randomised controlled trials that evaluate the effectiveness of e-learning on healthcare professional behaviour and patient outcomes - A need exists to develop and validate alternate objective measures that are informed by sound theoretical constructs to evaluate e-learning behavioural outcomes.	1. The effectiveness of e-learning on clinician behaviour and patient outcomes: A systematic review protocol 2. The effectiveness of internet-based e-learning on healthcare professional behaviour and patient outcomes: a systematic review
2	To identify the barriers and facilitators to opportunistic CKD screening by GPNs	Elicitation study	- The barriers to CKD screening were identified as complex, multi-factorial and driven by social and organisational factors. The financial costs associated with non-claimable services, regardless of patient benefit, were hard to justify in a private business environment	3. The barriers and facilitators to opportunistic CKD screening by general practice nurses
	Development of intervention and instructional design framework		- This paper presented 10 guiding design principles and how to practically apply them in the development of an e-learning program. It focussed on ways to enhance engagement and user satisfaction, knowledge and behaviour change. - Application of these principles will assist educators to develop high quality, pedagogically sound, engaging, and interactive e-learning resources.	4. High engagement - High quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators

Phase	Research aims	Methods	Contribution to new knowledge	Publication
3	To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions in relation to opportunistic screening practices in people at risk of CKD	RCT	- Results of the CKD-DETECT trial demonstrated that a targeted behavioural e-learning intervention was no more effective, in changing practice nurses behavioural intention to initiate a kidney health check, than a knowledge based e-learning program. - Given the lack of rigorously designed randomised controlled trials evaluating the effectiveness of e-learning on healthcare professional behaviour, this study demonstrated that e-learning may not be an appropriate educational medium to influence healthcare professional behaviour.	5. The CKD-DETECT STUDY: An RCT aimed at improving behavioural intention to initiate a Kidney Health Check in Australian practice nurses
	To evaluate the effectiveness of an asynchronous web-based e-learning module on GPNs' knowledge about CKD risk factors and screening practices. To evaluate GPNs' perceived satisfaction with an asynchronous web-based e-learning module.		- Results of the CKD-DETECT trial demonstrated that Australian General Practice Nurses may have poor base line knowledge of chronic kidney disease risk factors and screening practices - While an e-learning program can significantly improve knowledge scores, new knowledge levels were considered to be low. Consequently, new knowledge levels could not be considered to be clinically significant. - The CKD-DETECT trial supported previous studies demonstrating that e-learning is a satisfactory medium to deliver education to health care professionals. Furthermore it demonstrated the utility of a practical framework to develop e-learning programs. Effectiveness of this framework was measured using a new instrument of user satisfaction with design factors rather than variables outside the control of developers	6. An evaluation of general practice nurses' satisfaction with, and knowledge of chronic kidney disease risk factors and screening practices following completion of a case study based asynchronous e-learning module.

Table 8.1: A summary of each phase of the study, research aims, publications and contribution to new knowledge.

8.2 Key results and their relationship with current literature

8.2.1 The effectiveness of e-learning on healthcare professional behaviour

This program of work commenced with a systematic review in Chapter 2, which aimed to: ***Identify, appraise and synthesise the best available evidence regarding the effectiveness of e-learning programs on healthcare professional (HCP) behaviour and patient outcomes.***

Results of the review identified that e-learning was at least equivalent to traditional learning approaches and superior to no instruction at all when evaluating the effectiveness of e-learning on teaching skills (i.e. behaviour). The variation in intervention design and evaluation measures in the published studies meant that generalisable inferences about the effectiveness of e-learning on HCP behaviour were not possible. Studies in the review were heterogeneous and reported a diverse range of intervention characteristics including: the size of e-learning programs, number of modules undertaken, and time taken to complete them. Consequently, there was insufficient evidence to conclude that e-learning programs delivered exclusively via the internet significantly influenced HCP behaviour or patient outcomes. Finally, the systematic review did not identify any research that evaluated the effectiveness of e-learning interventions to improve opportunistic CKD screening in any setting.

8.2.2 Barriers and facilitators to opportunistic CKD screening by general practice nurses

Before an intervention to improve CKD screening in general practice could be designed and evaluated, it was necessary to first identify the barriers faced by GPNs to it being performed. Undertaking this process achieved the second aim

of this program of work: ***To identify the barriers and facilitators to opportunistic CKD screening by GPNs.***

Table 8.2 provides a summary of the barriers and facilitators to opportunistic CKD screening by Australian GPNs identified in the elicitation study reported in Chapter 3.

Attitude	Subjective Norm	Perceived Behavioural Control
Early detection and treatment	Approval of GPs and patients	Existing screening protocols
Reduction of disease burden	Activity based funding models (MBS[a] items)*	Presence of known risk factors
↑ awareness of CKD	Medically defined roles	Relationship with patient
↑ prevention of CKD	The business*	Unfunded time vs competing funded priorities*
Imposition on time & competing clinical priorities*		Lack of MBS item number*
Threat of patient harm (Stress and financial)*		Impact on patient*
Knowledge and/or skill deficit*		Practice business rules*

Table 8.2: Barriers and facilitators to opportunistic CKD screening by Australian GPNs (Adapted from Sinclair, Day, Levett-Jones, and Kable (2017)
[a] Medicare Benefits Schedule
*** Negative beliefs**

The challenges outweigh the benefits

This approach was consistent with the framework associated with the Theory of Planned Behaviour which underpinned this program of work. The elicitation study associated with publication three and presented in Chapter three of this thesis identified that participants recognised the benefits of opportunistic CKD screening, however the barriers were multifaceted with many inter-related variables that were socially and organisationally driven. These challenges meant that opportunistic screening was not always performed. Green and James (2013) investigated the barriers faced by registered nurses that prevent them from performing nutritional screening and similarly identified that organisational culture strongly influenced screening practices. They concluded

that registered nurses may be willing to undertake nutritional screening but the workplace environment dictated whether it would actually happen. Interestingly, the same disconnect was described by participants in the current study regarding positive beliefs and attitudes about the benefits of screening that did not translate into actual practice.

Scope of Practice

Tensions existed between practice nurse and general practitioner roles with a lack of clarity about who was responsible for undertaking CKD screening. Some participants experienced resistance from general practitioners who believed practice nurses should not be screening or consulting with patients. Participants cited early detection and treatment of CKD, reduction of disease burden, and opportunities to increase awareness and provide education related to disease prevention as the advantages of opportunistic screening. However, these positive attitudinal beliefs were offset by negative beliefs regarding the impost on nursing time, particularly when there were other competing priorities.

Competing priorities in a business environment

These findings of the elicitation study were consistent with previous research that cited time as the main factor preventing HCPs from conducting screening in other disease contexts (Broyles et al., 2012; Friedberg, Van Busum, Wexler, Bowen, & Schneider, 2013; Green & James, 2013; Guillery, Benzies, Mannion, & Evans, 2012). In studies about alcohol consumption (Broyles et al., 2012) and nutritional screening (Green, James, Latter, Sutcliffe, & Fader, 2014), logistical challenges in practice, in combination with competing clinical priorities have also been reported.

One of the barriers to CKD screening frequently described by participants was the impact on income for general practices. Without reimbursement through

the Medicare Benefits Scheme for kidney disease screening activities, opportunistic screening was not considered an economically viable use of nursing time. Participants suggested that general practitioners were mindful of the financial costs associated with non-claimable screening services and other competing and billable clinical services took precedence. Consequently, unfunded services regardless of benefit, were difficult to justify in a private business environment.

Negative Effects on Patients

Previous studies on barriers to screening for colorectal cancer (Omran, Barakat, Muliira, & Aljadaa, 2015), gestational diabetes (Buckley et al., 2012), alcohol intake (Broyles et al., 2012), and domestic violence screening (Guillery et al., 2012) have identified how HCP concerns about negative patient reactions can inhibit screening practices. The current study identified similar concerns in our participants, although to a lesser extent. These findings were also described in the only study to date that has explored the processes underpinning CKD management overall in a United Kingdom primary care setting (Blakeman, Protheroe, Chew-Graham, Rogers, & Kennedy, 2012).

New Knowledge

The elicitation study associated with publication three and presented in Chapter 3 of this thesis was the first study to identify and describe the barriers that inhibit the performance of opportunistic CKD screening by GPNs in the Australian general practice setting. Findings from the elicitation study led to hypothesise that CKD screening may be improved by developing a targeted intervention that addressed the salient attitudinal, normative, and perceived behavioural control beliefs of nurses working in the general practice setting. Findings from this phase of the study provided a framework for an intervention designed to evaluate the effectiveness of an e-learning module targeted at improving General Practice Nurses' behavioural intentions to initiate a kidney

health check on people identified as 'at risk' of CKD and/or have a conversation with the treating doctor about the need for a kidney health check.

Educational interventions: Moving beyond satisfaction and knowledge

The effectiveness of educational interventions is often evaluated using the constructs of learner satisfaction, knowledge gain and behavioural change. These constructs align with the first three levels of Kirkpatrick's (1994) evaluation model of educational outcomes as discussed in Chapter one of the thesis. Historically, the evaluation of e-learning has predominantly focussed on the domains of satisfaction and knowledge (Lahti, Hätönen, & Välimäki, 2014). This is due, in part, to the theoretical and practical challenges (such as geographical distance or the inability to evaluate behavioural outcomes objectively) of e-learning research that corresponds with higher levels of evaluation such as behaviour change. The systematic review discussed in Chapter 2 identified that few studies have examined the effectiveness of internet-based e-learning programs on behaviour, which aligns with level three of Kirkpatrick's model. Consequently, phase three of this program of work primarily focussed on evaluating the effectiveness of an asynchronous web-based e-learning module on behavioural intention, the antecedent to behaviour change.

8.2.3 Effectiveness of an asynchronous web-based e-learning module on GPNs' behavioural intentions

Phase three of this program of work culminated with the evaluation of the CKD-DETECT study, the results of which were reported in two manuscripts. The first, profiled in Chapter 6, reported the results of a parallel group, double blinded randomised controlled study which tested the two hypotheses associated with the third aim of this thesis:

The primary outcome was change in behavioural intention from baseline to follow-up. Behavioural intention was defined in four ways:

1. Initiating a kidney check.
2. Have a conversation with a GP to initiate a Kidney Check.
3. Sum of the previous two behavioural intention outcomes - calculated by summing the resulting scores for -initiating a kidney check and having a conversation with a GP to initiate a Kidney Health Check.
4. Indirect behavioural intention (for the secondary hypothesis).

A significant positive linear relationship between behavioural intention outcome one (initiate a kidney health check) and behavioural intention outcome two (initiate a conversation) [r^2 0.54 ($p < 0.0001$) pre-intervention and r^2 0.48 ($p < 0.0001$) post-intervention] was identified. Consequently, the primary and secondary hypotheses were analysed as a behavioural intention summed score.

The intervention was designed to influence the behavioural constructs of the Theory of Planned Behaviour namely attitude, subjective norm and perceived behavioural control. There were no significant differences in behavioural intention between the intervention and control groups at follow-up, when controlling for baseline values. These findings were replicated in the modified intention to treat analysis. *Consequently, the primary hypothesis was not supported.*

The trial revealed some unexpected results when regression models were used to examine the relationship between change in the Theory of Planned Behaviour constructs and intentions at follow-up for *all* participants. Irrespective of study arm, completing the study had an equivalent effect on all participants. A significant change was identified for all behavioural constructs and the intention sum. These changes were not attributed to the effect of the intervention. Attitude and perceived behavioural control models accounted for approximately 35% of the explained variance in behavioural intentions, and subjective norm accounted for approximately 33% of the variance. The inclusion of all theoretical constructs, explained 37% of the variance in

intention. This is consistent with previous reviews that have reported between 33.7% (Conner & Sparks, 2005) and 40% (Godin & Kok, 1996) for predicting clinical intentions in health care professionals.

Regression models were also used to assess the relationship between the Theory of Planned Behaviour predictor variables and behavioural intention sum for all participants (n=309) who completed the TPB-CKDISI at baseline. When all baseline Theory of Planned Behaviour predictor variables were included, 26% of the variation in the intention sum was explained. As discussed in the previous paragraph, the relationship between intention sum and change in predictor variables at follow up was significant in *all* completers (n=212) regardless of randomisation. *These findings supported the secondary hypothesis.*

New Knowledge

This is the first study to have measured the impact of e-learning to influence health care professional behaviour change in chronic disease screening using a RCT design. It is also the first to manipulate factors identified using empirical enquiry, that influence chronic kidney disease screening by General Practice Nurses.

Some fundamental methodological and philosophical flaws exist in e-learning research, particularly the use of comparative design studies. Comparisons between e-learning and traditional education methods are illogical and methodologically flawed due to the heterogeneity between comparison groups. In addition, traditional teaching methods lack uniformity and such designs include multiple confounders that cannot be controlled (Cook, 2005; Friedman, 1994).

Level one evidence, presented in chapter two of this thesis, investigated the effectiveness of e-learning approaches and reported mixed results. Direct comparisons between the studies reported in the systematic review were

difficult due to the heterogeneity between comparator groups and quality and nature of the interventions. These studies were different to the CKD-DETECT trial because they used face-to-face evaluation methods (Durmaz, Dicle, Cakan, & Cakir, 2012), compared e-learning to no training at all (Elgie, Sapien, Fullerton, & Moore, 2010; Gordon, Chandratilake, & Baker, 2011; Smeekens et al., 2011) or practical instruction (Pape-Koehler et al., 2013), or classroom instruction (Bandla et al., 2012) or traditional learning in a blended learning context (Cantarero-Villanueva et al., 2012). In contrast to all of these studies, the CKD-DETECT trial did not demonstrate a statistically significant difference between intervention and active control groups. However, in comparison with the seven studies reviewed, the CKD-DETECT trial compared outcomes from two e-learning modules that were designed with a consistent framework (Sinclair, Levett-Jones, et al., 2017), rather than using no comparator at all, or traditional or blended instructional methods. A lower fidelity or 'no training at all' comparator could have possibly yielded different or comparable results but would not have assisted in the wider investigation of the effectiveness of e-learning on health care professional behaviour.

Results from the CKD-DETECT trial suggest the need for further research in this area to evaluate the effectiveness of asynchronous e-learning programs in influencing clinical behaviour (Sinclair, Kable, Levett-Jones, & Booth, 2016). While e-learning approaches can improve access to educational resources by nurses, they may not be the ideal mode of delivery to influence change in clinical behaviour. In addition, interventions should be designed to overcome barriers to practice change in the general practice setting.

8.2.4 Effectiveness of an asynchronous web based e-learning module on GPNs' knowledge about CKD risk factors and screening practices

The secondary aims of the CKD-DETECT trial aligned with the first two levels of Kirkpatrick's (1994) evaluation model of educational outcomes, satisfaction

and knowledge. As expected, the positive change in pre-post intervention scores supported existing evidence that e-learning is an effective method to improve knowledge outcomes in health professional education (Cook et al., 2008; Lahti et al., 2014).

New Knowledge

This was the first study to evaluate General Practice Nurses' knowledge of kidney disease risk factors and screening practices following completion of an e-learning module. Despite demonstrating that e-learning was an effective medium to improve knowledge in this area, participant knowledge levels were still inadequate. More concerning was that participants' baseline knowledge scores were poor which may be suggestive of a wider knowledge deficit in Australian General Practice Nurses.

The CKD-DETECT trial pathway set a 75% minimum score to allow participants from the intervention group to proceed directly to Module 2 without having to undertake Module 1. If participants' scored < 75% in the knowledge instrument the e-learning program automatically routed them to Module 1 first, because it was considered necessary for participants to have a requisite level of knowledge about risk factors and screening prior to commencing the intervention. However mean post-test scores were 54.8% for all participants who undertook Module 1. This demonstrated that the knowledge module was not sufficient to improve knowledge scores to what was considered a satisfactory level to identify people at risk and how to initiate a kidney health check with them.

8.2.5 Perceived satisfaction with an asynchronous web based e-learning module

Results are consistent with what is already known

The CKD-DETECT trial used a newly developed satisfaction instrument which precludes comparison with other studies. Participants in the CKD-DETECT trial rated their satisfaction with the e-learning modules highly which confirms existing research (Lahti et al., 2014) that e-learning is an acceptable learning method, albeit using a different evaluative framework.

New knowledge

Traditional learner satisfaction measures reported in the literature do not accurately represent user satisfaction with the design of an e-learning program; rather, they represent the user experience of undertaking an e-learning program overall. In contrast to existing learner satisfaction instruments, the CKD-DETECT trial evaluated satisfaction with the design of the program rather than variables such as interface and system quality, reliability, or internet speeds, all of which are outside the control of educators and program developers.

The measurement of learner satisfaction with the CKD-DETECT e-learning modules were undertaken using a newly developed instrument informed by an *a priori* framework (see Sinclair, Levett-Jones, et al., 2017). The use of the Learner Satisfaction with e-Learning instrument and its associated framework will assist educators with e-learning development and provide a better understanding of domains that can be improved after learner evaluation. Additionally, it now provides a validated manner by which to evaluate learner satisfaction with e-learning by excluding artefacts that are not under the direct control of the developer.

8.3 Rigour in the use of mixed methods

Despite the increasing popularity of mixed methods research, methods of demonstrating rigour in studies that use mixed methods are still poorly defined. Whilst the use of mixed methods can be seen to enhance validity, it is still necessary for the researcher to be rigorous in their approach (Lavelle et al., 2013). Creswell et al. (2011) advocate that mixed methods investigations should demonstrate rigour using the same criteria as would be used in a quantitative and qualitative investigation, as well as specific mixed methods criteria. Regardless of the specific tool or method used, the key to demonstrating rigour in mixed methods research is in providing the reader with a clear audit trail and well considered and justified rationales for the decisions made throughout the research process (Lavelle et al., 2013).

8.3.1 Achieving rigour in the elicitation study

In the preceding three decades the quality of qualitative research and concept of methodological rigour has been the subject of debate (Milne & Oberle, 2005). Rigour is a "way of demonstrating the legitimacy of the research process, ultimately ensuring the empirical evidence is representative of reality" (McBrien, 2008, p. 1286). Establishing the trustworthiness of a qualitative study is integral to the notion of rigour (Denzin & Lincoln, 2011; Shenton, 2004). Cypress (2017) suggested that after years of debate the qualitative research community has yet to reach consensus or indeed determine whether it is necessary to agree on how quality in qualitative research should be measured. Adding to the complexity of this debate is the lack of clear guidelines about what constitutes rigour in qualitative research. Three positions are dominant in the literature, 1) qualitative research should be evaluated according to quantitative criteria; 2) alternative evaluation frameworks should be developed for qualitative research and; 3) that each qualitative study should be assessed individually (Cypress, 2017; Rolfe, 2006). In addition to the variety of

evaluation frameworks argued by methodological experts are the myriad of terms, and their associated definitions, to describe what constitutes rigour in qualitative research. The lack of consensus stems from the origins of rigour in quantitative research methods which is classically illustrated using the concepts of validity and reliability (Seale, 1999).

Some qualitative researchers have distanced themselves from positivist terminology and pursued alternative terminology and methods to establish the trustworthiness of a study (Denzin & Lincoln, 2011). Consequently, authors have created alternative criteria that have been described as analogues of validity and reliability (Ryan-Nicholls & Will, 2009). Confusion occurs when positivist variants of validity and reliability are used in qualitative research. Notions of validity and reliability criteria in quantitative research are incongruent when applied to naturalistic inquiry (Shenton, 2004). Qualitative researchers, therefore, are beginning to use terms that are more congruent with naturalistic inquiry.

The criteria for rigour for the purpose of the qualitative stage of this study was the trustworthiness criteria espoused by Denzin and Lincoln (2011). Due to the myriad orientations towards validity and reliability and the resulting complexity of the debate surrounding rigour phase two adopted a realist position (Porter, 2007). This position assumed that truth is a socially constructed concept and reconciles that while multiple descriptions of reality exist, multiple paradoxical or conflicting descriptions cannot (Sandelowski & Barroso, 2007). Trustworthiness was demonstrated via the credibility, confirmability and dependability criteria for the qualitative stage of this research (Denzin & Lincoln, 2011; Letts et al., 2007).

Credibility

Establishing credibility is an essential step towards demonstrating the trustworthiness of qualitative data in a mixed method study (Denzin & Lincoln,

2011, Letts et al., 2007). Due to the epistemological view that multiple realities exist in human experience, it is vital that the researcher comprehensively demonstrates that they have provided an accurate portrayal of the phenomenon being examined (Morse & Field, 1996). The questions posed here are: Do the findings accurately report the phenomenon being studied? Are they authentic? Are they credible to the participants and to the reader? (Denzin & Lincoln, 2011)

The reporting and consequent credibility of the phenomenon being studied extends to the experience of the researcher (Angen, 2000). This includes the degree of expertise in data collection methods (Tuckett, 2005). The student researcher in this study has:

- Completed a Master of Philosophy degree that utilised a qualitative descriptive research design
- Read extensively on qualitative interview methods and completed courses in mentorship and clinical supervision which included training in questioning and interviewing techniques.

The authenticity and hence credibility of the data were further supported through student researcher debriefing and supervision with an independent researcher with extensive experience with elicitation studies and through sustained engagement with the data. The final step taken in this present study to ensure credibility and establish its trustworthiness was through the use of a second researcher to independently analyse the data.

Dependability

The criterion of dependability relates to the stability (Denzin & Lincoln, 2011) or consistency (Miles & Huberman, 1994) of the data over the period of the study (Ryan-Nicholls & Will, 2009). In order for this to occur, the design of the study needs to be consistent throughout the project with a clear decision trail

articulated to enable auditing of the process (Letts et al., 2007). According to Morse and Field (1996), the consistency, or dependability, of a study questions whether the findings could be replicated using similar participants or context. Dependability is established with the comprehensive reporting of the research process whereby a clear audit trail is available for the reader and/or other researchers to follow if they choose to replicate the study. For these reasons dependability is sometimes used interchangeably with the term auditability (Ryan-Nicholls & Will, 2009). Dependability is similar to the concept of replicability in quantitative research (Denzin & Lincoln, 2011). However, experience is a subjective and dynamic concept whereby any given phenomenon being studied constantly evolves and develops new meaning by those who experience it. Consequently, the positivist assumption which suggests that if a study was replicated under the same conditions similar results would be generated is untenable in the qualitative context (Shenton, 2004). This study met the criteria of dependability by ensuring that the research design and processes were clearly documented in chapters one and three of this thesis.

Confirmability

Confirmability relates to the factual accuracy of the researcher's account and consequent freedom from bias in the research process and subsequent findings (Morse & Field, 1996). The criterion of confirmability considers the comparative neutrality of the researcher and the processes that are established to ensure the findings of the study emerge from participants' responses rather than the bias and influence of the researcher (Denzin & Lincoln, 2011). Where credibility relates to the legitimate description of the phenomenon, confirmability questions if the researcher has accurately translated or interpreted what the words or themes *mean* to the participants involved in the research. More specifically, has the researcher described/interpreted the expressed

phenomenon from the participants' perspective rather than being biased by their own ideology or assumptions (Maxwell, 1992)?

In order to establish confirmability the researcher must provide sufficient detail to illustrate that the findings of the research are grounded in the data through the use of excerpts from interviews. This was done in the elicitation study by providing multiple participant responses in quotation form to demonstrate how the findings were grounded in the data.

8.3.2 Achieving rigour in the CKD-DETECT trial

Evidence-based practice involves the application of evidence into clinical and educational practice based on results of rigorously conducted research (Heale & Twycross, 2015). The concept of rigour in quantitative research significantly differs from qualitative research. From a philosophical position, qualitative studies accept that there are multiple truths and realities. Alternatively, quantitative research views truth as static or objective, that is, it either exists or it doesn't (Claydon, 2015).

Rigour in quantitative research relates to how the research has been designed and executed. Poorly designed and executed studies will create questions about the reliability and validity of their reported results (Bowen, 2015; Claydon, 2015). Consequently, rigour in quantitative research is determined by examining the validity and reliability of the study design and processes.

Validity

Rigour is primarily concerned with a studies internal validity. Poor research design and processes will increase the likelihood of the results being affected by bias and raise questions about their accuracy and validity (Claydon, 2015). Critical appraisal checklists such as the Consolidated Standards of Reporting Trials (CONSORT) statement (Moher et al., 2012) assist in establishing whether

a research study has internal and external validity in addition to assessing results.

The reporting of the results from the CKD-DETECT trial to a peer-reviewed journal required the submission of a completed CONSORT statement (See Appendix 23) as a supplementary file. This process enabled the demonstration of steps implemented to minimise threats to internal and external validity. These threats were minimised by ensuring that:

1. Allocation of participants was blinded and randomised through a web-based randomisation schedule which used a permuted block randomisation with blocks of randomly varying size, stratified by rurality and years of experience (< 10 years or 10+ years) to minimise the potential for selection bias.
2. An *a priori* study protocol was followed with no deviation.
3. Instruments developed and used for the study followed best practice principles and underwent extensive assessment to establish face and content validity. Construct validity of the LSAe-Lwas established in a separate, yet to be published, paper independent of this program of work.
4. Intention-to-treat and per-protocol analyses were performed on all available data from participants randomised into the study so that group results were analysed according to group assignment to minimise the potential for selection bias.
5. Effect sizes and 95% confidence intervals were reported to demonstrate variable differences between groups.

Reliability

Reliability pertains to the consistency of the instruments used to measure outcome variables in a study (Heale & Twycross, 2015). The reliability of the

instruments used in the CKD-DETECT trial were demonstrated through reporting internal consistency using item-to-total correlation and Cronbach's α.

8.4 Limitations of this study

There are several limitations associated with this program of work that should be considered when interpreting results. These limitations should be considered in the context of the corresponding phase of the study.

8.4.1 Phase one limitations

The systematic review was informed by a peer reviewed search protocol (Sinclair et al., 2015) and its findings were reported using the guidelines provided in the PRISMA statement. Despite the use of a peer reviewed protocol and a rigorously designed search strategy, the search outcomes and subsequent findings were at risk of selection bias and we cannot exclude the possibility that relevant studies were not identified.

The search strategy was restricted to studies published in English language and may not have identified suitable studies written in other languages. The overall methodological quality of evidence included in this systematic review was variable, consequently statistical pooling was not possible and a meta-analysis could not be performed.

8.4.2 Phase two limitations

As with most qualitative research, the generalisation, a quantitative criterion, of findings from the elicitation study to the general practice setting may be limited. However, the more suitable criterion of transferability is the responsibility of the reader to identify if the context of the study is congruent with their own setting (Teddlie & Tashakkori, 2009). Participants were General Practice Nurses who worked in regional New South Wales, Australia and may not be representative of those who work in metropolitan, rural or remote

settings. The elicitation study reported in Chapter three of this thesis used a qualitative online survey. It would have been preferable to also utilise face-to-face focus groups for data collection. Focus groups would have enabled the exploration of participants' responses further with the use of probing questions. Probing questions may have revealed richer responses than those provided using an online survey format (Kallio, Pietilä, Johnson, & Kangasniemi, 2016). However, the aim was to identify General Practice Nurses' salient beliefs relating to chronic kidney disease screening practices rather than explore and find deeper meaning from the data. The decision to use an online survey was a pragmatic one, based on logistical, financial and time restrictions associated with this program of work.

8.4.3 Phase three limitations

E-learning does not meet all learners' preferred learning styles (Klašnja-Milićević, Vesin, Ivanović, & Budimac, 2011). The final phase of this program of work was not designed to address learners' preferred learning styles or evaluate learning for various learning styles. No data were collected relating to learner participation in terms of, but not limited to, time spent engaging with program (i.e. learning dosage), and number of attempts required to accurately answer questions. These data could have been used to inform future iterations and isolate issues that may not have been initially identified by the development and review teams.

The research design utilised for phase three could have been strengthened by adopting a longitudinal design that measured participants' knowledge and behavioural intentions at three, six and twelve month time points after the completion of the trial intervention. This would have assisted in evaluating behavioural intention over time between the two groups and whether knowledge was retained and put into practice. Given that this research has been conducted within scholarly time restraints for the purposes of a Doctorate

of Philosophy qualification, a longitudinal design was beyond the scope of this work.

The TPB-CKDISI was developed using established guidelines (Ajzen, 2002; Francis et al., 2004). Despite this, the use of a self-reported instrument may have influenced the association between the behavioural intention sum and predictor variables of the Theory of Planned Behaviour due to potential social desirability and recall bias. The pre- and post-survey items for the CKD-DETECT trial numbered 157 in total. While longer instruments are considered more reliable (DeVellis, 2012), instrument length and potential participant response burden, may have influenced the responses to this instrument (Rolstad, Adler, & Rydén, 2011). Using an objective behavioural measure would have strengthened this design. However this was considered impractical and costly given the number of participants required to power the study adequately and their distribution across Australia. Furthermore, in real world practice, assessment in asynchronous e-learning programs deployed in the context of CPD outside formal education contexts are exclusively conducted online. The use of the TPB afforded a more practical way in which to measure behavioural intentions as an immediate antecedent to General Practice Nurses' behaviour.

Participants were blinded to treatment allocation to avoid selection bias in the CKD-DETECT trial. However, the nature of the intervention may have meant they were able to determine the study arm to which they had been randomised. Finally, the low response rate (i.e. number of participants in the study) and incomplete responses mean that results may not be representative of General Practice Nurses across Australia.

8.5 Recommendations

8.5.1 Recommendations for future research

Results of this program of work indicate several opportunities for further research. They are listed below in point form:

1. Additional research is required to explore whether the findings of the elicitation study are consistent in metropolitan, rural or remote general practice settings. Studies in this area should consider using focus groups or face to face interviews as an addition to online data collection methods. A more in-depth approach to data collection may reveal further salient factors that influence screening behaviour in the general practice setting.
2. Instrument development is an iterative process. Despite this program of work confirming the face and content validity, further research is required to establish the psychometric integrity of the instruments. Due to the scholarly time restraints of this work, the reliability of the instruments was not established. Consequently, further research is required to measure their stability using a test-retest reliability method.
3. Results demonstrated that e-learning was effective in improving Chronic Kidney Disease knowledge however, pre-post knowledge scores were low. Future research could consider comparing e-learning with a lower fidelity comparator. Given the specificity and relative simplicity associated with risk factors and what constitutes best practice screening, learning dosage (i.e. time required to learn) and effectiveness could be measured between the use of e-learning and an infographic style education tool.
4. Clinical decision making is complex. Future research should explore shared decision making in the general practice setting. Particular consideration should made to identify environmental, workplace and

cognitive factors that influence decision making. Future interventions can then be developed that are more sensitive to the factors that influence nurses in this area. In view of the findings of the elicitation study reported in Chapter 3 and studies that have reported role tensions (Halcomb, Salamonson, Davidson, Kaur, & Young, 2014; McInnes, Peters, Bonney, & Halcomb, 2017b), future research should consider testing new models of care delivery in the general practice setting. These models should incorporate the scope of practice of nurses, improve inter-professional collaboration and the utilisation of nurses' skills and knowledge.

5. In the absence of a claimable Medicare item number for screening, future research should investigate ways to improve the volitional control of nurses to initiate a kidney health check. Any research in this area should consider inter-professional or team-based interventions with a focus on improving collaborative shared decision making, and understanding scope of practice, which will benefit patients and business models in general practice.
6. As previously identified, the pre-post knowledge instrument demonstrated that general practice nurses' baseline knowledge was poor. There is a need for future research in this area. Given the positive results of the CKD-DETECT trial, e-learning is an effective medium to distribute educational opportunities. After successful completion of this program of work funding will be sought to revise the program and enable free access to all Australian General Practice Nurses.
7. Despite being ideally positioned to lead chronic kidney disease screening initiatives, considerable barriers still remain that prevent General Practice Nurses from providing this service. Considering that existing research (Halcomb, Salamonson, Davidson, Kaur, & Young, 2014; McInnes, Peters, Bonney, & Halcomb, 2017b) has described a disconnect

between GPs understanding of the General Practice Nurses' role and their actual scope of practice, it would be prudent to measure the effectiveness of interventions that use inter-professional education approaches to promote better collaboration and improve shared decision making. This is all the more important given that health care professional behaviours are considered habitual when conducted in a stable context, and entrenched behaviours are more difficult to change (Gardner, 2015).

8. Professional relationships between nurses and doctors in general practice have been cited as problematic (Halcomb and Ashley, 2017). Collaborative practice underpins the delivery of safe and effective health care regardless of the health setting. Future research should consider collaborative, team-based interventions that require practice nurses and general practitioners to work collaboratively to develop models of care that focus on improving chronic disease screening and management practices in the absence of current claimable Medicare item numbers.
9. Finally, it may be prudent to test alternative approaches to educating health care professionals or conducting mass screening efforts to improve the early detection of chronic kidney disease. Further research could consider the use of public health campaigns to increase screening rates. This has been a successful approach for educating the public to ask their GPs about smoking cessation (Durkin, Brennan, & Wakefield, 2012), breast screening (Jacobsen & Jacobsen, 2011), skin checks for melanoma (Brunssen, Waldmann, Eisemann, & Katalinic, 2017), and bowel cancer screening (Martini, Morris, & Preen, 2016). Health promotion campaigns are effective strategies which positively influence health behaviour (Noar, Bell, Kelley, Barker, & Yzer, 2018). Future research could consider targeted campaigns to shift the focus from health care professionals to the community identifying whether they understand risk factors for chronic kidney disease. People with risk factors can then be encouraged

to approach their primary care provider about the need for a kidney health check.

8.5.2 Implications for clinical practice and policy

The barriers to chronic kidney disease screening within the context of this program of work were influenced by activity based funding models, medically defined roles, unfunded time versus competing funded priorities, workplace culture and practices and the absence of an MBS item number for chronic disease screening. These factors vary between and within general practice settings and are known barriers to optimising the General Practice Nurse role (Hoare, Mills, & Francis, 2012; Oelke, Besner, & Carter, 2014). General practice principals (i.e. owners) and funding bodies should consider strategies and incentives to overcome these barriers.

The apparent failure of GPs to appreciate the nurses' scope of practice impedes collaborative practice and can contribute to low job satisfaction and poor retention rates (McInnes, Peters, Bonney, & Halcomb, 2015; McInnes et al., 2017b).

The elicitation study in this thesis revealed that the two most frequently reported factors that prevented nurses from performing screening were unfunded time versus competing funded priorities and the lack of an MBS item number for screening. These factors may not be overcome without the Australian Federal Government introducing a dedicated MBS item number for integrated chronic disease screening. This is not a novel or new recommendation. In 2015, the National Vascular Disease Prevention Alliance made a submission to the Standing Committee on Health Inquiry into best practice in chronic disease prevention and management in primary care. The submission primarily called for the introduction of an integrated health check for the early detection of vascular and related diseases, including chronic kidney disease, which would be facilitated by a dedicated MBS item number.

An integrated approach would be cost effective to chronic disease screening and recognises the interaction between risk factors and numerous vascular and related diseases. In the absence of a dedicated MBS item number for chronic disease screening, interim focus is required on developing more effective collaborative working relationships between nurses and doctors in the general practice setting.

As discussed previously, general practices in Australia are predominantly family owned enterprises where funding is derived from the federally funded universal health care model 'Medicare'. Historically, the general practice service model has developed to be focussed on patient presentation rather than preventative service models of care (Palmer & Short, 2014). In some cases, costs associated with non-claimable services such as chronic disease screening are considered difficult to justify in a private business environment (Sinclair, Day, et al., 2017). Health care delivery reform is required where claimable services are based on disease prevention, and better health outcomes which are underpinned through the provision of evidence based care (Gillam & Siriwardena, 2018). The introduction of payment models that reward prevention and outcomes will require general practices to focus on collaborative models of care.

The expansion of the General Practice Nurse role in Australia is inhibited by the lack of MBS item numbers to cover services that can be managed by nurses. Internationally, fee-for-service models in some countries cover wellness visits and chronic care management services that can be delivered independently by primary health care nurses (Ganguli, Souza, McWilliams, & Mehrotra, 2017). Despite the Australian Governments introduction of practice nurse incentive payments, some doctors do not see this as a payment for service to meet population and service demands (McInnes, Peters, Bonney, & Halcomb, 2017a). Consequently, the current Medicare system should be reviewed with

consideration of payment reform and the re-introduction and expansion of claimable MBS item numbers for services that can be rendered exclusively or collaboratively by General Practice Nurses. Existing Medicare Benefit Schedule items limit nurses' scope of practice and ability to practice autonomously and may encourage some general practices to focus on income generation at the expense of preventative care and screening services.

8.5.3 Recommendations for health care professional education

At the core of this program of work was a targeted e-learning intervention that sought to influence the antecedents of behavioural intention. The results from the CKD-DETECT trial support a compelling argument that further education is required to improve nurses' knowledge and volitional control in chronic kidney disease screening. From the results of phase three of the program of work, the following recommendations for health care professional education are offered:

1. The study identified that General Practice Nurses' baseline knowledge of chronic kidney disease risk factors and screening methods was poor. Peak professional bodies and organisations must ensure that there is a variety of education mediums and opportunities that nurses and other health care professionals can access to improve knowledge in this area.
2. The delivery of best-practice care requires a collaborative effort. In this study, volitional control explained 24% of the variation in participants' behavioural intention to initiate a kidney health check. This suggested that factors that influenced the decision to initiate a kidney health check were inhibited by negative control factors that directly influenced their behavioural intention. These may have included negatively perceived workplace practices and/or culture, fee for service funding models and a poor understanding of nurses' scope of practice in the general practice setting. Developing educational interventions that focus on the more powerful determinants of behavioural intention may produce more

positive behavioural results than reported in the CKD-DETECT trial. The implementation and evaluation of inter-professional educational initiatives in this area are particularly warranted. Inter-professional education opportunities will enable general practitioners and nurses to work collaboratively to identify barriers to opportunistic screening practices and develop strategies to overcome them that are relevant to their workplace.

8.6 Significance of this study: A personal reflection

I have worked in renal nursing for over fifteen years. During that time I have witnessed many people commence emergency haemodialysis as they, for whatever reason, had not been diagnosed with CKD in a timely manner. My colleagues and I refer to this patient population "crash landers". The impact of emergency haemodialysis commencement on this cohort is immeasurable. I have worked with Kidney Health Australia over the past 10 years assisting in the delivery of workshops aimed to improve general practice nurses' understanding of risk factors and how to conduct kidney health checks. Over time I started to question the effectiveness of this approach as we witnessed the number of people in Australia commencing renal replacement therapy increase. When I commenced my PhD, I wanted to understand the barriers to general practice nurses initiating kidney health checks and develop an intervention, which I hoped would improve their ability to do so.

As I sit here now and reflect on the findings and results of this work, there are several significant areas that I, both as an educator and clinician, feel are worthy of mention that I will list here in point form:

1. The results of the systematic review suggested there was insufficient evidence that e-learning was able to influence behaviour or skill development. The studies included in the systematic review were poorly

designed and used favourable comparators which no doubt influenced the results. The CKD-DETECT trial compared two e-learning programs and while we could not demonstrate the effectiveness of the intervention compared to the active control, there was a statistically significant change in behavioural intention by all participants regardless of the group to which they were randomised. As I sit here now, these results do little to convince me of e-learning's place as an educational medium to influence behaviour change. This aligns with the findings of the systematic review in Chapter two which concluded that there is insufficient evidence regarding the effectiveness of e-learning on healthcare professional behaviour

2. The elicitation study identified the barriers to chronic kidney disease screening as complex and multifaceted with many interrelated variables that were both socially and organizationally driven. As an educator, the opportunity to conduct the elicitation study afforded me the opportunity to reflect on how I develop education based activities. When I commenced my PhD, I already had in mind the intervention that I wanted to use for the study. However, after completing the content analysis, I had a cathartic moment where I realised that a knowledge based intervention would not assist in overcoming the barriers to opportunistic screening that participants had described. The opportunity to engage with the literature concerning behaviour change strategies strongly influenced my outlook on developing behavioural change interventions. My hope is that the process that I have described in this thesis and now have begun to report at conferences, influences other educators to consider how they develop initiatives to influence behaviour change.
3. While identifying that General Practice Nurses have limited knowledge of chronic kidney disease, which warrants further work, I am left

considering whether knowledge alone will improve the early detection of people with chronic kidney disease. In short, the answer is no, it will not. I am left with little doubt, that they most effective way to improve the early detection of chronic kidney disease in the general practice setting (without the introduction of an integrated chronic disease screening MBS item number) is to engage in collaborative dialogue between nurses and doctors to identify processes that will work for them in their practice context. Educators, researchers, peak professional bodies, and organisations like Kidney Health Australia should now focus their efforts on initiatives that bring healthcare professionals together to work collaboratively to focus on prevention strategies and achieving the best outcomes for their patients.

8.7 Conclusion

This program of work was the first study to identify the barriers and facilitators of screening and evaluate an intervention specifically designed to target participants' attitudinal, normative and control barriers to chronic kidney disease screening. While this program of work achieved its stated aims, it produced mixed results. However the new knowledge generated makes an important contribution to what is already known on the topic nationally and internationally.

The findings and results of the publications presented in this thesis will inform further educational strategies to improve general practice nurses' knowledge and behaviour in this area. The results provide a persuasive argument for further investment and work in improving knowledge and behavioural intention to initiate opportunistic screening so that we can reduce disease-related morbidity and mortality, through the early detection of people with chronic kidney disease.

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Table of Appendices

Appendix 1: Subject Matter Expert review panel UON HREC approval

HUMAN RESEARCH ETHICS COMMITTEE

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Tracy Levett-Jones**
Cc Co-investigators / Research Students:	**Associate Professor Ashley Kable** **Mr Peter Sinclair**
Re Protocol:	**Expert panel review of two survey instruments**
Date:	**24-Aug-2015**
Reference No:	**H-2015-0296**
Date of Initial Approval:	**24-Aug-2015**

Thank you for your **Initial Application** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.
Your submission was considered under **L1 Low Risk Research Expedited** review by the Chair/Deputy Chair.
I am pleased to advise that the decision on your submission is **Approved** effective **24-Aug-2015**.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.
Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2015-0296**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Best wishes for a successful project.

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

Research Services
Research Integrity Unit
The Chancellery
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 17894
F +61 2 492 17164
Human-Ethics@newcastle.edu.au

Appendix 2: Elicitation study UON HREC approval

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Professor Tracy Levett-Jones**
Cc Co-investigators / Research Students:	**Associate Professor Ashley Kable** **Mr Peter Sinclair**
Re Protocol:	**Investigating practice nurses' beliefs regarding chronic kidney disease screening practices**
Date:	**13-Nov-2015**
Reference No:	**H-2015-0378**
Date of Initial Approval:	**13-Nov-2015**

- Thank you for your **Response to Conditional Approval (minor amendments)** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.
- Your submission was considered under **Expedited** review by the Ethics Administrator.

I am pleased to advise that the decision on your submission is **Approved** effective **13-Nov-2015**.

- In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.
- Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2015-0378**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Best wishes for a successful project.

Professor Allyson Holbrook

Chair, Human Research Ethics Committee

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Appendix 3: Randomised Control Trial UON HREC approval

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Associate Professor Ashley Kable**
Cc Co-investigators / Research Students:	**Professor Tracy Levett-Jones** **Mr Peter Sinclair**
Re Protocol:	**Using e-learning and the theory of planned behaviour to predict behavioural intention in Chronic Kidney Disease screening practices in Australian general practice nurses**
Date:	**16-Nov-2016**
Reference No:	**H-2016-0394**
Date of Initial Approval:	**14-Nov-2016**

Thank you for your **Initial Application** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under **L2 Low Risk Research Expedited** review by the HREC Panel.

I am pleased to advise that the decision on your submission is **Approved** effective **14-Nov-2016**.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request. Your approval number is **H-2016-0394**.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants You may then proceed with the research.

Conditions of Approval

This approval has been granted subject to you complying with the requirements for *Monitoring of Progress*, *Reporting of Adverse Events*, and *Variations to the Approved Protocol* as detailed below.

PLEASE NOTE:
In the case where the HREC has "noted" the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University's HREC.

- ***Monitoring of Progress***

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

- ***Reporting of Adverse Events***

1. It is the responsibility of the person **first named on this Approval Advice** to report adverse events.
2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.
3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form (via RIMS at https://rims.newcastle.edu.au/login.asp) within 72 hours of the occurrence of the event or the investigator receiving advice of the event.
4. Serious adverse events are defined as:
    - Causing death, life threatening or serious disability.
    - Causing or prolonging hospitalisation.
    - Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.
    - Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
    - Any other event which might affect the continued ethical acceptability of the project.

5. Reports of adverse events must include:
    - Participant's study identification number;
    - date of birth;
    - date of entry into the study;
    - treatment arm (if applicable);
    - date of event;
    - details of event;
    - the investigator's opinion as to whether the event is related to the research procedures; and
    - action taken in response to the event.

6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the annual progress report to the HREC.

- ***Variations to approved protocol***

If you wish to change, or deviate from, the approved protocol, you will need to submit an *Application for Variation to Approved Human Research* (via RIMS at https://rims.newcastle.edu.au/login.asp). Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. **Variations must be approved by the (HREC) before they are implemented** except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

Linkage of ethics approval to a new Grant

HREC approvals cannot be assigned to a new grant or award (ie those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

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Appendix 4: Elicitation study recruitment notice for newsletter and social media posts

We are undertaking some research with the aim of understanding what practice nurses think about kidney disease screening practices. Specifically, we would like to understand what practice nurses think are the advantages and disadvantages of screening for kidney disease as well as what social challenges may exist and what control they may or may not have over screening practices in their workplace.

If you are a practice nurse and are interested in contributing to this research, please click on this link https://goo.gl/An1aBR and it will take you to the participant information statement. At the bottom of the participant information statement you will find the link to the study which is totally online. The survey is anonymous and depending on the amount of information you want to provide, we anticipate the survey should take between ten and twenty minutes of your time.

Thank you for considering participating in this research

Pete Sinclair

PhD student

University of Newcastle

Appendix 5: Participant information statement for elicitation study

Chief Investigator Professor Tracy Levett-Jones,
School of Nursing and Midwifery
Faculty of Health and Medicine
University Drive, Callaghan NSW
Ph. 61 0249215699
Tracy.Levett-Jones@newcastle.edu.au

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Participant Information Statement for the Research Project:

Investigating practice nurses' beliefs regarding chronic kidney disease screening processes

Document Version 2.0; dated 6th November, 2015

You are invited to participate in the research project identified above which is being conducted by Professor Tracy Levett-Jones, Associate Professor Ashley Kable and Mr Peter Sinclair (PhD candidate) from the School of Nursing and Midwifery at the University of Newcastle. The research is part of Peter Sinclair's PhD studies at the University of Newcastle and is supervised by Professor Tracy Levett-Jones and Associate Professor Ashley Kable.

Why is the research being done?

This research is part of a wider research project that is investigating the use of e-learning in teaching screening practices for the detection of Chronic Kidney Disease (CKD). The aim of this part of the project is to identify practice nurses beliefs relating to the advantages and disadvantages of screening for CKD as well as identify who they think the most important people or groups of people are, who would approve or disapprove of the screening for CKD. The research also seeks to determine what practice nurses perceive as facilitating factors or barriers which could make it easier or more difficult to screen for CKD in the community.

Who can participate in the research?

Participants will be eligible for the study if they are currently working as a practice nurse in a general practice.

What would you be asked to do?

If you agree to participate, you will be asked to complete an anonymous online survey that asks ten questions relating to the aims of the research. There will be a space for you to provide a response to each question.

Who is the online survey being hosted through and what are their security measures?

The survey for this research will be conducted using the popular online survey tool 'SurveyMonkey.' SurveyMonkey uses the same Secure Sockets Layer (SSL) protocol as online retailers and banking organisations. SSL creates a secure connection between the user and the SurveyMonkey server to encrypt the information being transmitted through the web page. SurveyMonkey also complies with the Health Insurance Portability and Accountability (HIPAA) Act which sets further standards for protecting sensitive data. If you would like further

information on the security features of SurveyMonkey please see https://www.surveymonkey.com/mp/take-a-tour/?ut_source=header

What choice do you have?

Participation in this research is entirely your choice. Your completion of the online survey will be taken as implied consent. Because your responses are anonymous, once you complete the survey, your data cannot be withdrawn. Whether or not you decide to participate, your decision will not disadvantage you in any way.

How long will this take?

The time anticipated to answer these questions will vary depending on the amount of information you choose to provide. We estimate that it may take between 10-20 minutes to complete.

What are the risks and benefits of participating?

There are no direct benefits for completing the online survey. However, your responses will inform the development of an e-learning program to support continuing professional development opportunities in the area of Chronic Kidney Disease as well as the formulation of a survey related to this area of care delivery. There are no anticipated risks for participating in this research.

How will your privacy be protected?

Due to the anonymous nature of the survey the responses you provide will not be identifiable. You are not required to provide any identifying personal information unless you identify that you would like to be provided with a summary of the results at the end of this research project. If you would like a copy of the summary of findings please email peter.sinclair@uon.edu.au and the researcher will send you a summary of the results when they have been completed. Additionally, all data collected from the study will be securely stored for a minimum of five years as per University of Newcastle requirements on the chief investigators password protected computer in a locked office at the University of Newcastle.

How will the information collected be used?

Data collected during this study will inform the development of an e-learning program and survey related to chronic kidney disease screening. The data will also form the basis of papers submitted for publication in scholarly journals and at professional conferences. No individuals or organisations will be identified in any of these fora. Non-identifiable data may also be shared with other parties to encourage scientific scrutiny and to contribute to further research and public knowledge, or as required by law. Finally, the data will form part of a thesis to be submitted for Peter Sinclair's doctor of philosophy degree.

What do you need to do to participate?

Please read this information statement and be sure you understand its contents for you consent to participate in this study. If there is anything you do not understand or you have any questions, please contact Peter Sinclair, whose details are listed below. Please also consider printing and retaining a copy of this information statement for your own personal records.

To participate in this study, please follow the link here https://www.surveymonkey.com/r/HPNES to the online survey. Clicking on this link will be taken as informed and implied consent that you are willing to participate in this research.

If you would like further information about this research please contact:

Peter Sinclair	Professor Tracy Levett-Jones,
School of Nursing and Midwifery	School of Nursing and Midwifery
Faculty of Health and Medicine	Faculty of Health and Medicine
University Drive, Callaghan NSW	University Drive, Callaghan NSW
Ph. 02 49217436	Ph. 02 49215699
Peter.Sinclair@uon.edu.au	Tracy.Levett-Jones@newcastle.edu.au

Thank you for considering this invitation.

Complaints about this research

This project has been approved by the University of Newcastle's Human Research Ethics Committee, approval number: H-2015-0378. Should you have concerns about your rights as a participant in this research, or if you have a complaint about the manner in which the research is conducted, it may be given to the researcher (Peter Sinclair via peter.sinclair@uon.edu.au) or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au

Appendix 6: Participant information statement for randomised control trial

Chief Investigator Associate Professor Ashley Kable

School of Nursing and Midwifery

Faculty of Health and Medicine

University Drive, Callaghan NSW

T: +61 2 4921 6334

E: Ashley.Kable@newcastle.edu.au

Information Statement for the Research Project:

Using e-learning to improve kidney disease screening practices in general practice

Document Version 1; Dated 14/09/16

You are invited to participate in the research project identified above which is being conducted by Associate Professor Ashley Kable, Professor Tracy Levett-Jones and Mr Peter Sinclair from the School of Nursing and Midwifery at the University of Newcastle.

The research is part of Mr Peter Sinclair's doctoral studies at the University of Newcastle, supervised by Associate Professor Ashley Kable and Professor Tracy Levett-Jones.

Why is the research being done?

Previous research has identified the challenges some Australian practice nurses face screening for chronic kidney disease (CKD) in the general practice setting. This research has demonstrated that knowledge alone is not enough to influence screening practices. The intervention for this research has been designed to

address these challenges and will evaluate an e-learning program designed to improve kidney disease screening practices in general practice settings. If proven effective, practice nurses will have the knowledge and skills to effectively implement cost effective CKD screening practices in their workplace, which may in turn, influence renal mortality and morbidity in vulnerable 'at risk' populations.

Who can participate in the research?

We are seeking participants who are currently working in a nursing aligned role (eg. practice nurse) in a general practice in Australia. If you have not worked in a general practice nursing aligned position in the past 12 months then unfortunately you are not eligible to participate

What would you be asked to do?

If you agree to participate, you will be randomised to one of two online education programs designed to address the barriers to CKD screening in general practice. These programs were developed as part of a multi-phase research program, have been peer reviewed, are evidence based and represent the final phase of the research. You will be asked to provide some non-identifying demographic information and then complete a two part survey relating to your existing CKD knowledge and your opinions about CKD screening in your workplace. You will then commence the online program you are allocated to and finally complete the survey questions at the end of the program to evaluate its effectiveness in terms of knowledge improvement and the programs ability to provide you with realistic strategies to assist you in improving CKD screening where you work. You will also be asked a series of questions to evaluate your satisfaction with the online program. The time spent participating in this research is eligible towards your nursing continuing professional development (CPD) hours and a CPD certificate will be emailed to you within seven days of you completing the final survey.

If you wish to participate, click the internet link below to register for the study. You will be taken to a registration page where you will be required to enter your name, email address, postcode and a question relating to how long you have worked as a general practice nurse. These will used for three purposes: 1. To assist in randomisation; 2. To enable us to notify you of the e-learning module you will be allocated to (An independent research assistant who is bound by a confidentiality agreement will allocate you an identification number and email you the link to your allocated program within 72 hours of registration) and; 3. To send you your CPD certificate of completion for you to use as part of your annual CPD hours. Your name and email address will not be

revealed to the research team and will not be used for any purpose other than those described here.

Participants completing all surveys will be entered in to a prize draw to win one of the three $100.00 Coles Group and Myer gift vouchers to be drawn at the end of the research.

Who is the online survey and e-learning program being hosted through and what are their security measures?

The e-learning program and its associated surveys will be conducted using 'Questionmark Perception' (https://www.questionmark.com/content/questionmark-perception) - an e-learning assessment tool that is hosted on the University of Newcastle secure servers. The University of Newcastle servers uses the same Secure Sockets Layer (SSL) protocol as online retailers and banking organisations. SSL creates a secure connection between the user and the University of Newcastle server to encrypt the information being transmitted through the web page. If you would like further information on the security features of 'Questionmark Perception' please contact peter.sinclair@newcastle.edu.au

What choice do you have?

Participation in this research is entirely your choice. Only those people who give their informed consent will be included in the project. Whether or not you decide to participate, your decision will not disadvantage you. If you do decide to participate, you may withdraw from the project at any time prior to submitting your completed survey. Please note that due to the anonymous nature of the survey, you will not be able to withdraw your response after it has been submitted. Similarly, if you decide that you do not wish to continue the online learning program, for whatever reason, you can do this and your decision will not disadvantage you.

If you do decide to participate, you may withdraw from the project at any time (eg up to the point of publication) without giving a reason and have the option of withdrawing your data.

How much time will it take?

The time to complete the online education program will depend on how you interact with it. We anticipate that it will take you between 60 and 90 minutes

depending on which group you are randomised to. You do not have to complete the program in one sitting and can log back in, with the login that will be emailed to you at commencement to complete it at a time that is convenient you.

***What are the risks and benefits associated with participating*?**

There are no anticipated risks associated with participating in this research. Participants will be able to claim this time for Continuing Professional Development (CPD) hours as part of the inherent requirements for maintaining competency to practice as a nurse with the Australian Health Practitioner Regulation Agency. If results demonstrate the effectiveness of e-learning in improving CKD screening practices, the research methods and intervention development processes used in this study will be easily transferable to similar practice contexts. Furthermore, if proven effective, practice nurses will be better placed with the requisite knowledge and skills to effectively screen for CKD, which may in turn, influence renal mortality and morbidity in vulnerable 'at risk' populations.

At the conclusion of the research phase of this project, the module will be redesigned according to the results of the satisfaction survey and then made freely available to all nurses via multiple organisation based e-learning platforms including the Renal Society of Australasia.

How will your privacy be protected?

If you decide to participate in this research, an independent research assistant, who has signed a confidentiality agreement, will allocate you a study identification number and add your name, email address and study number to a database. Identifying data (i.e. participants' names, email addresses and study identification numbers) will be stored on a password protected computer file only accessible by the research assistant. This database will be digitally deleted once the final study data has been collected and all participants have had their certificate of completion emailed to them. The research assistant will only provide the researchers with participant study identification numbers, no identifying information will be provided to the researchers. Consequently, all survey information is anonymous and it will not be possible for the research team to identify you from your answers. Access to the data generated from the survey will be restricted to the research team. All data will be kept on a secure password protected computer for a minimum period of five years. After which all data will be digitally deleted following University of Newcastle protocol for disposing of confidential data. Weekly data back-ups will be saved to a secure

university network drive and cloud server which is only accessible by the research team and is password protected.

How will the information collected be used?

The data will also form the basis of papers submitted for publication in scholarly journals and at professional conferences. No individuals or organisations will be identified in any of these fora. Non-identifiable data may also be shared with other parties to encourage scientific scrutiny and to contribute to further research and public knowledge, or as required by law. Finally, the data will form part of a thesis to be submitted for Peter Sinclair's Doctor of Philosophy degree. If you would like a copy of the summary of findings please email peter.sinclair@uon.edu.au and the researcher will send you a summary of the results when they have been completed.

***What do you need to do to participate*?**

Please read this Information Statement and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have questions, contact the researcher.

If you would like to participate, please tick the associated consent and eligibility statements below and click on the submit button.

Further information

If you would like further information please contact either

Peter Sinclair	Associate Professor Ashley Kable
School of Nursing and Midwifery	School of Nursing and Midwifery
Faculty of Health and Medicine	Faculty of Health and Medicine
University Drive, Callaghan NSW	University Drive, Callaghan NSW
Ph. 02 49217436	Ph. 02 4921 6334
Peter.Sinclair@uon.edu.au	Ashley.Kable@newcastle.edu.au

Thank you for considering this invitation.

Peter Sinclair	Associate Professor Ashley Kable
PhD Candidate	Supervisor

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. H-2016-0394

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Services, NIER Precinct, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 4921 6333, email Human-Ethics@newcastle.edu.au.

Appendix 7: CKD-DETECT recruitment web landing page example

STUDY ENROLMENT PAGE

Name *

Email *

Postcode *

General practice nursing experience *

- ○ I have < 10 years of general practice nursing experience
- ○ I have 10+ years of general practice nursing experience

Participation information statement

Information Statement for the Research Project
Using e-learning to improve kidney disease screening practices in general practice

You are invited to participate in the research project identified above which is being conducted by Associate Professor Ashley Kable, Professor Tracy Levett-Jones and Mr Peter Sinclair from the School of Nursing and Midwifery at the University of Newcastle.

The research is part of Mr Peter Sinclair's doctoral studies at the University of Newcastle, supervised by Associate Professor Ashley Kable and Professor Tracy Levett-Jones.

Consent *

- ☐ I am a nurse who has worked in a general practice setting within the last 12 months
- ☐ I understand my personal information will remain confidential to the researchers and I have had the opportunity to have my questions answered to my satisfaction
- ☐ I understand I can withdraw from the project at any time up to the point of publication without giving a reason for withdrawing
- ☐ I consent to completing the e-learning program/s and surveys associated with this research
- ☐ I have read the participant information statement above and agree to participate in this research and give my consent freely

Recaptcha

☐ I'm not a robot — reCAPTCHA Privacy - Terms

SUBMIT

Appendix 8: Publication copyright

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Licensed Content Publisher	Elsevier
Licensed Content Publication	International Journal of Nursing Studies
Licensed Content Title	The effectiveness of Internet-based e-learning on clinician behaviour and patient outcomes: A systematic review
Licensed Content Author	Peter M. Sinclair,Ashley Kable,Tracy Levett-Jones,Debbie Booth
Licensed Content Date	May 1, 2016
Licensed Content Volume	57
Licensed Content Issue	n/a
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Type of Use	reuse in a thesis/dissertation
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Expected completion date	Jan 2019
Estimated size (number of pages)	250
Requestor Location	Peter Sinclair 10 William Streeet New Lambton, NSW 2305 Australia Attn: Peter Sinclair

Appendix 9: Online supplementary files from elicitation study

Online supplementary file 1: General Practice Nursing in Australia

Practice nurses are integral members of the primary care team in the general practice (GP) setting and are crucial to the success of the primary care agenda. In Australia, a GP nurse can be either an enrolled nurse (EN), usually certificate or diploma qualified; registered nurse (RN), usually degree qualified; or nurse practitioner (NP) employed in the GP. Their scope of practice is governed by their registration status (i.e. RN or EN), advanced practice roles (i.e. clinical nurse specialist), post registration credentialing and/or endorsement (i.e. NP). In some GP settings, unqualified healthcare workers such as assistants in nursing may also be employed. In a 2014 report, there was an estimated 12,322 nurses working in Australian GP;[15] approximately 64% of practices employ at least one nurse and, on average of 2.7 nurses are employed per GP nationally.[16] The role of GP nurses continues to broaden as a result of Australian federal government initiatives including incentives for employing practice nurses and the addition of Medicare Benefit Scheme (MBS) item numbers specific to nursing services that are delivered independently of the general practitioner.[17] However, the scope and autonomy with which GP nurses deliver preventative and health promotion services is restricted to the conditions of their employment and context of their workplace culture and practices.[18] Practice nurses are ideally placed to lead screening programs and collaborate with general practitioners for the early detection of CKD.[4] However, it is not known whether nurses working in GP settings in Australia possess the requisite knowledge and skills to lead these screening programs, or whether their scope of practice and the culture within GP settings affords them the opportunity to do so. Consequently, the study described in this paper sought to identify the behavioural (attitudinal), normative and perceived control beliefs relating to CKD opportunistic screening practices of GP nurses working in a regional area

of New South Wales, Australia. For the purposes of this study, opportunistic screening was defined as performing a kidney health check (i.e. Blood pressure, urinary albumin-creatinine ration and a blood test for creatinine to determine estimated glomerular filtration rate) on high risk individuals in the general practice setting, without symptoms of kidney disease. [1,2]

Online supplementary file 2: The Theory of planned behaviour

The TPB asserts that the immediate antecedent of behaviour is intention.[27] Intention is influenced by three predictor variables, behavioural beliefs (attitudinal), subjective norms and perceived behavioural control (PBC). Attitudes are influenced by knowledge, values and beliefs derived from experience and reflect an individual's positive or negative beliefs about performing a given behaviour, in this case opportunistic CKD screening, and whether they are in favour of carrying it out. Subjective norms relate to the individual's perception of social pressure from significant others (for example: general practitioners, practice managers, practice nurses, other practice staff, or patients) to undertake the target behaviour, and their motivation to conform to such pressure. Finally, PBC represents the degree of control the individual perceives they have over the factors that facilitate or inhibit the target behaviour.[28,29] This recognises that while an individual may have the intention to carry out a specific behaviour they also need to have the opportunity, resources and support in order to do so.[30] Figure 1 provides a diagrammatic representation of the relationship between behavioural beliefs, subjective norms, perceived behavioural control, intention and actual behaviour.

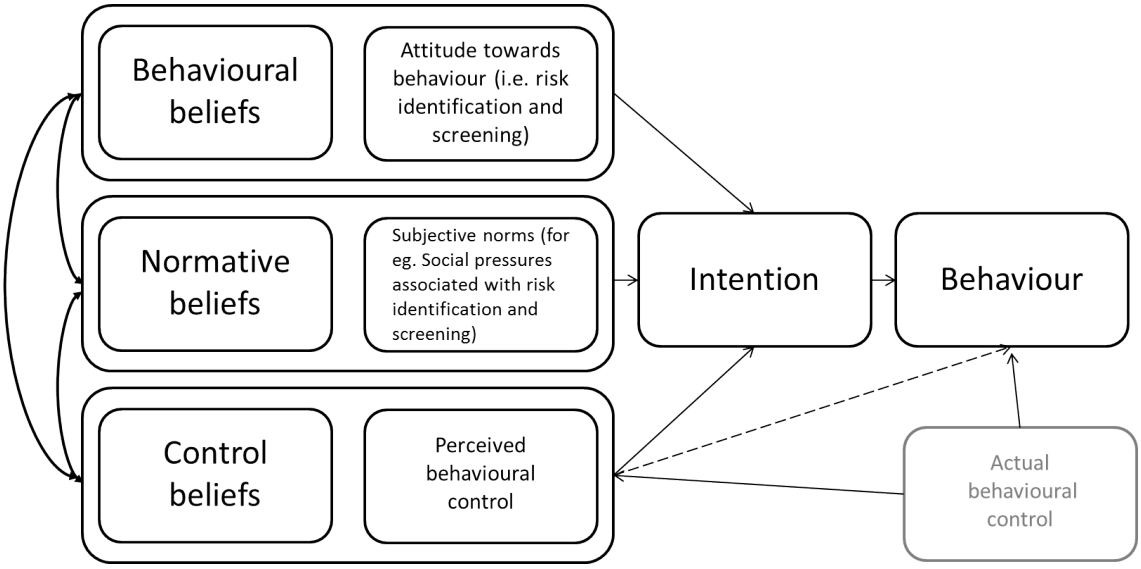

Figure 1: The theoretical constructs of the theory of planned behaviour (Adapted from Ajzen, 2002)

Online Supplementary file 3: Elicitation study questions

Question	Construct
1. What do you believe are the advantages of screening for Chronic Kidney Disease during a nursing consultation?	Behavioural (attitudinal) beliefs (positive)
2. What do you believe are the disadvantages of screening for Chronic Kidney Disease during a nursing consultation?	Behavioural beliefs (negative)
3. Do you have any further comments, personal views or opinions about screening for Chronic Kidney Disease during a nursing consultation?	Behavioural beliefs (general attitude)
4. Are there any individual or groups in your workplace (or elsewhere) who would approve of you screening for Chronic Kidney Disease during a nursing consultation? If so, whom and why?	Normative beliefs (positive)
5. Are there any individual or groups in your workplace (or elsewhere) who would disapprove of you screening for Chronic Kidney Disease during a nursing consultation? If so, whom and why?	Normative beliefs (negative)
6. Do you have any further comments regarding other people's views, whether positive or negative, about screening for Chronic Kidney Disease during a nursing consultation?	Normative beliefs (general)
7. What factors or circumstances enable you to screen for Chronic Kidney Disease during a nursing consultation in your current workplace?	Control beliefs (positive)
8. Are there any barriers or other issues that come to mind when you think about screening for Chronic Kidney Disease during a nursing consultation in your current workplace?	Control beliefs (negative)

Online Supplementary file 3. Open ended questions utilised in the online elicitation survey and associated constructed measured

Online supplementary file 4: Tables 2A and 2B

Advantages	Participant quotes	Frequency (*n* = 26)	Response %
Early detection and treatment	*Early diagnosis leading to better outcomes. Better patient care mapping and understanding of health care needs* (Participant 4) *Early identification in order to manage chronic disease early and maintain health* (Participant 13)	20	77
Reduction of disease burden	*…that [CKD] will be detected and treated, assisting in stabilising or reducing the effects on the cardiovascular system, burden on the patient in terms of quality of life now and in the future as well as the cost on the health care system* (Participant 12) *Nursing consults usually allow more time to discuss conditions and lifestyle changes that can improve health* (Participant 22)	16	62
Increased awareness and prevent CKD	*- A nurse can provide simple advice such as eat less salt or processed food, explain dehydration and kidney function relationship, blood pressure and kidney function relationship* (Participant 7) *- To increase awareness and provide information and education to patients about prevention of CKD* (Participant 19) *- Promoting patient awareness of kidney health. Many patients with high blood pressure are unaware of the link to CKD so a nursing consultation is a good opportunity to educate patients* (Participant 21)	9	35

Table 2A: Behavioural (attitudinal) beliefs - Most frequently reported advantages of screening for Chronic Kidney Disease in nursing consultations (*n*=26)

Disadvantages	Supportive quotes (Participant number)	Frequency (*n* = 26)	Response %
Impost on time and competing clinical priorities	*…with so many other conditions and the acute nature of when patients are often present* (that*) there are often minimal opportunities to screening for anything other than the incident (or condition) that is directly presented for* (Participant 1) *Time consuming when nursing staff are pressed for time* (Participant 4)	11	42
No disadvantages	*There are never any disadvantages about screening for any chronic disease* (Participant 19)	9	35
Threat of patient harm (stress and financial)	*…patients' not really able to cope with diagnosis* (Participant 3) *Cost to patient if not bulk billed and further testing i.e. blood tests* (Participant 4)	8	31
Knowledge and/or skills deficit identified	*Lack of nurse knowledge to answer questions* [asked] *by patient* (Participant 9) [I am] *not sure what screening to do* (Participant 11)	4	15

Table 2B: Behavioural (attitudinal beliefs) - Most frequently reported disadvantages of screening for Chronic Kidney Disease (*n*=26)

Online supplementary file 5: Tables 3A and 3B

Perceived social supporters	Supportive quotes (Participant number)	Frequency (*n* = 24)	Response %
General practitioners	*Doctors are pro nursing assessment if it provides data for clinical decision making* (Participant 2) *Some GP's welcome the nurses role in screening for chronic diseases and in the role of preventative care* (Participant 20)	18	75
Patient endorsement or approval	*Patients and doctors approve of early identification of disease and improved patient outcomes* (Participant 19)	7	29

Table 3A: Normative beliefs - Most frequently reported individuals or groups perceived to approve of screening for Chronic Kidney Disease (*n*=24)

Perceived social pressures	Supportive quotes (Participant number)	Frequency (*n* = 24)	Response %
Activity based funding model (MBS)	*Screening activity for any chronic disease is not Medicare rebatable so therefore not economical use of nursing time* (Participant 2) *With no specific item number associated with screening activities, it does not get the time required allocated to the task* (Participant 24)	13	54
Medically defined roles	*Some general practitioners practising do not believe the nurse should be screening or consulting with patients as they believe that it is their role, not the nurses. Some patients believe it is their doctor's role to discuss their health concerns, rather than the nurse who is only there to perform basic care* (Participant 15) *Older doctors who are a little set in their ways may not approve, they regard it as a doctor's job!* (Participant 18) *The surgery is so busy and there are not enough nurses to perform screenings as well as the other roles they are employed to do such as immunisations, ECG's, wound dressings etc.* (Participant 22)	10	42
The business	*The practice as a whole has to financially survive in a hostile Medicare environment, additional unfunded services, regardless of patient benefit, are difficult to justify* (Participant 1) *I work in a bulk billing practice, therefore I am limited in the item numbers that I can bill for* (Participant 13)	7	29

Table 3B: Normative beliefs - Most frequently reported individuals or groups perceived to disapprove of screening for Chronic Kidney Disease (*n*=24)

Online supplementary file 6: Table 4

Enablers	Response %	Barriers	Response %
Funded Existing screening protocols or initiatives in the setting (45- 49 year-old health assessment)	65	Unfunded time versus competing funded priorities	80
Presence of known risk factors	35	Lack of Medicare item number	60
Relationship with patients	15	Impact on patient	40
		Practice business rules	36

Table 4: Perceived behavioural control - Most frequently reported factors that enable or prevent screening for Chronic Kidney Disease in the general practice setting (*n*=26)

Appendix 10: Publication copyright – Nephrology

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License date	May 21, 2019
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Licensed Content Publication	Nephrology
Licensed Content Title	Barriers and facilitators to opportunistic chronic kidney disease screening by general practice nurses
Licensed Content Author	Peter M Sinclair, Jenny Day, Tracy Levett-Jones, et al
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Licensed Content Volume	22
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Type of use	Dissertation/Thesis
Requestor type	Author of this Wiley article
Format	Print and electronic
Portion	Full article
Will you be translating?	No
Title of your thesis / dissertation	Using e-learning and the theory of planned behaviour to predict behavioural intention in Chronic Kidney Disease screening practices in Australian practice nurses
Expected completion date	Jan 2019
Expected size (number of pages)	250
Requestor Location	Peter Sinclair 10 William Streeet New Lambton, NSW 2305 Australia Attn: Peter Sinclair

Appendix 11: SME face & content validity rating instrument for learner satisfaction, knowledge evaluation and TPB-CKDISI tools

1 - Not relevant/Clear & concise, 2 - Somewhat relevant/Clear & concise, 3 - Quite relevant/Clear & concise, 4 - Highly relevant/Clear & concise

1 - Highly ambiguous, 2 - Somewhat ambiguous, 3 - Quite clear, 4 - Not ambiguous at all

Question	Item difficulty rating	Criteria	Rating (please tick as appropriate)				Comments
			1	2	3	4	
1		Relevant					
		Clear & concise					
		Ambiguous					
2		Relevant					
		Clear & concise					
		Ambiguous					
3		Relevant					
		Clear & concise					
		Ambiguous					
4		Relevant					
		Clear & concise					
		Ambiguous					
5		Relevant					
		Clear & concise					

		Ambiguous					
Etc…		Relevant					
		Clear & concise					
		Ambiguous					

Please rate this survey instrument overall regarding its ability to evaluate [ENTER CONSTRUCT] as whole. This instrument is:

1. Extremely suitable 2. Suitable 3. Adequate 4. Inadequate for evaluating [ENTER CONSTRUCT] (Please circle)

Is there any unnecessary repetition of questions? If so which ones?

Are there any knowledge questions that should have been included and appear to have been omitted?

Is there any further demographic information that has been overlooked?

Other comments

Appendix 12: Theory of Planned Behaviour Chronic Kidney Disease Identification and Screening Instrument

Scenario:

John Smythe is a 62 year old man with a history of hypertension. He smokes a packet of cigarettes a day, his alcohol intake is 6 units per week and his BMI is 32kg/m^2.

John presents to your practice setting and tells you he feels lethargic and has shortness of breath on exertion.

Variable/ Construct	Item type	Alpha	Item-total correlation	Item wording
Behavioural intention				1. Would you initiate a Kidney Health Check for John? YES ☐ NO ☐ 2. How difficult was it for you to make this decision? (Very Difficult >>> Very Easy)
Behavioural intention				3. Would you have a conversation with a General Practitioner about initiating a Kidney Health Check on John? YES ☐ NO ☐ 4. How difficult would it be to have a conversation with a General Practitioner about initiating a Kidney Health Check if this scenario occurred in your workplace (Very Difficult >>> Very Easy)
Attitude		0.868	.	
Attitude ↑awareness	Belief Strength ---------- Outcome evaluation	0.839	0.718	5. Performing a Kidney Health Check improves patient awareness of CKD [Strongly Agree >>> Strongly Disagree] 6. Improving the awareness of CKD in patients considered at risk of CKD is [Very Important >>> Not important] to me
Attitude ↑awareness	Belief Strength ---------- Outcome evaluation	0.830	0.776	7. Performing a Kidney Health Check would allow me the opportunity to provide information about kidney health to my patients [Strongly Agree >>> Strongly Disagree] 8. Patient education about kidney health, particularly those considered at risk for CKD is [Very Important >>> Very unimportant] to me
Attitude ↑ prevention	Belief Strength ---------- Outcome evaluation	0.834	0.757	9. Performing a Kidney Health Check may help prevent CKD in at risk patients [Strongly Agree to Strongly Disagree] 10. Preventing CKD in people with known risk factors is [Very Important >>> Very unimportant] to me

Variable/ Construct	Item type	Alpha	Item-total correlation	Item wording
Attitude ↑prevention	Belief Strength ---------- Outcome evaluation	0.836	0.746	11. Early detection of CKD means that evidence-based management strategies can be initiated to prevent disease progression [Strongly Agree >>> Strongly Disagree] 12. Preventing disease progression through the early treatment of CKD is [Very Important >>> Very unimportant] to me
Attitude ↓ disease burden	Belief Strength ---------- Outcome evaluation	0.847	0.672	13. Identifying CKD early may assist in diminishing the disease burden experienced by patients [Strongly Agree >>> Strongly Disagree] 14. Decreasing patient disease burden is [Very Important >>> Very unimportant] to me
Attitude Early detection	Belief Strength ---------- Outcome evaluation	0.832	0.777	15. Performing a Kidney Health Check may help detect CKD from an early stage [Strongly Agree >>> Strongly Disagree] 16. The early detection of CKD is [Very Important >>> Very unimportant] to me
Attitude Impost on time	Belief Strength ---------- Outcome evaluation	0.915	0.179	17. Initiating a Kidney Health Check takes time that I do not have [Strongly Agree >>> Strongly Disagree] 18. Having to initiate a Kidney Health Check when I am time poor is [Very Difficult >>> Very Easy]
Subjective norms		0.800	.	
Subjective norms General Practitioner	Injunctive item ---------- Motivation to comply	0.718	0.682	19. The General Practitioner/s where I work would expect me to initiate a Kidney Health Check on patients I identify as being at risk of CKD [Strongly Agree >>> Strongly Disagree] 20. Doing what General Practitioner/s expect of me is [Very Important >>> Very unimportant]
Subjective norms General Practitioner	Injunctive item ---------- Motivation to comply	0.700	0.724	21. The General Practitioner/s where I work would expect me to review patients for CKD risk factors [Strongly Agree >>> Strongly Disagree] 22. General Practitioners expectations about what I should do are [Very Important >>> Very unimportant] to me
Subjective norms Medically defined roles	Injunctive item ---------- Motivation to comply	0.829	0.459	23. Practice Nurses think that General Practitioners and Practice Nurses should work together to initiate Kidney Health Checks [Strongly Agree >>> Strongly Disagree] 24. Other practice nurses views and perspectives are [Very Important >>> Very unimportant] to me

Variable/ Construct	Item type	Alpha	Item-total correlation	Item wording
Subjective norms Medically defined roles	Injunctive item ---------- Motivation to comply	0.747	0.619	25. General Practitioners where I work would [Always approve>>>> Never approve] of me initiating Kidney Health Checks 26. General Practitioners expectations about me initiating Kidney Health Checks is [Very Important >>> Very unimportant] to me
Perceived behavioural control		0.860	.	
PBC Unfunded time	Control strength ---------- Control power	0.853	0.535	27. Screening for CKD is **not** an economical use of nursing time [Strongly Agree >>> Strongly Disagree] 28. Initiating a Kidney Health Check is [Very Easy >>> Very Difficult] for me because it is **not** an economical use of my time
PBC Lack of MBS item #	Control strength ---------- Control power	0.838	0.653	29. It is difficult to justify unfunded Kidney Health Checks, despite the potential benefits for the patient [Strongly Agree >>> Strongly Disagree] 30. Even though there is no MBS item number, I am still [Very Likely >>> Very unlikely] to initiate a Kidney Health Check for patients considered at risk
PBC Funded CKD protocols/ programs	Control strength ---------- Control power	0.862	0.460	31. I would be more likely to initiate Kidney Health Checks if funded screening protocols (MBS item numbers) or programs exist [Strongly Agree >>> Strongly Disagree] 32. It is [Very Easy >>> Very Difficult] to justify Kidney Health Checks if they are **not** funded
PBC Practice rules	Control strength ---------- Control power	0.839	0.643	33. Practice Nurses need to discuss the need for Kidney Health Checks with General Practitioners for patients who present with known risk factors [Strongly Agree >>> Strongly Disagree] 34. It is [Very Easy >>> Very Difficult] to discuss the need for a Kidney Health check with a General Practitioner when a patient presents with known risk factors
PBC Practice rules	Control strength ---------- Control power	0.837	0.654	35. I have the confidence to discuss patients who need a Kidney Health Check with a General Practitioner [Strongly Agree >>> Strongly Disagree] 36. Discussing patients who need a Kidney Health Check with a General Practitioner is [Very Easy >>> Very Difficult] for me

Variable/ Construct	Item type	Alpha	Item-total correlation	Item wording
PBC Presence of known risk factors	Control strength ---------- Control power	0.831	0.696	37. If a person presents with known CKD risk factors, a Kidney Health Check should be conducted, regardless of whether there is a claimable MBS item number or not [Strongly Agree >>> Strongly Disagree] 38. I am [Very Likely >>> Very unlikely] to perform a Kidney Health Check due to the lack of an MBS item number
PBC Practice rules	Control strength ---------- Control power	0.819	0.768	39. Being able to initiate a Kidney Health Check when I determine the need for it, is part of the role of a Practice Nurse [Strongly Agree >>> Strongly Disagree] 40. Initiating a Kidney Health Check is [Very Easy >>> Very Difficult] for me

Appendix 13: The CKD Knowledge evaluation instrument

1. In Australia the most common factor that leads to the need for dialysis or kidney transplant is:

a) **Diabetes**

b) Hypertension

c) Glomerulonephritis

d) Hypovolaemia and dehydration

2. Ms Jones is a 65 year old Aboriginal woman. She weighs 80Kg, her BMI is 31kg/m^2 and she has a history of diabetes, hypertension, smoking and chronic obstructive pulmonary disease (COPD). Which of the following should be considered as risk factors for CKD for Ms Jones? (Click all that apply)

a) COPD, diabetes and age

b) Weight, age and Aboriginal or Torres Strait origin

c) Smoking, diabetes and hypertension

d) COPD, smoking and diabetes

3. What are the risk factors for CKD? (Click all that apply)

a) Age > 60 years
b) Aboriginal or Torres Strait origin
c) Male gender
d) Smoking
e) Excessive alcohol intake
f) Diabetes Mellitus
g) Hypertension
h) Obesity
i) Age > 50 years
j) Established cardiovascular disease
k) Excessive NSAID use
l) Family history of CKD
m) A history of Acute Kidney Injury (AKI)

4. Harold is a 63-year-old gentleman with a history of hypertension, type II diabetes mellitus and coronary artery disease. His BMI is 34kg/m^2 and he presents to your practice complaining of an exacerbation of his gout. He consumes approximately six units of alcohol per week and is a non-smoker. From this example what risk factors does Harold have that predispose him to CKD?

a) His age
b) Hypertension
c) Type II diabetes mellitus
d) Coronary artery disease
e) A BMI of 34kg/m^2
f) Gout
g) Alcohol consumption
h) His smoking status

5. Which of the following risk factors indicate the need to perform an initial kidney health check? (Click all that apply)

a) Sedentary lifestyle
b) History of dementia
c) Chronic smoker
d) Presence of cardiovascular disease

6. Today you are reviewing Ms Laurie Jones. Ms Jones presents to your practice with flulike symptoms. Ms Jones is a 32 year old indigenous woman well known to your practice. She has been a 'pack a day' smoker since she was 16. Her father recently received a kidney transplant after being on haemodialysis for four years.

If you were to screen Ms Jones for kidney disease, which of the following are considered 'best practice' for screening? (Click all that apply)

a) Urine dipstick for proteinuria
b) Blood Glucose Check
c) Weight and BMI
d) Urine albumin-creatinine ratio
e) ECG
f) Bladder scan
g) Blood Pressure
h) Blood test for eGFR

7. Australian best practice guidelines for the detection of albuminuria include (Select one only):

a) Urine albumin-creatinine ratio to test for albuminuria

b) Urine dipstick for microalbuminuria

c) 24 hour urine test for protein to determine degree of kidney disease

d) Urine dipstick to test for proteinuria

8. Certain clinical scenarios may lead to possible unreliable or misleading eGFR results. These include: (Click all that apply)

a) Acute changes in kidney function
b) High muscle mass
c) Presence of chronic liver disease
d) High-protein diet
e) High-fat, low carbohydrate diet
f) Older age

9. According to best practice, the kidney health check consists of all of the following except (click all that *do not apply*)

a) Blood pressure
b) Urinary dipstick for protein
c) Urinary dipstick for microalbuminuria
d) Urine albumin-creatinine ratio
e) Urine albumin-protein ratio
f) Blood test for estimated Glomerular Filtration Rate

10. Natasha is a new patient on your practices books. She is a 52–year-old Caucasian female with no significant medical history prior to this presentation. She presents at your practice today complaining of shortness of breath and general fatigue. You obtain the following observations and biochemistry:

Pulse: 82	Respiratory Rate: 18	Potassium: 4.2 mmol/L
Blood Pressure: 154/94 mmHg	Creatinine: 205 µmol/L	HCO3: 28 mmol/L
Temperature: 36.7	Urea: 17.3 mmol/L	eGFR 23 mL/min/1.73m^2

Which of the following is the *best* measure of Ms Jones' kidney function?

a) Serum Creatinine

b) Serum Urea

c) eGFR

d) Serum Potassium

11. Certain clinical scenarios may lead to possible unreliable or misleading urine albumin secretion results. These include: (Click all that apply)

a) Acute changes in kidney function
b) High muscle mass
c) Urinary tract infection
d) Presence of chronic liver disease
e) Acute febrile illness
f) High-fat, low carbohydrate diet
g) Extreme exercise within the past 24 hours
h) Exacerbation of gout

12. A serum creatinine is used to calculate the eGFR. When calculating the eGFR what other factors are taken into the equation? (Click all that apply)

a) Urea
b) Age
c) Gender
d) Albumin

Appendix 14: Results of face and content validity process for the LSAeL instrument

Sub-scale	Item	Pre/ post review	I-CV$_r$	p_c	k	Rating[a]	I-CV$_c$	p_c	k	Rating[a]
Gain attention (Q1-4)										
Discrete item	1	Pre	1.00	0.031	1.00	Excellent	0.60	0.310	0.42	Weak
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	2	Pre	0.60	0.310	0.42	Weak	1.00	0.031	1.00	Excellent
		Post[b]								
Stem item and 4 sub items	3	Pre	0.60	0.310	0.42	Weak	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Stem item and 3 sub items	4	Pre	1.00	0.031	1.00	Excellent	0.60	0.310	0.42	Weak
		Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Goal description (Q5-10)										
Discrete item	5	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	6	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	7	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	8	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	9	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	10	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Stimulate recall of prior knowledge (Q11-12)										
Stem item and 2 sub items	11	Pre	1.00	0.031	1.00	Excellent	0.80	0.155	0.76	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	12	Pre	1.00	0.031	1.00	Excellent	0.60	0.310	0.42	Weak
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent

Present the material to be learned (Q13-22)										
Stem item and 4 sub items	13	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Stem item and 4 sub items	14	Pre	1.00	0.031	1.00	Excellent	0.40	0.310	0.13	Poor
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	15	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	16	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	17	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	18	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	19	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	20	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	21	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	22	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Provide guidance for learning (Q23-24)										
Discrete item	23	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	24	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Elicit performance practice (Q25-26)										
Stem item and 3 sub items	25	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	26	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Feedback provision (Q27)										
Stem item and 4 sub items	27	Pre	1.00	0.031	1.00	Excellent	0.80	0.155	0.76	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent

Performance assessment (Q28-30)										
Discrete item	28	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Discrete item	29	Pre	1.00	0.031	1.00	Excellent	0.60	0.310	0.42	Weak
		Post[b]				Remove				Remove
Discrete item	30	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Enhance knowledge retention and transfer (Q31-32)										
Discrete item	31	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Stem item and 2 sub items	32	Pre	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
		Post	1.00	0.031	1.00	Excellent	1.00	0.031	1.00	Excellent
Final S-$CV_{relevance}$: 1.0 S-$CV_{clarity}$: 1.0 UA: 100%										

Table XYZ: Results of the content validation process of the LSAeL

I-CV: Item Content Validity; I-CV_r: I-$CV_{relevance}$; P_c: probability of random agreement; K: modified kappa coefficient obtained by the relevant proportion of agreements: [a]Evaluation criteria of k: poor ≤ 0.39, weak = 0.40–0.59; good = 0.60–0.73; excellent ≥ 0.74 according to Fleiss (1981); SS-CVI: I-CVI average of items in the sub-scale; I-CV_c: I-$CV_{clarity}$; [b] Item removed from instrument during review

Appendix 15: Learner Satisfaction with Asynchronous e-Learning (LSAeL) instrument

Sub-scale and Items	
Gain attention	
1. The introductory video/s captured my attention	
2. The introductory video/s provided a sound rationale for the module	
3. The introductory video/s explained how the learning objectives were relevant to my practice	
Identify goals and logical presentation of content	
4. The module/s provided clear learning objectives	
5. I understood what I needed to do to complete the module	
6. The content of the module aligned with the learning objectives	
7. The resources available to me in the module assisted me to achieve the learning objectives	
8. The layout of the module/s was user-friendly	
9. The module/s provided questions that were easy to understand	
Resources and strategies to enhance content delivery	
10. The module/s enabled me to use my existing knowledge and experience as a foundation for new learning	
11. The module/s utilised audio elements effectively	
12. The module/s utilised video elements effectively	
13. The module/s utilised animations and graphics effectively	
14. The module/s presented the right amount of information for the topic	
Maintain attention	
15. The module/s provided useful content	
16. The module/s provided interesting content	
17. The module/s provided engaging content	
18. The module/s motivated me to learn	
19. The module/s posed questions that required me to think carefully	
20. The module/s used multimedia that maintained my interest	
Elicit performance practice	
21. The module/s offered a variety of ways to assess my learning	
22. The module/s provided questions that adequately assessed my learning	
Provide informative feedback and consolidate learning	
23. The 'pop-up' boxes helped me recall important information	
24. The module/s provided feedback that was beneficial to my learning	
25. The module/s provided feedback that showed me where or why my response was incorrect (if applicable)	
26. The module/s provided me with results and feedback at an appropriate time	
27. The module/s made it easy for me to evaluate my understanding of the learning objectives	
Flexible navigation and knowledge transfer	
28. The introductory/help pages gave me clear instructions about how to progress through the module/s	
29. I will be able to apply what I have learned from this module/s to my clinical practice	
30. The module/s enabled me to review additional content if or when I needed to.	

Appendix 16: Demographic data collected

1. Gender: O Male O Female O Transgender / Intersex / Unspecified

2. Age:

3. What is the postcode of your workplace address where you work as a practice nurse?

4. What is the primary language spoken in your home

O English O other

If other, what is the primary language that you speak at home?

5. How many, if any, other primary health care nurses work at your primary workplace?

6. How many general practitioners work at your primary workplace?

7. Approximately, how many patients are registered at your practice? (i.e. How many patients are on your practices 'books'?)

8. Is your primary place of work a 'bulk billing' practice O Yes O No

Your nursing career

Which of the following describes your current job title best?

9. O An enrolled nurse O An endorsed enrolled nurse

O A registered nurse O A nurse practitioner

O Other If other, what is your current job title?

10. How many hours do you work per week on average in the general practice setting?

11. How many years have you been working as a nurse?

12. How many years in total have you worked as a practice nurse?

13. Which of the following Chronic Kidney Disease (CKD) education resources have you participated in, or accessed, in the previous five years? (click all the apply)

O Face to face workshop

O e-learning program

O Journal article

O Pharmaceutical representative visit

O Webcast

O None of the above

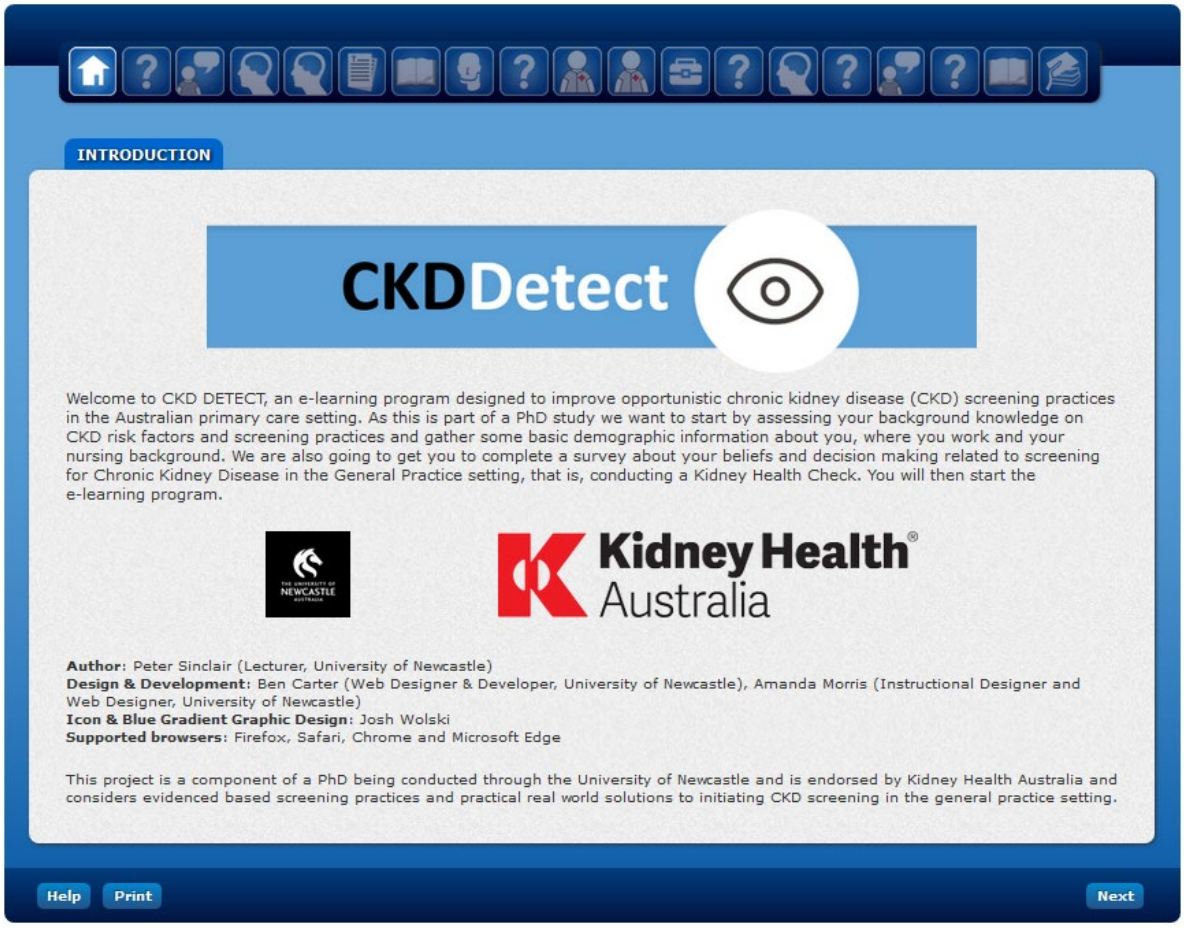
O Other

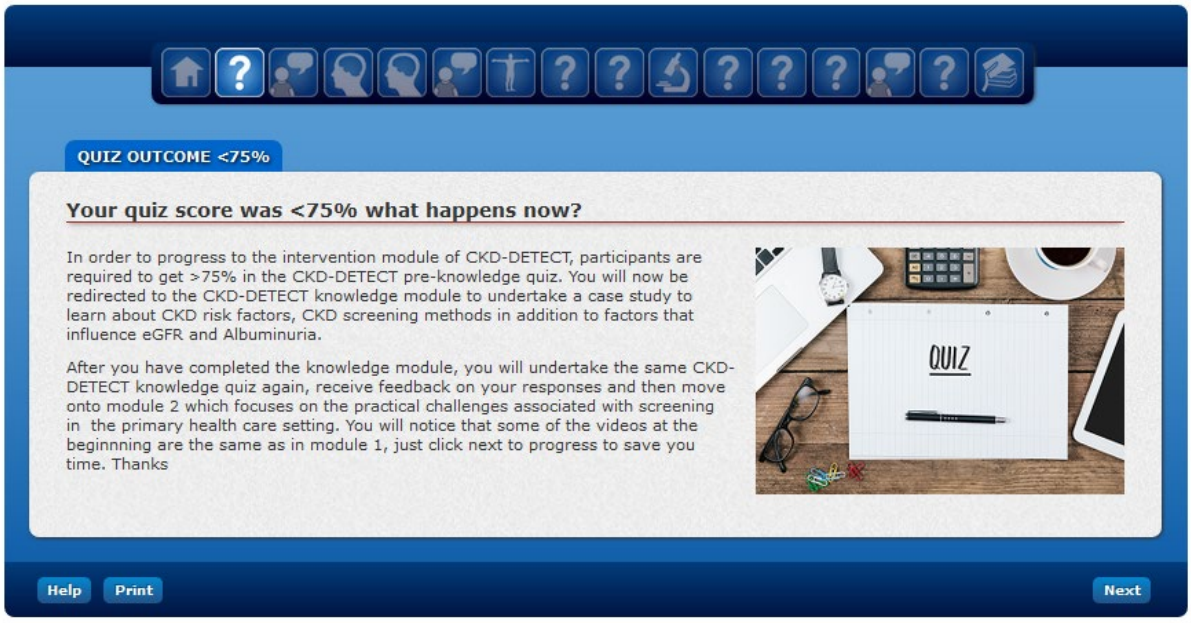
If other, please describe in the space provided below

Appendix 17: Copyright permission: Nursing and Health Sciences

License Number	4187331416360
License date	Sep 13, 2017
Licensed Content Publisher	John Wiley and Sons
Licensed Content Publication	Nursing & Health Sciences
Licensed Content Title	High engagement, high quality: A guiding framework for developing empirically informed asynchronous e-learning programs for health professional educators
Licensed Content Author	Peter M. Sinclair,Tracey Levett-Jones,Amanda Morris,Ben Carter,Paul N. Bennett,Ashley Kable
Licensed Content Date	Jan 16, 2017
Licensed Content Pages	12
Type of use	Dissertation/Thesis
Requestor type	Author of this Wiley article
Format	Print and electronic
Portion	Full article
Will you be translating?	No
Title of your thesis / dissertation	Using e-learning and the theory of planned behaviour to predict behavioural intention in Chronic Kidney Disease screening practices in Australian practice nurses
Expected completion date	Jan 2019
Expected size (number of pages)	250
Requestor Location	Peter Sinclair 10 William Streeet New Lambton, NSW 2305 Australia Attn: Peter Sinclair
Publisher Tax ID	EU826007151
Billing Type	Invoice
Billing address	Peter Sinclair 10 William Streeet New Lambton, Australia 2305 Attn: Peter Sinclair

Appendix 18: Pictorial representation of Module 1 (Knowledge – active control)





INTRODUCTION

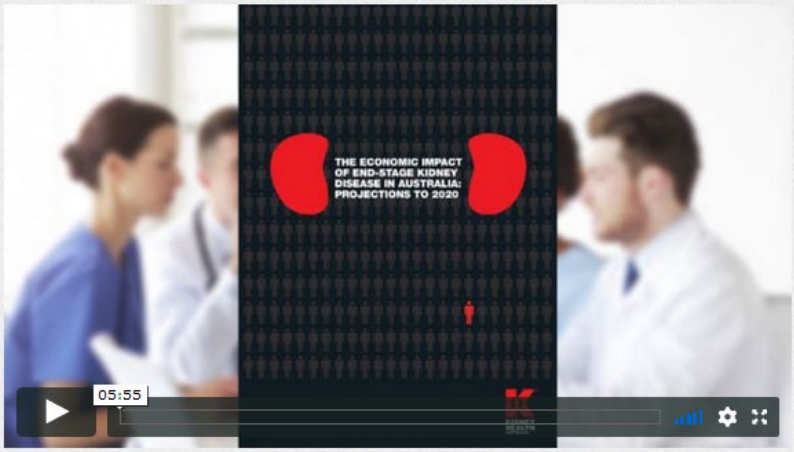
LEARNING OUTCOMES

- Identify the major risk factors for developing chronic kidney disease
- Describe the best practice screening method for early chronic kidney disease

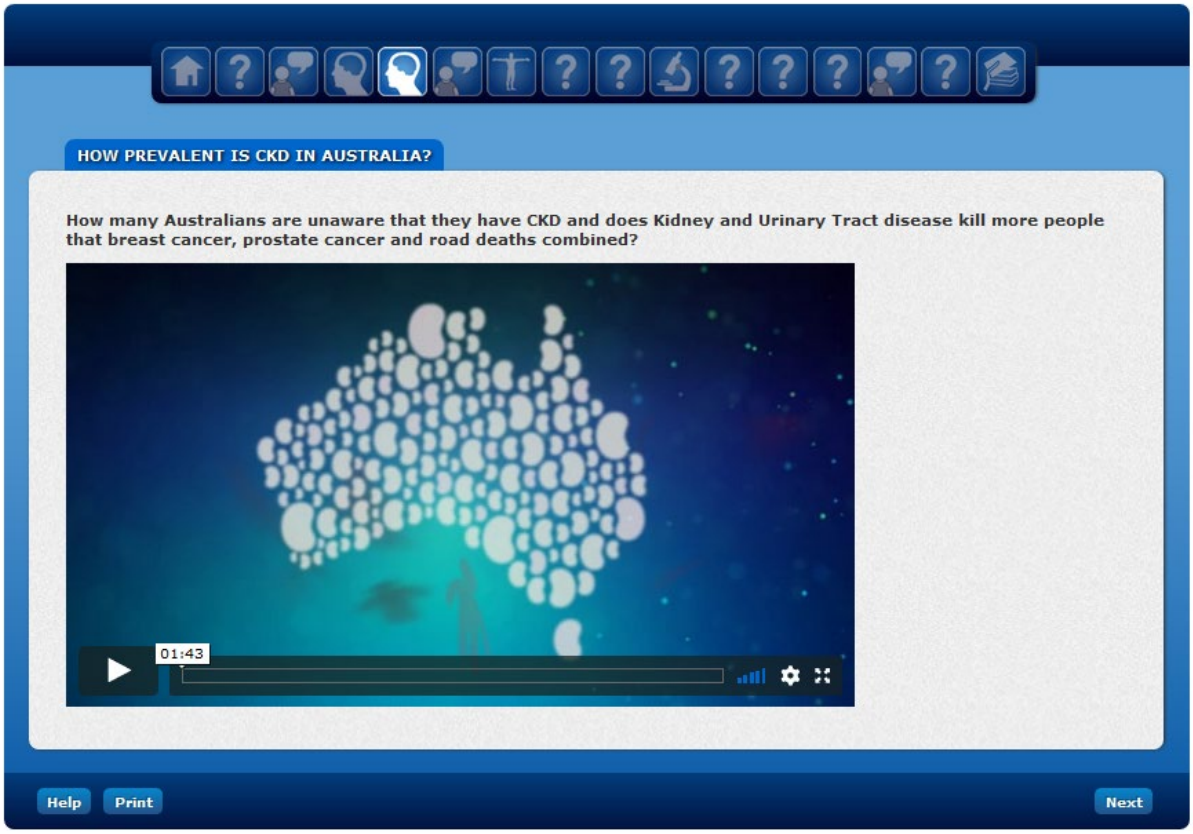
Help Print Next

THE ECONOMIC AND PERSONAL COST OF KIDNEY DISEASE IN AUSTRALIA

Watch this short video to learn more about the impact of CKD on people's lives and our health system.



Help Print Next


HOW PREVALENT IS CKD IN AUSTRALIA?
How many Australians are unaware that they have CKD and does Kidney and Urinary Tract disease kill more people that breast cancer, prostate cancer and road deaths combined?
01:43
Help
Print
Next


MEET JOHN ANDERSON
00:29
The details from John's last GP visit two years ago are outlined below:
Personal Details
Age: 62
Gender: Male
Marital status: Married
Occupation: Farmer
Social/Family history
Smoking: 20-25 cigarettes per day
Alcohol: 2-3 units 5 nights per week
Past medical history
Type II diabetes (diet controlled)
Hypertension
Osteoarthritis
Help
Print
Next

PHYSICAL ASSESSMENT

Physical assessment

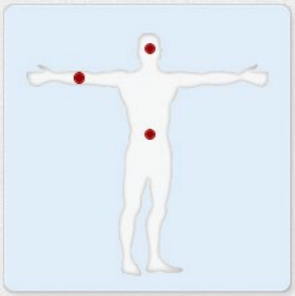
You assess John prior to him seeing the GP. Click the red markers to reveal your findings, then use the BMI calculator on the right to calculate John's BMI before proceeding.

Observations

Assessment: General lethargy
Oedema: Nil signs
Lung: Sounds clear
JVP: Not elevated
Skin: Dry, poor turgor
Mucous membranes: Slightly dry

Observations

Height: 175cm
Weight: 93kg
T: 36.3
P: 94
R: 18
BP: L=162/88
$Sa0_2$: 97%



Hide all

(weight in kg) (height in metres)^2

Enter John's height in cm: 175

Enter John's weight in kg: 93

John's BMI ? = 30.37

Clear | Calculate BMI

BMI	John's BMI result
<18.5	Underweight
18.5-24.9	Acceptable
25-29.9	Overweight
≥30	Obese

Medications

Ibuprofen: 400mg prn
Paracetamol SR ? (Panadol Osteo): 665mg prn

QUESTION AND ASSESSMENT

CKD Risk Factors

Drag and drop the risk factors that predispose John to CKD to their correct columns in the table below:

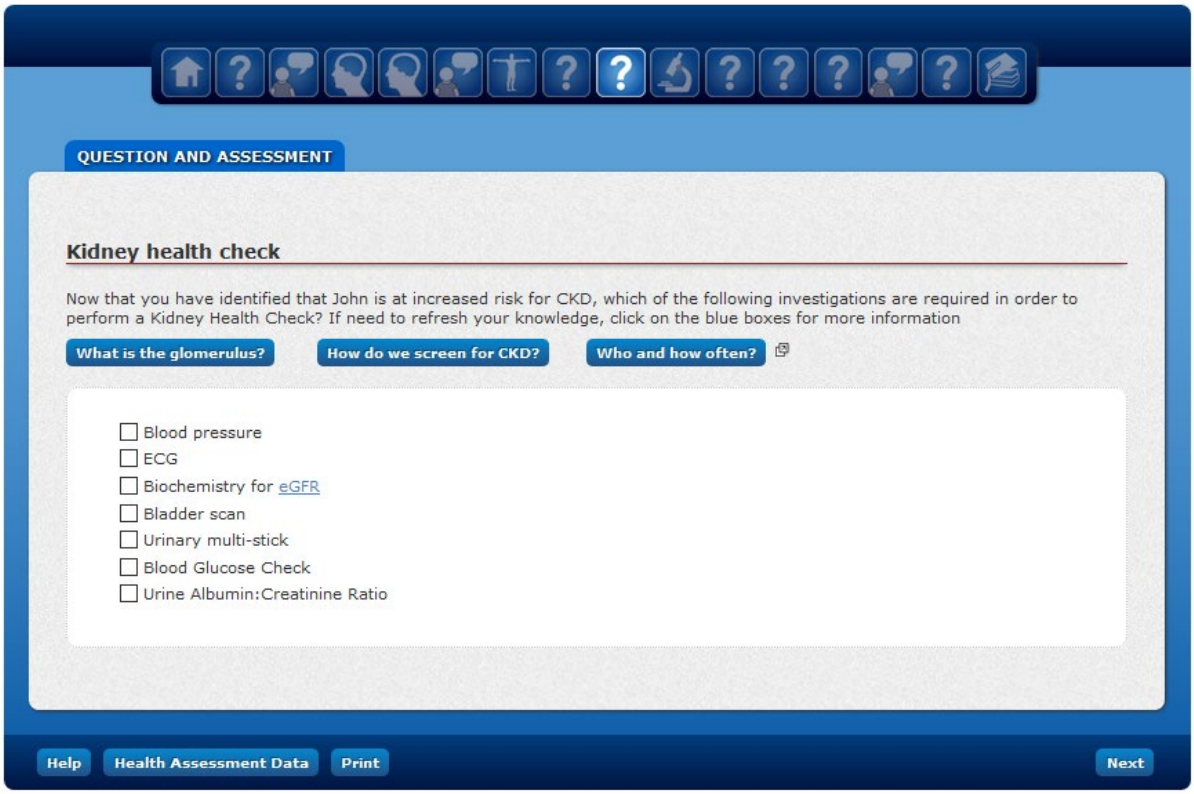
CKD risk factor	CKD Risk factor (not relevant in this scenario)	Not a CKD risk factor

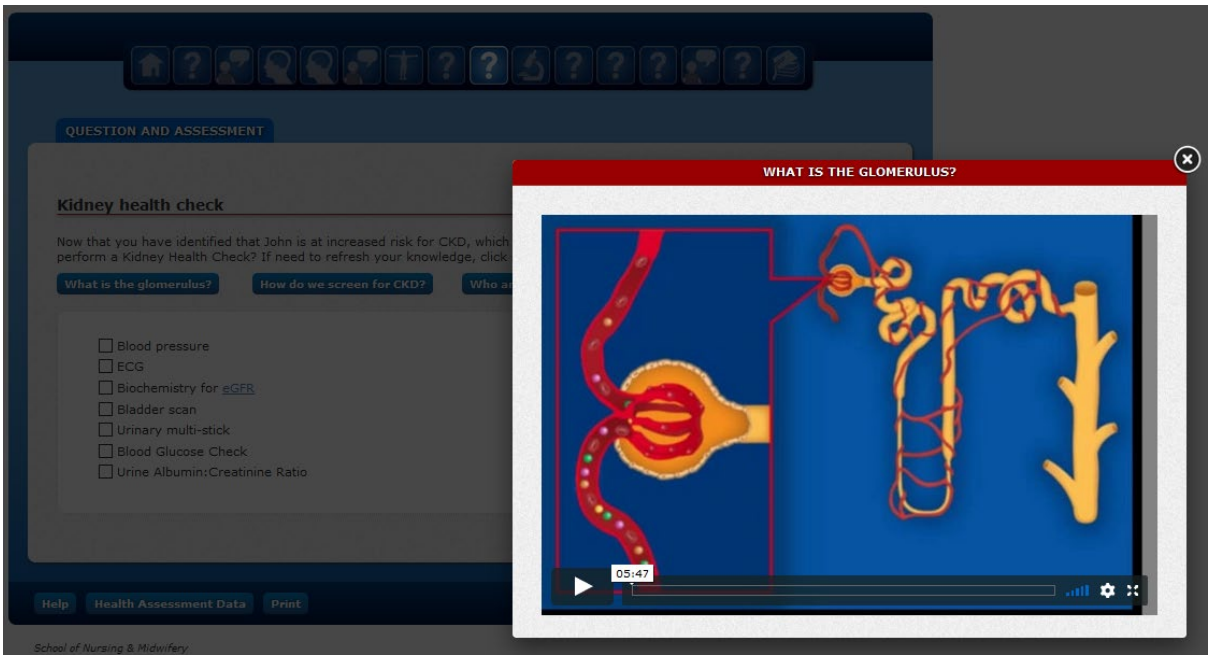
NSAID use | 60+ 60 years or older | Obesity | Diabetes | Aboriginal or Torres Strait Islander | Heart problems or stroke | Family history | History of acute kidney injury | Sedentary lifestyle | Smoker | High blood pressure | COPD

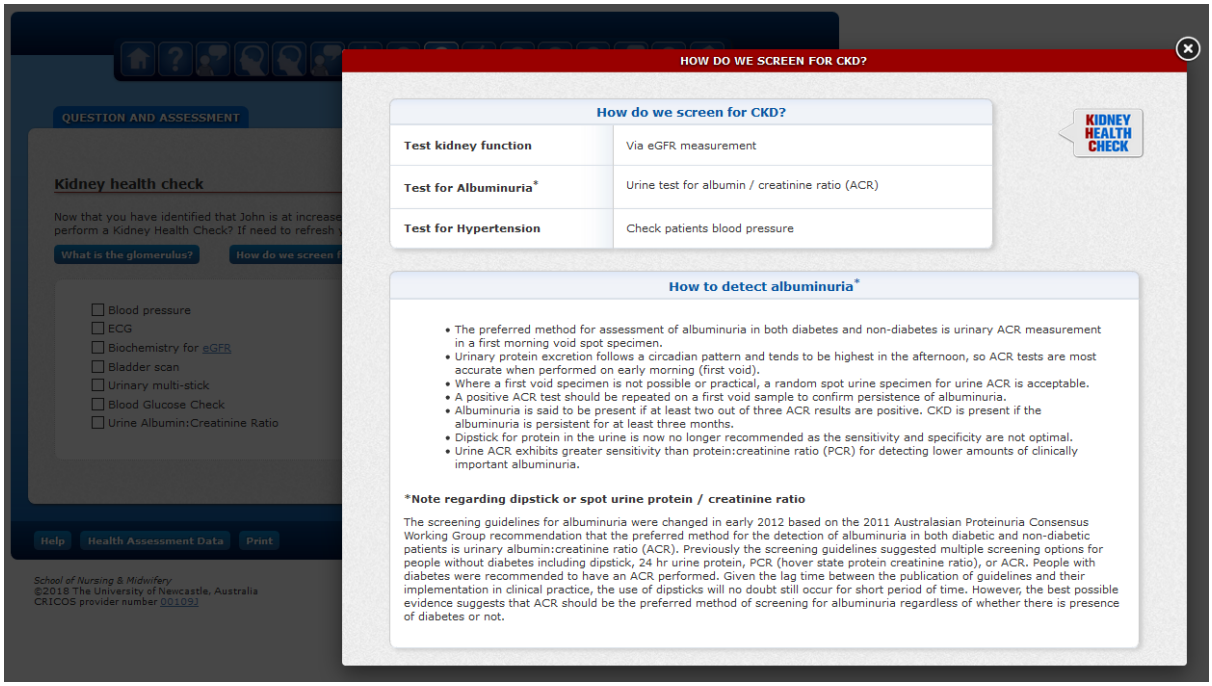
Is John at increased risk of CKD?

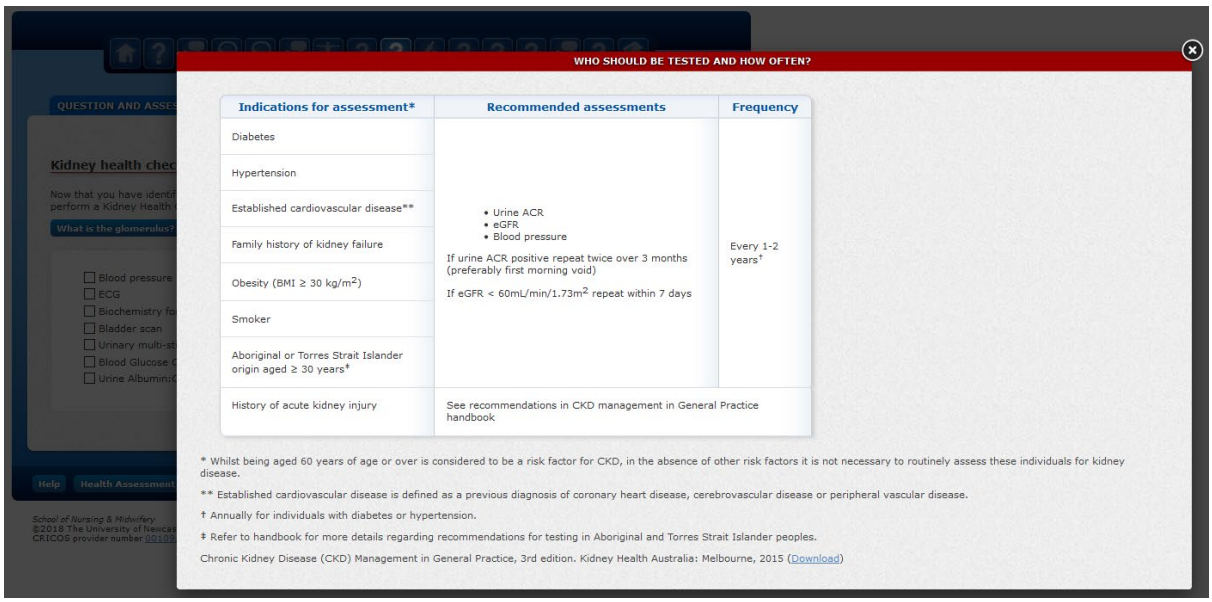
- ◯ No
- ◯ Yes

Help | Health Assessment Data | Print | Next


QUESTION AND ASSESSMENT
Kidney health check
Now that you have identified that John is at increased risk for CKD, which of the following investigations are required in order to perform a Kidney Health Check? If need to refresh your knowledge, click on the blue boxes for more information
What is the glomerulus?
How do we screen for CKD?
Who and how often?
Blood pressure
ECG
Biochemistry for eGFR
Bladder scan
Urinary multi-stick
Blood Glucose Check
Urine Albumin:Creatinine Ratio
Help
Health Assessment Data
Print
Next


QUESTION AND ASSESSMENT
Kidney health check
WHAT IS THE GLOMERULUS?
05:47
Help
Health Assessment Data
Print
School of Nursing & Midwifery


QUESTION AND ASSESSMENT
Kidney health check
Now that you have identified that John is at increase
perform a Kidney Health Check? If need to refresh
What is the glomerulus?
How do we screen
Blood pressure
ECG
Biochemistry for eGFR
Bladder scan
Urinary multi-stick
Blood Glucose Check
Urine Albumin:Creatinine Ratio
Help
Health Assessment Data
Print
School of Nursing & Midwifery
©2018 The University of Newcastle, Australia
CRICOS provider number 00109J
HOW DO WE SCREEN FOR CKD?
How do we screen for CKD?
Test kidney function
Via eGFR measurement
Test for Albuminuria*
Urine test for albumin / creatinine ratio (ACR)
Test for Hypertension
Check patients blood pressure
KIDNEY HEALTH CHECK
How to detect albuminuria*
• The preferred method for assessment of albuminuria in both diabetes and non-diabetes is urinary ACR measurement in a first morning void spot specimen.
• Urinary protein excretion follows a circadian pattern and tends to be highest in the afternoon, so ACR tests are most accurate when performed on early morning (first void).
• Where a first void specimen is not possible or practical, a random spot urine specimen for urine ACR is acceptable.
• A positive ACR test should be repeated on a first void sample to confirm persistence of albuminuria.
• Albuminuria is said to be present if at least two out of three ACR results are positive. CKD is present if the albuminuria is persistent for at least three months.
• Dipstick for protein in the urine is now no longer recommended as the sensitivity and specificity are not optimal.
• Urine ACR exhibits greater sensitivity than protein:creatinine ratio (PCR) for detecting lower amounts of clinically important albuminuria.
*Note regarding dipstick or spot urine protein / creatinine ratio
The screening guidelines for albuminuria were changed in early 2012 based on the 2011 Australasian Proteinuria Consensus Working Group recommendation that the preferred method for the detection of albuminuria in both diabetic and non-diabetic patients is urinary albumin:creatinine ratio (ACR). Previously the screening guidelines suggested multiple screening options for people without diabetes including dipstick, 24 hr urine protein, PCR (hover state protein creatinine ratio), or ACR. People with diabetes were recommended to have an ACR performed. Given the lag time between the publication of guidelines and their implementation in clinical practice, the use of dipsticks will no doubt still occur for short period of time. However, the best possible evidence suggests that ACR should be the preferred method of screening for albuminuria regardless of whether there is presence of diabetes or not.


WHO SHOULD BE TESTED AND HOW OFTEN?
Indications for assessment*
Recommended assessments
Frequency
Diabetes
Hypertension
Established cardiovascular disease**
Family history of kidney failure
Obesity (BMI ≥ 30 kg/m2)
Smoker
Aboriginal or Torres Strait Islander origin aged ≥ 30 years‡
• Urine ACR
• eGFR
• Blood pressure
If urine ACR positive repeat twice over 3 months (preferably first morning void)
If eGFR < 60mL/min/1.73m2 repeat within 7 days
Every 1-2 years†
History of acute kidney injury
See recommendations in CKD management in General Practice handbook
* Whilst being aged 60 years of age or over is considered to be a risk factor for CKD, in the absence of other risk factors it is not necessary to routinely assess these individuals for kidney disease.
** Established cardiovascular disease is defined as a previous diagnosis of coronary heart disease, cerebrovascular disease or peripheral vascular disease.
† Annually for individuals with diabetes or hypertension.
‡ Refer to handbook for more details regarding recommendations for testing in Aboriginal and Torres Strait Islander peoples.
Chronic Kidney Disease (CKD) Management in General Practice, 3rd edition. Kidney Health Australia: Melbourne, 2015 (Download)

PATHOLOGY

John's biochemistry and urine chemistry results

John's blood and urine results are back from the laboratory. Please review his results below. The journal paper titled **Back to Basics: Common Renal Blood Tests** is available below for you to review if required.

John's Blood Results

Item	Value	Units	Ref Range
Sodium	144	mmol/L	(135-145)
Potassium	5	mmol/L	(3.5-5.1)
Chloride	104	mmol/L	(100-110)
Bicarbonate	27	mmol/L	(22-32)
Anion Gap	18	mmol/L	(4-13)
Osmolality		mmol/L	(275-295)
Glucose	**8.4**	mmol/L	(3-7.8)
Urea	**10.9**	mmol/L	(2.9-8.2)
Creatinine	**160**	umol/L	(64-108) Male
eGFR	**39**	mL/min/1.73m^2	(>60)
Protein	69	g/L	(60-83)
Albumin	42	g/L	(35-50)
Calcium	2.37	mmol/L	(2.15-2.55)
Corr Calcium	2.39	mmol/L	(2.15-2.55)
Phosphate	1.43	mmol/L	(0.81-1.45)
Magnesium		mmol/L	(0.7-1.10)

Urine chemistry

Item	Value	Units	Ref Range
Volume	Spot	L	L
Creatinine	14.1	mmol/L	
Albumin	73	mg/L	<30
Albumin/Creat Ratio	5.2	mg/mmol	<2.5(Male)

Back to Basics: Common Renal Blood Tests

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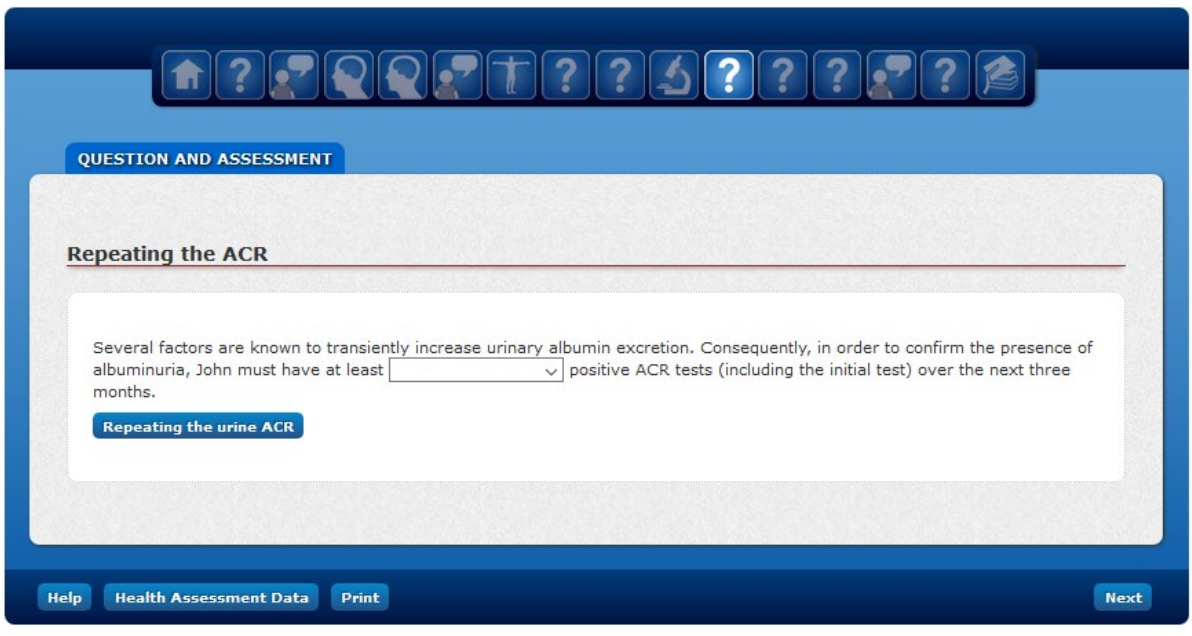

QUESTION AND ASSESSMENT

Repeating the ACR

Several factors are known to transiently increase urinary albumin excretion. Consequently, in order to confirm the presence of albuminuria, John must have at least [ ] positive ACR tests (including the initial test) over the next three months.

Repeating the urine ACR

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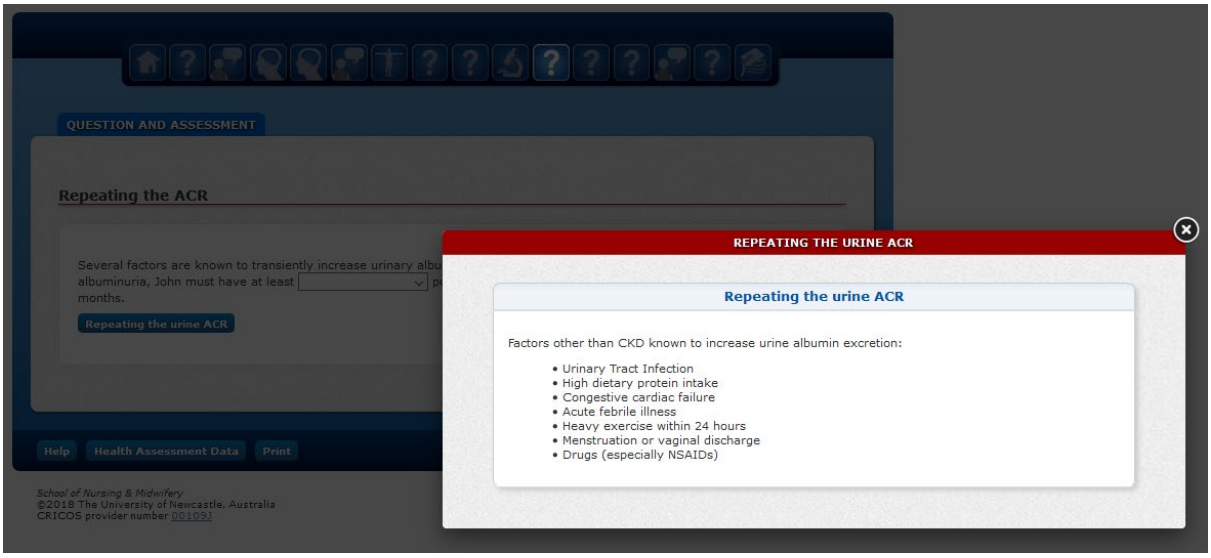
QUESTION AND ASSESSMENT
Repeating the ACR
Several factors are known to transiently increase urinary albu
albuminuria, John must have at least
months.
Repeating the urine ACR
Help
Health Assessment Data
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School of Nursing & Midwifery
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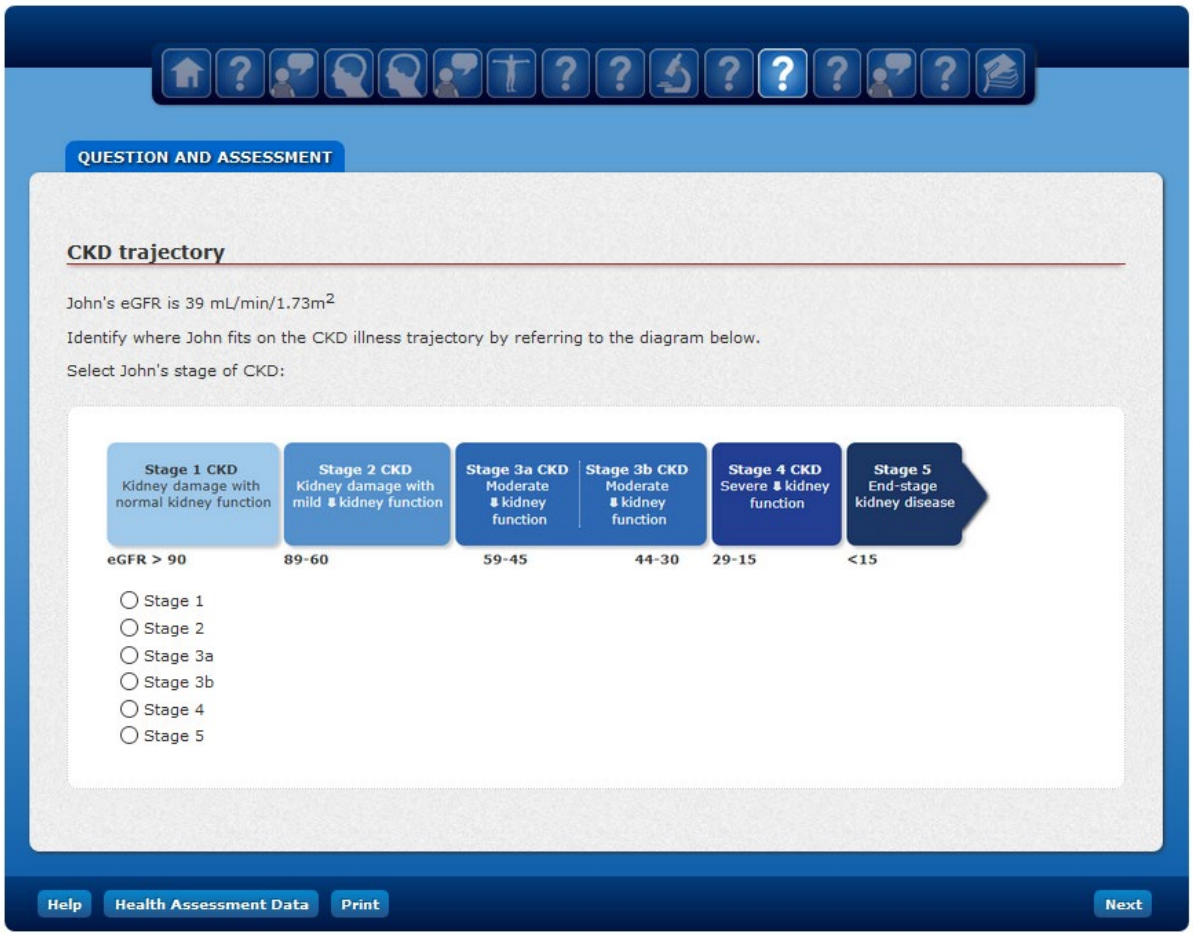
CRICOS provider number 00109J
REPEATING THE URINE ACR
Repeating the urine ACR
Factors other than CKD known to increase urine albumin excretion:
• Urinary Tract Infection
• High dietary protein intake
• Congestive cardiac failure
• Acute febrile illness
• Heavy exercise within 24 hours
• Menstruation or vaginal discharge
• Drugs (especially NSAIDs)


QUESTION AND ASSESSMENT
CKD trajectory
John's eGFR is 39 mL/min/1.73m2
Identify where John fits on the CKD illness trajectory by referring to the diagram below.
Select John's stage of CKD:
Stage 1 CKD
Kidney damage with normal kidney function
Stage 2 CKD
Kidney damage with mild ⬇ kidney function
Stage 3a CKD
Moderate ⬇ kidney function
Stage 3b CKD
Moderate ⬇ kidney function
Stage 4 CKD
Severe ⬇ kidney function
Stage 5
End-stage kidney disease
eGFR > 90
89-60
59-45
44-30
29-15
<15
Stage 1
Stage 2
Stage 3a
Stage 3b
Stage 4
Stage 5
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QUESTION AND ASSESSMENT

Repeating the eGFR

As identified earlier in the module, there are situations where eGFR results may be unreliable and/or misleading. Given that John has an eGFR of <60 mL/min/1.73 m^2, a retest should occur within [ ] to ensure this was not a transient change. In order to support the diagnosis of CKD, a minimum of [ ] reduced eGFR's should be recorded within 3 months

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POST KNOWLEDGE QUIZ

We will re-attempt the knowledge quiz

We will leave module 1 here and redo the knowledge quiz on the next page, after you have done the quiz, you will get your results and then move straight into module 2. Good luck!

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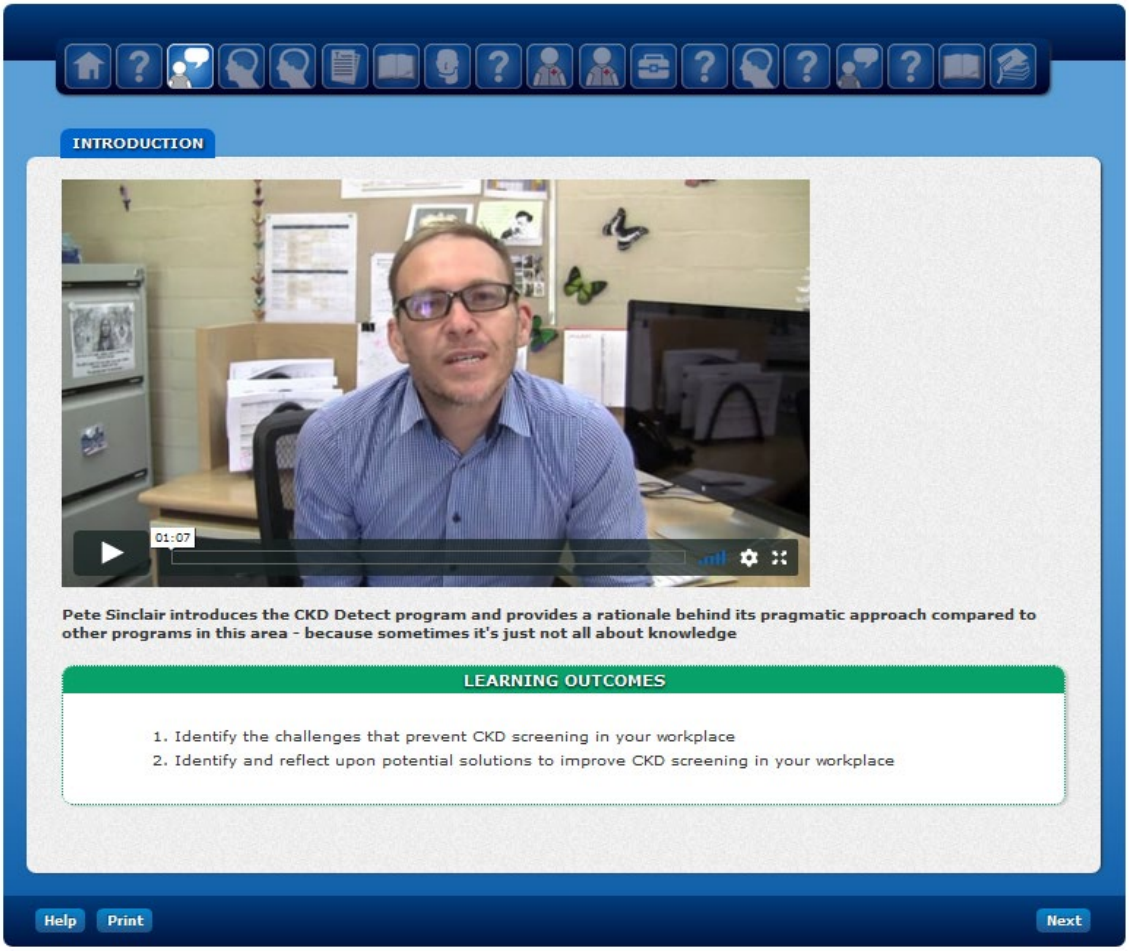
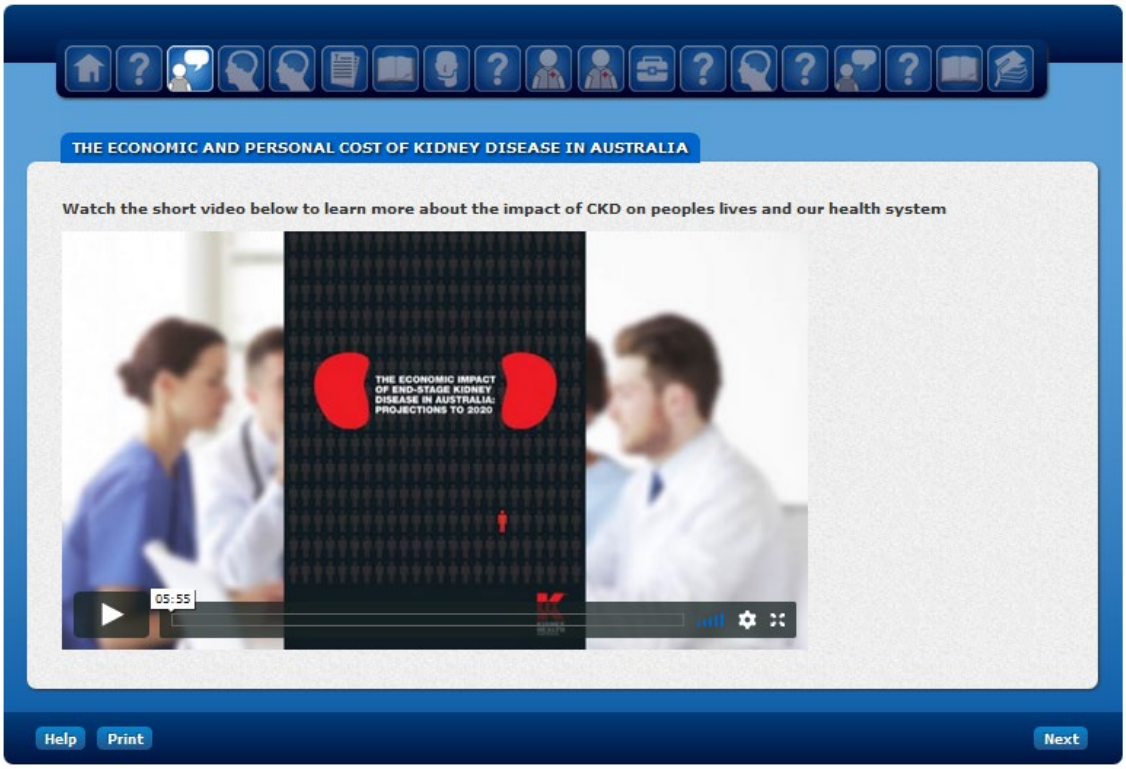
Appendix 19: Pictorial representation of Module 2 (Behaviour - Intervention)





HOW PREVALENT IS CKD IN AUSTRALIA?

How many Australians are unaware that they have CKD and does Kidney and Urinary Tract disease kill more people that breast cancer, prostate cancer and road deaths combined?

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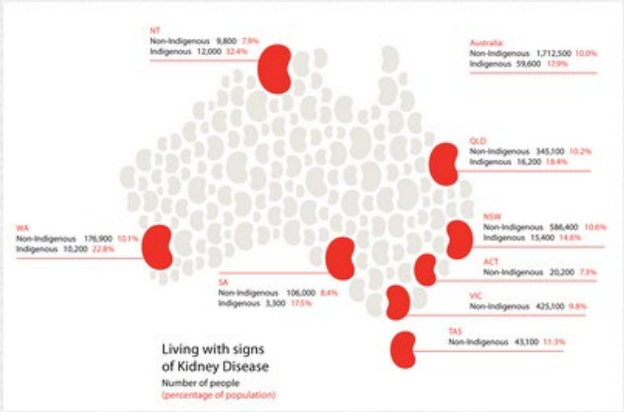
CKD BURDEN

The burden of CKD in Australia



How many people in your state are living with signs of kidney disease? CLICK ON THE IMAGE ABOVE FOR A CLOSER VIEW.

Source: Ludlow (2016)

Australian population studies have estimated that every year at least *16,000 Australian adults* will develop CKD. The vast majority of these people will be unaware they have CKD, as it is a largely asymptomatic condition, and identification relies on opportunistic testing in people with identified risk factors.

Help Print Next

A SILENT DISEASE

One of the biggest challenges that we face is that 90% of kidney function can lost without a person experiencing any symptoms.

So there is a clinical imperative for all health care professionals working in primary care to work together to improve CKD screening practices in the community.

of kidney function can be lost without experiencing any symptoms

Help Print Next

RISK FACTORS & SCREENING

In the pre-quiz, you were assessed about the 9 risk factors for CKD and what to do when you come across a patient with those risk factors.

Indications for assessment*	Recommended assessments	Frequency
Diabetes	• Urine ACR • eGFR • Blood pressure If urine ACR positive repeat twice over 3 months (preferably first morning void) If eGFR < 60mL/min/1.73m² repeat within 7 days	Every 1-2 years†
Hypertension		
Established cardiovascular disease**		
Family history of kidney failure		
Obesity (BMI ≥ 30 kg/m²)		
Smoker		
Aboriginal or Torres Strait Islander origin aged ≥ 30 years‡		
History of acute kidney injury	See recommendations in CKD management in General Practice booklet	

* Whilst being aged 60 years of age or over is considered to be a risk factor for CKD, in the absence of other risk factors it is not necessary to routinely assess these individuals for kidney disease.

** Established cardiovascular disease is defined as a previous diagnosis of coronary heart disease, cerebrovascular disease or peripheral vascular disease.

† Annually for individuals with diabetes or hypertension.

‡ Refer to booklet for more details regarding recommendations for testing in Aboriginal and Torres Strait Islander peoples.

Chronic Kidney Disease (CKD) Management in General Practice, 3rd edition. Kidney Health Australia: Melbourne, 2015 (Download)

CKD SCREENING SHOULD BE UNDERTAKEN AS A PART OF EVERY CHRONIC DISEASE & CARDIOVASCULAR RISK ASSESSMENT

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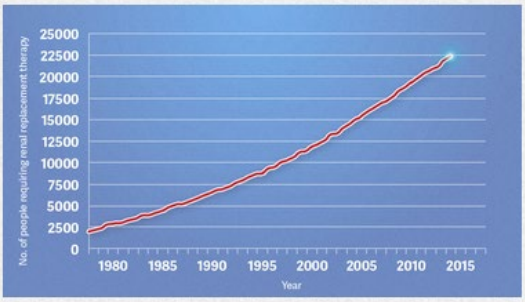
BARRIERS TO CKD SCREENING

The barriers to CKD screening in general practice

A recent Australian study in the journal Nephrology identified several challenges that general practice nurses faced when it came to screening for kidney disease in the general practice setting. You can click on the journal image below if you would like to read a copy of the study.

The renal community has spent a long time working on interventions to improve CKD screening, but haven't seemed to be able to make as big as an impact as we had hoped, particularly the number of people requiring renal replacement therapy increasing each year.



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CHALLENGES IN GENERAL PRACTICE

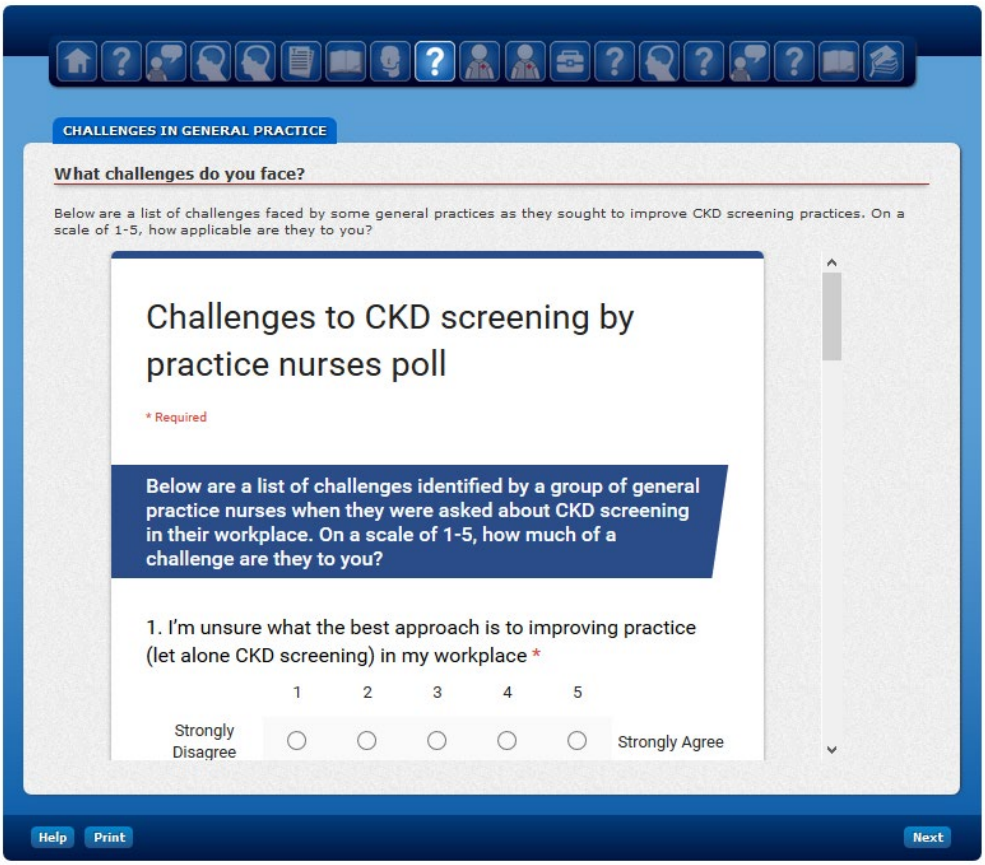
What challenges do you face?

We know that not all General Practice surgeries are the same in terms of staffing, skill mix, and workplace culture.

So it would be wrong to think a one size fits all 'intervention' would likely improve CKD screening. So we thought we would be more pragmatic and ask you to consider what challenges you face or would you face, in regards to improving CKD screening in your work place. Have a think for 60 seconds, maybe write them down. For example, are you apprehensive about speaking with recalcitrant colleagues or are you worried about how a GP will respond to you raising clinical issues? Or perhaps you're not sure how to raise the need to get an ACR done or perhaps you're just not sure how your practice can manage screening in a cost effective way?

We have come up with a list of challenges faced by several general practices as they sought to improve CKD screening practices and how they managed them. On the following page we'd like you to rate on a scale of 1-5 whether these challenges are similar to ones that you face. After that, you will get the chance to select some of these challenges and learn how two very different general practice surgeries have overcome them.

Help Print Next


CHALLENGES IN GENERAL PRACTICE
What challenges do you face?
Below are a list of challenges faced by some general practices as they sought to improve CKD screening practices. On a scale of 1-5, how applicable are they to you?
Challenges to CKD screening by practice nurses poll
* Required
Below are a list of challenges identified by a group of general practice nurses when they were asked about CKD screening in their workplace. On a scale of 1-5, how much of a challenge are they to you?
1. I'm unsure what the best approach is to improving practice (let alone CKD screening) in my workplace *
1 2 3 4 5
Strongly Disagree
Strongly Agree
Help
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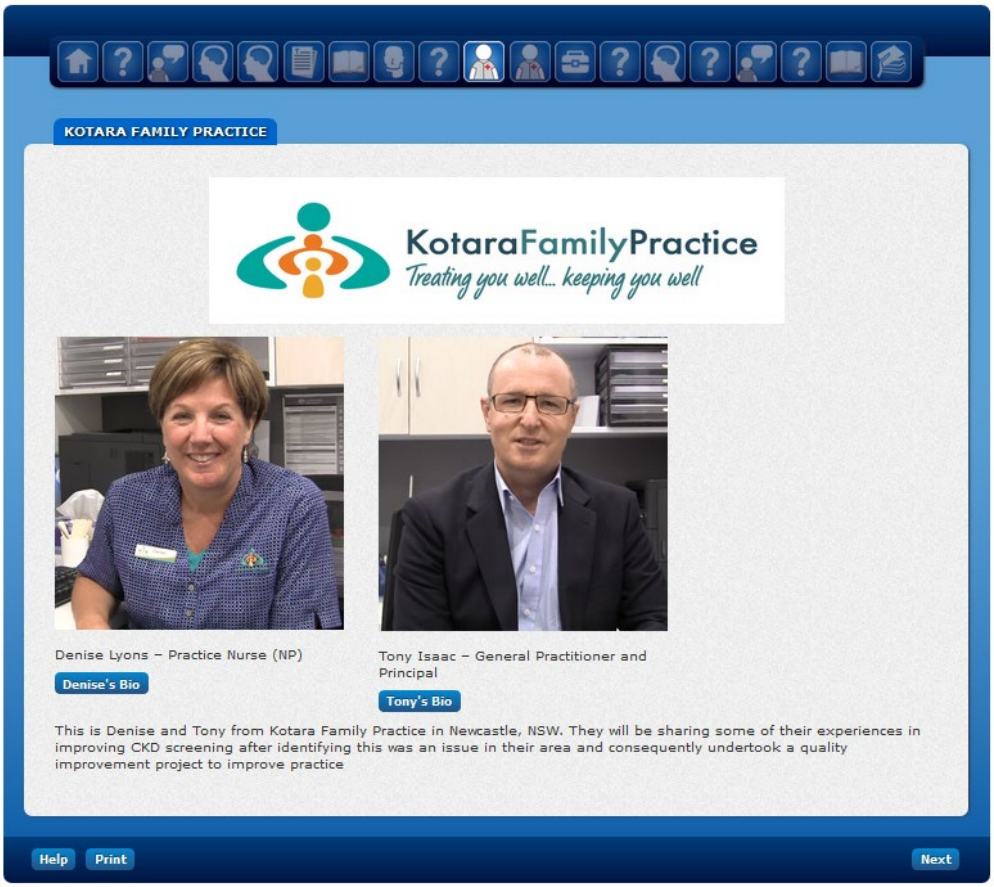
KOTARA FAMILY PRACTICE
KotaraFamilyPractice
Treating you well... keeping you well
Denise Lyons – Practice Nurse (NP)
Denise's Bio
Tony Isaac – General Practitioner and Principal
Tony's Bio
This is Denise and Tony from Kotara Family Practice in Newcastle, NSW. They will be sharing some of their experiences in improving CKD screening after identifying this was an issue in their area and consequently undertook a quality improvement project to improve practice
Help
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SHOALHAVEN FAMILY MC

SHOALHAVEN FAMILY MEDICAL CENTRES

Hao Pham – General Practitioner and Principal

Hao's Bio

Dianna Fornasier – Practice Nurse (NP)

Di's Bio

This is Di Fornasier and Dr Hao Pham from the Shoalhaven Family Medical Centres, a consortium of four practices that have successfully introduced an evidence based health culture surrounding kidney health which has received national recognition. They will be sharing some of their insights and experiences throughout this e-learning program. The Illawarra-Shoalhaven area has recently been identified as one of the foremost CKD hotspots in Australia.

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CHALLENGES HOMEPAGE

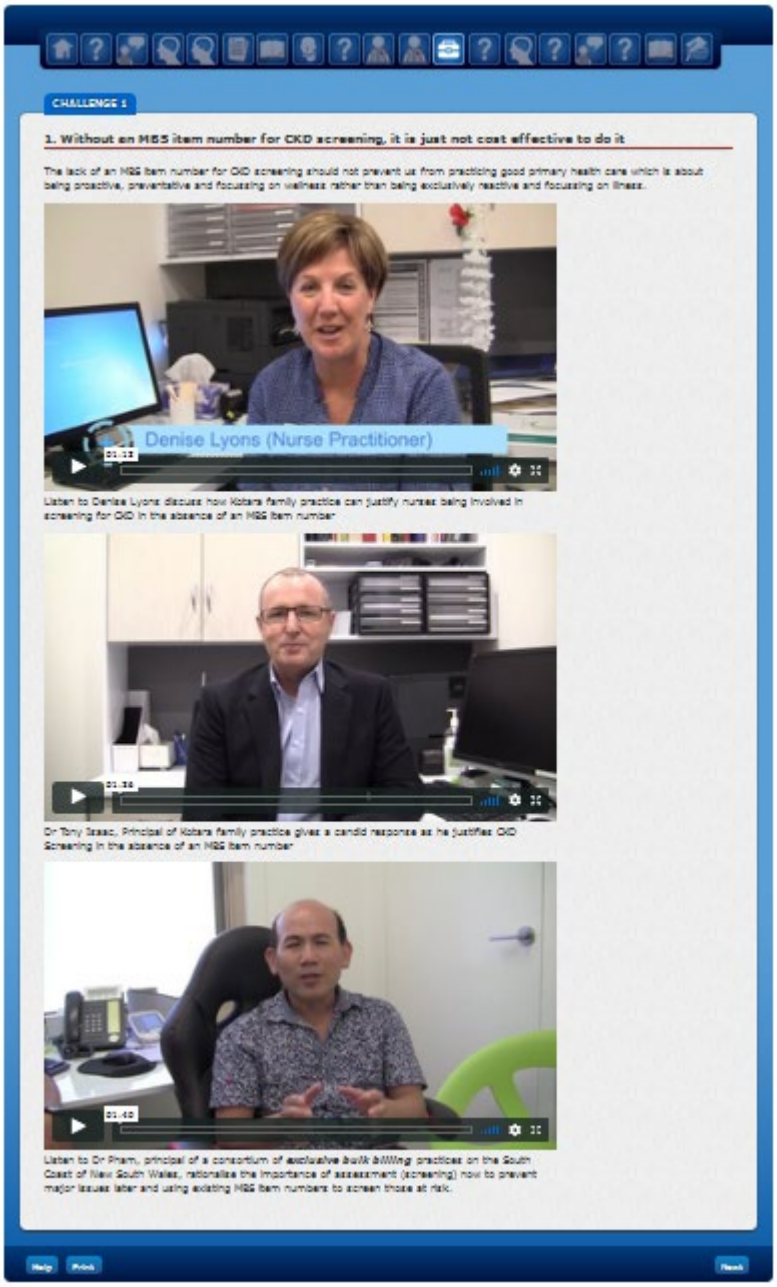
Some approaches to these challenges

In the poll on the previous page you identified some of the challenges you have with CKD screening. Click on a challenge below that is relevant to you and then *click NEXT in the bottom right hand corner*. You will then be directed to a page where the teams from Kotara family practice and Shoalhaven Family MC will share some approaches to that challenge for you to consider and perhaps implement. After you have reviewed the challenge, click NEXT again and you will be returned to this page to select other challenges you may wish to explore. When you are done, click on the button that says 'I have finished this section and am ready to wrap up this program' and then *click NEXT to proceed*.

- ◯ Challenge 1: Without an MBS item number for CKD screening, it is just not cost effective to do it
- ◯ Challenge 2: I'm unsure what the best approach is to improving practice in my workplace
- ◯ Challenge 3: I can't collaborate with some of the 'traditional' doctors in my workplace who think that initiating screening is outside nurses' scope of practice.
- ◯ Challenge 4: We don't have any ways to find people who are at risk of CKD efficiently?
- ◯ Challenge 5: Staff in my workplace don't know what the risk factors for CKD are or how to screen for it
- ◯ Challenge 6: I can't seem to remember to check for people who are at risk
- ◯ Challenge 7: I am too busy to screen for CKD, there are more important priorities
- ◯ Challenge 8: I am not confident enough to bring up the need for a kidney health check with the GP
- ◯ Challenge 9: CKD screening is not part of the practice nurses role
- ◯ Other: Please complete comment box below (*Then click NEXT to proceed*)
- ◯ **I have finished this section and am ready to wrap up the module** (*Then click NEXT to proceed*)

If you face a challenge that you are particularly concerned about that is not mentioned in the list above please list it here. We will not be able to offer in suggestions in this program but will investigate potential solutions and incorporate them into future versions of this program

Help Print Next


CHALLENGE 1
1. Without an MBS item number for CKD screening, it is just not cost effective to do it
The lack of an MBS item number for CKD screening should not prevent us from practicing good primary health care which is about being proactive, preventative and focussing on wellness rather than being exclusively reactive and focussing on illness.
Denise Lyons (Nurse Practitioner)
01:13
Listen to Denise Lyons discuss how Kobara family practice can justify nurses being involved in screening for CKD in the absence of an MBS item number
01:36
Dr Tony Issac, Principal of Kobara family practice gives a candid response as he justifies CKD Screening in the absence of an MBS item number
01:42
Listen to Dr Pham, principal of a consortium of exclusive bulk billing practices on the South Coast of New South Wales, rationalise the importance of assessment (screening) now to prevent major issues later and using existing MBS item numbers to screen those at risk.
Help
Print

CHALLENGE 1

1. Without an MBS item number for CKD screening, it is just not cost effective to do it

The lack of an MBS item number for CKD screening should not prevent us from practicing good primary health care which is about being proactive, preventative and focussing on wellness rather than being exclusively reactive and focussing on illness.

Listen to Denise Lyons discuss how Kotara family practice can justify nurses being involved in screening for CKD in the absence of an MBS item number

CHALLENGE 2: PART I

2. I'm unsure what the best approach is to improving practice in my workplace: How to develop organisational buy-in - Part 1.

▾ Implementing change to CKD screening at Kotara Family Practice

Listen to Denise Lyons speak about implementing change to CKD screening at Kotara Family Practice, NSW

▸ A practical framework for change
▸ A 'whole of team' approach to CKD screening
▸ Collaboration within the practice team

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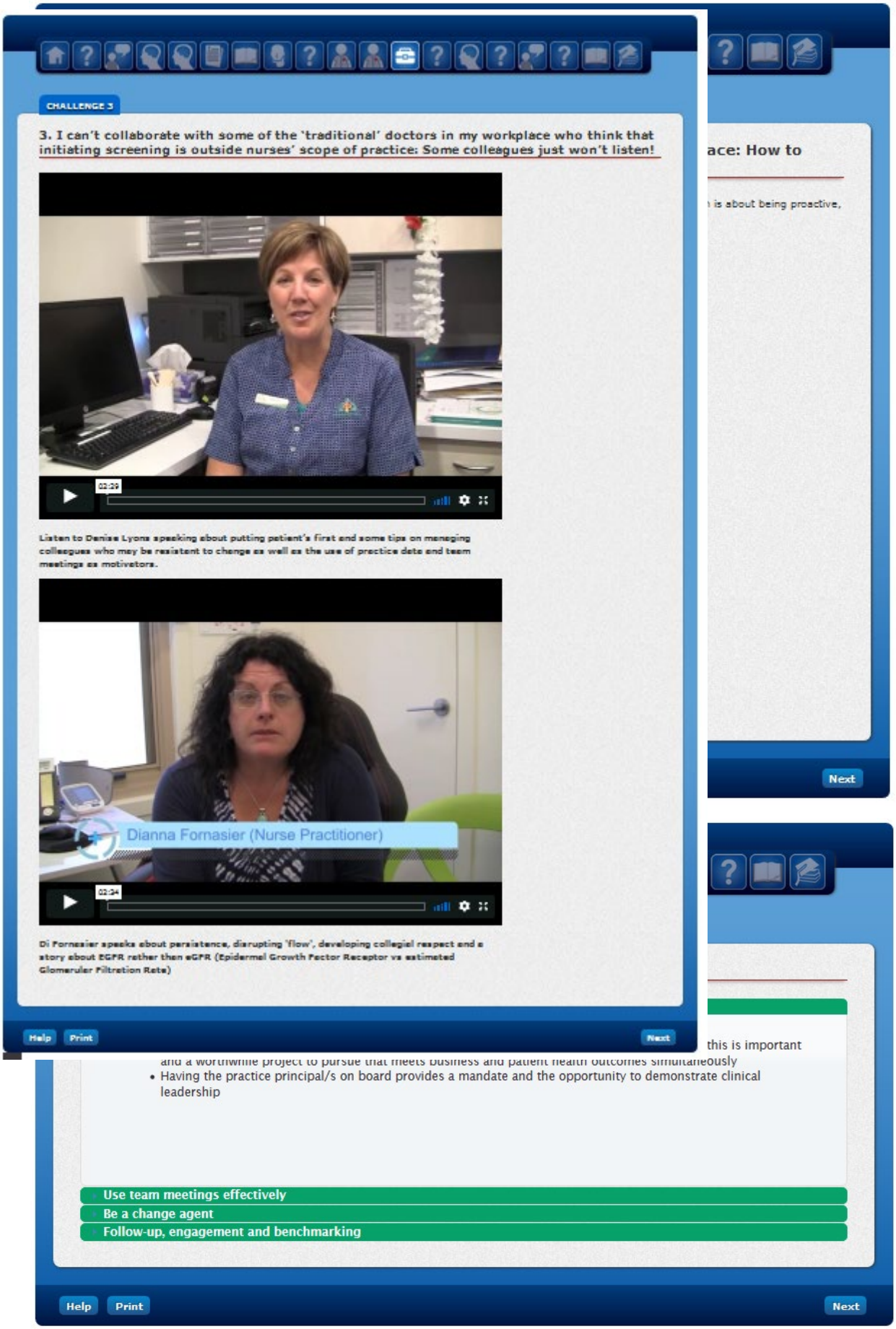
CHALLENGE 3
3. I can't collaborate with some of the 'traditional' doctors in my workplace who think that initiating screening is outside nurses' scope of practice: Some colleagues just won't listen!
Listen to Denise Lyons speaking about putting patient's first and some tips on managing colleagues who may be resistant to change as well as the use of practice data and team meetings as motivators.
Dianna Fornasier (Nurse Practitioner)
Di Fornasier speaks about persistence, disrupting 'flow', developing collegial respect and a story about EGFR rather than eGFR (Epidermal Growth Factor Receptor vs estimated Glomerular Filtration Rate)
Help
Print
Next
ace: How to
is about being proactive,
Next
this is important
and a worthwhile project to pursue that meets business and patient health outcomes simultaneously
• Having the practice principal/s on board provides a mandate and the opportunity to demonstrate clinical leadership
Use team meetings effectively
Be a change agent
Follow-up, engagement and benchmarking
Help
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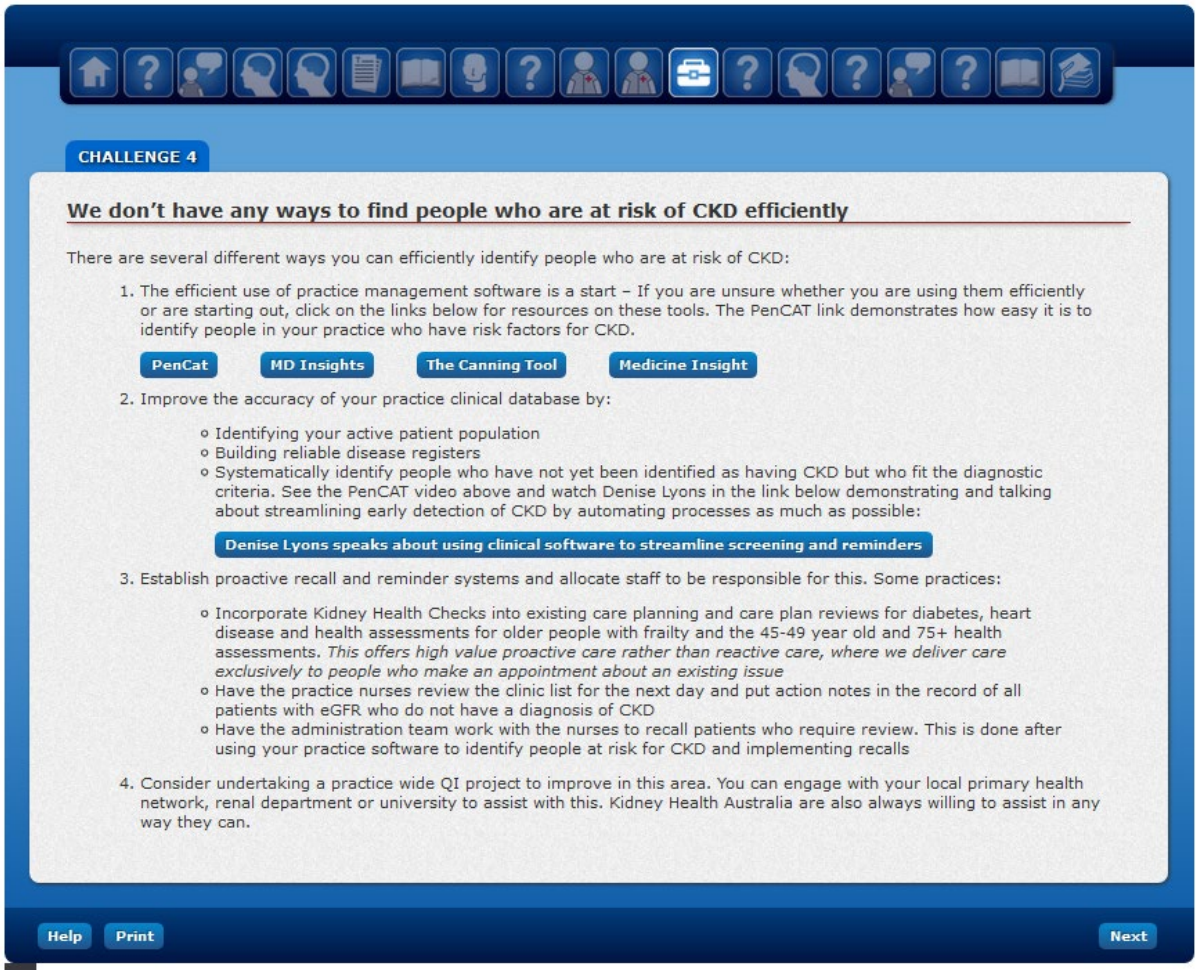
CHALLENGE 4
We don't have any ways to find people who are at risk of CKD efficiently
There are several different ways you can efficiently identify people who are at risk of CKD:
1. The efficient use of practice management software is a start – If you are unsure whether you are using them efficiently or are starting out, click on the links below for resources on these tools. The PenCAT link demonstrates how easy it is to identify people in your practice who have risk factors for CKD.
PenCat
MD Insights
The Canning Tool
Medicine Insight
2. Improve the accuracy of your practice clinical database by:
Identifying your active patient population
Building reliable disease registers
Systematically identify people who have not yet been identified as having CKD but who fit the diagnostic criteria. See the PenCAT video above and watch Denise Lyons in the link below demonstrating and talking about streamlining early detection of CKD by automating processes as much as possible:
Denise Lyons speaks about using clinical software to streamline screening and reminders
3. Establish proactive recall and reminder systems and allocate staff to be responsible for this. Some practices:
Incorporate Kidney Health Checks into existing care planning and care plan reviews for diabetes, heart disease and health assessments for older people with frailty and the 45-49 year old and 75+ health assessments. This offers high value proactive care rather than reactive care, where we deliver care exclusively to people who make an appointment about an existing issue
Have the practice nurses review the clinic list for the next day and put action notes in the record of all patients with eGFR who do not have a diagnosis of CKD
Have the administration team work with the nurses to recall patients who require review. This is done after using your practice software to identify people at risk for CKD and implementing recalls
4. Consider undertaking a practice wide QI project to improve in this area. You can engage with your local primary health network, renal department or university to assist with this. Kidney Health Australia are also always willing to assist in any way they can.
Help
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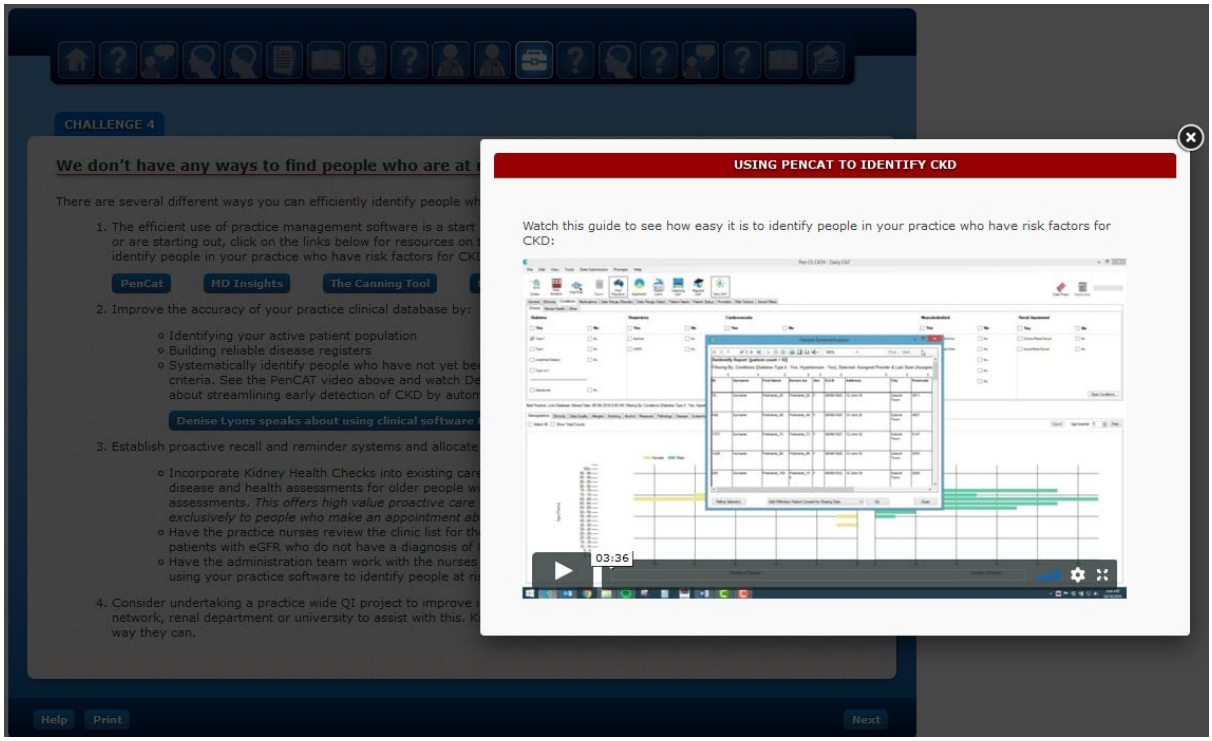
CHALLENGE 4
USING PENCAT TO IDENTIFY CKD
Watch this guide to see how easy it is to identify people in your practice who have risk factors for CKD:
03:36
Help
Print
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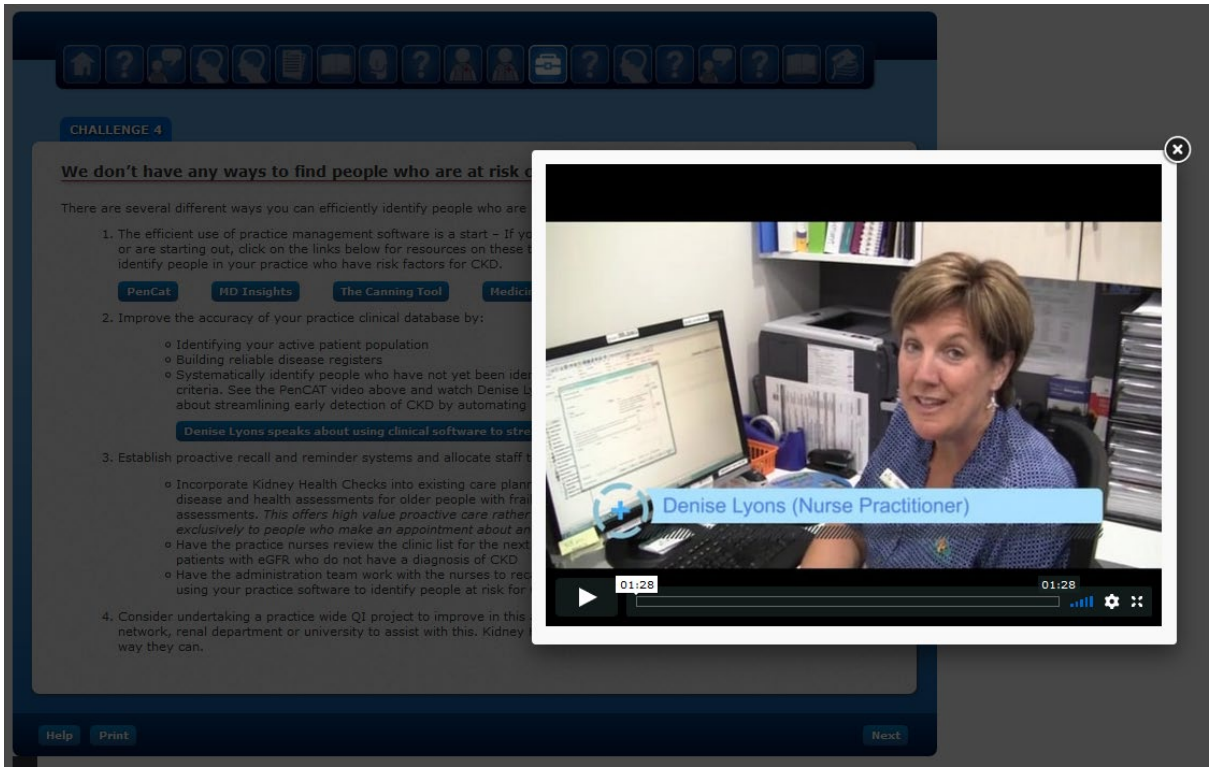
CHALLENGE 4
We don't have any ways to find people who are at risk
There are several different ways you can efficiently identify people who are
1. The efficient use of practice management software is a start – If yo
or are starting out, click on the links below for resources on these
identify people in your practice who have risk factors for CKD.
PenCat
MD Insights
The Canning Tool
2. Improve the accuracy of your practice clinical database by:
Identifying your active patient population
Building reliable disease registers
Systematically identify people who have not yet been ide
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exclusively to people who make an appointment about an
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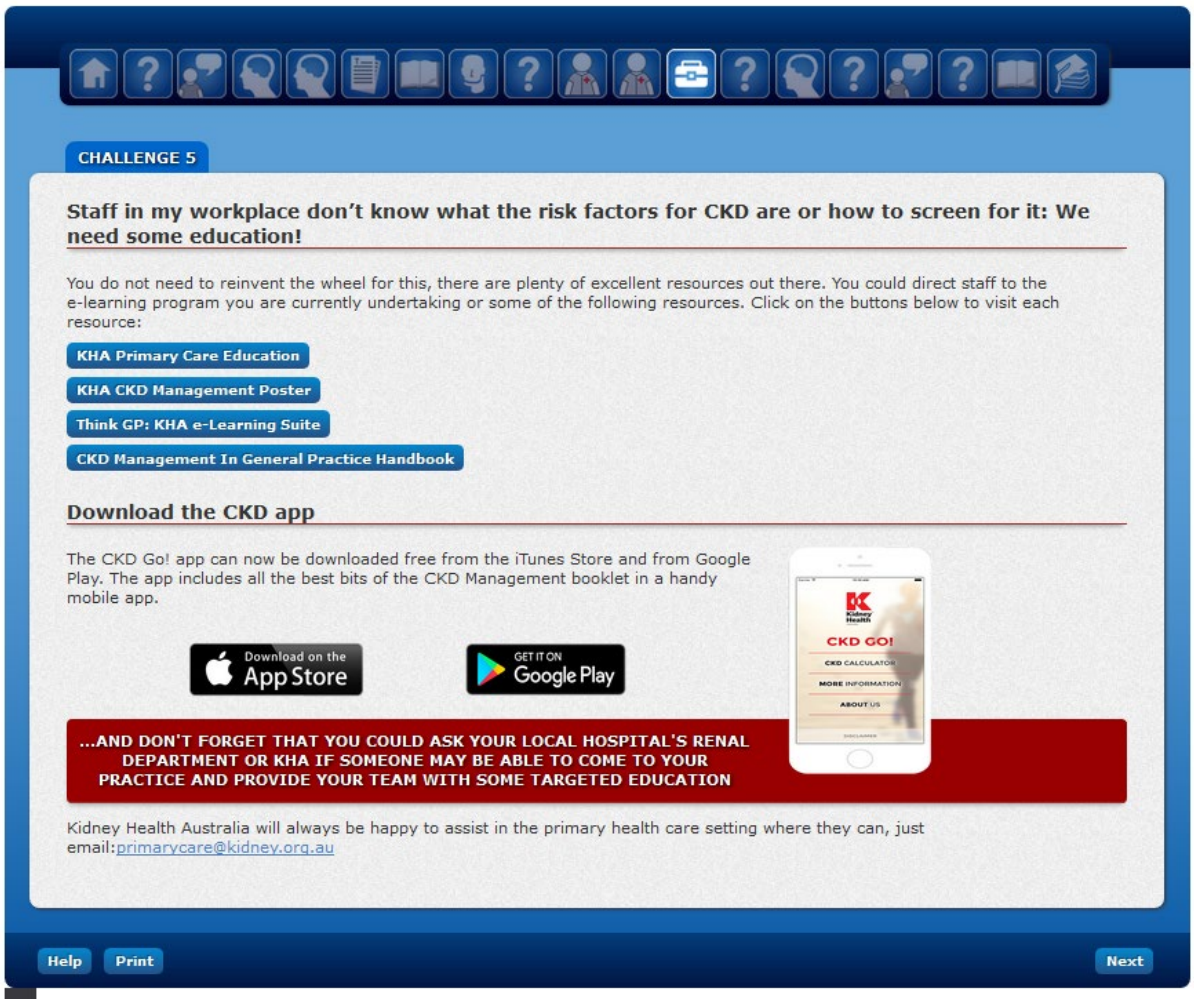
patients with eGFR who do not have a diagnosis of CKD
Have the administration team work with the nurses to rec
using your practice software to identify people at risk for
4. Consider undertaking a practice wide QI project to improve in this
network, renal department or university to assist with this. Kidney
way they can.
Help
Print
Next
Denise Lyons (Nurse Practitioner)
01:28
01:28


CHALLENGE 5
Staff in my workplace don't know what the risk factors for CKD are or how to screen for it: We need some education!
You do not need to reinvent the wheel for this, there are plenty of excellent resources out there. You could direct staff to the e-learning program you are currently undertaking or some of the following resources. Click on the buttons below to visit each resource:
KHA Primary Care Education
KHA CKD Management Poster
Think GP: KHA e-Learning Suite
CKD Management In General Practice Handbook
Download the CKD app
The CKD Go! app can now be downloaded free from the iTunes Store and from Google Play. The app includes all the best bits of the CKD Management booklet in a handy mobile app.
Download on the App Store
GET IT ON Google Play
CKD GO!
CKD CALCULATOR
MORE INFORMATION
ABOUT US
...AND DON'T FORGET THAT YOU COULD ASK YOUR LOCAL HOSPITAL'S RENAL DEPARTMENT OR KHA IF SOMEONE MAY BE ABLE TO COME TO YOUR PRACTICE AND PROVIDE YOUR TEAM WITH SOME TARGETED EDUCATION
Kidney Health Australia will always be happy to assist in the primary health care setting where they can, just email:primarycare@kidney.org.au
Help
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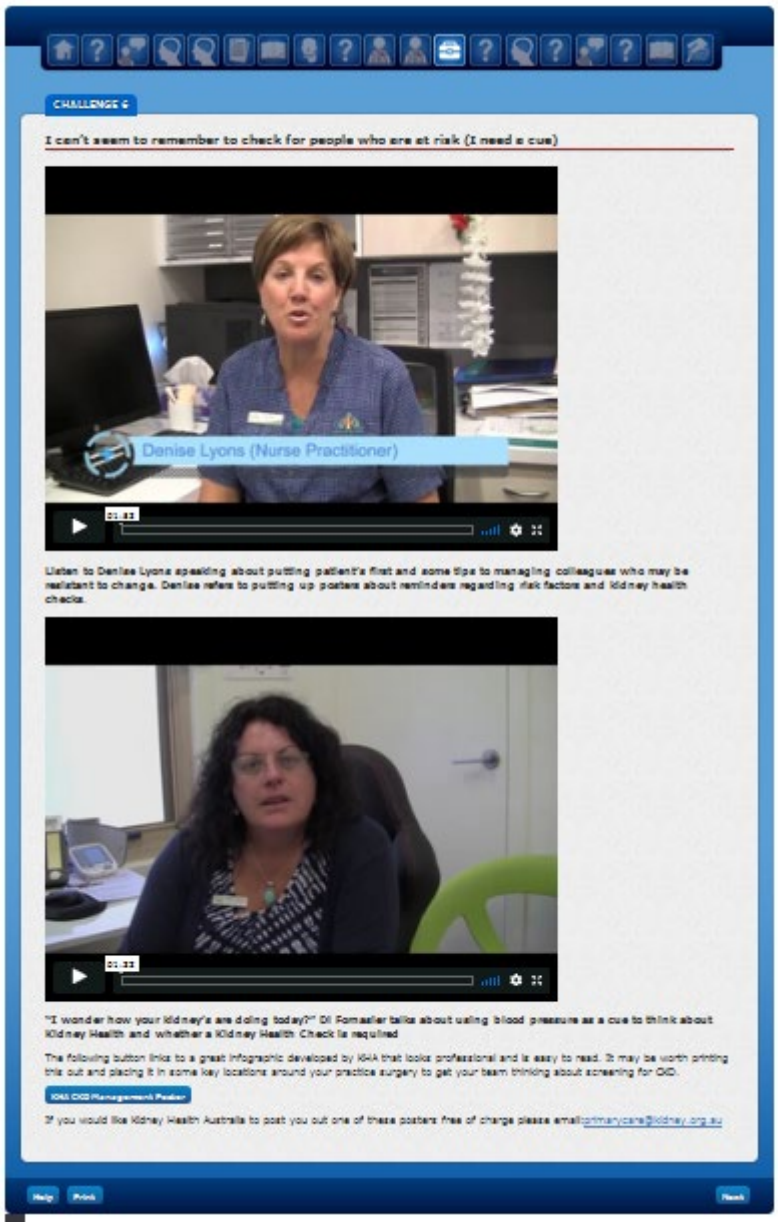
CHALLENGE 6
I can't seem to remember to check for people who are at risk (I need a cue)
Denise Lyons (Nurse Practitioner)
01:43
Listen to Denise Lyons speaking about putting patient's first and some tips to managing colleagues who may be resistant to change. Denise refers to putting up posters about reminders regarding risk factors and kidney health checks.
01:33
"I wonder how your kidney's are doing today?" Dr Fornasier talks about using blood pressure as a cue to think about Kidney Health and whether a Kidney Health Check is required
The following button links to a great infographic developed by KHA that looks professional and is easy to read. It may be worth printing this out and placing it in some key locations around your practice surgery to get your team thinking about screening for CKD.
If you would like Kidney Health Australia to post you out one of these posters free of charge please email
Help
Print
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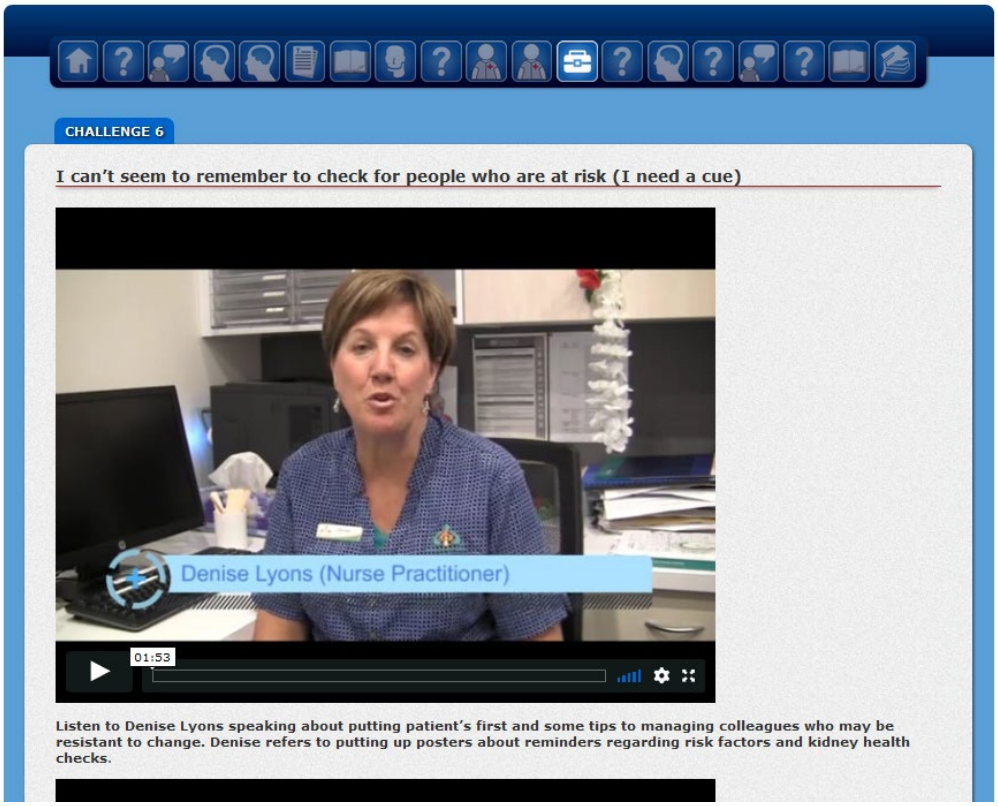
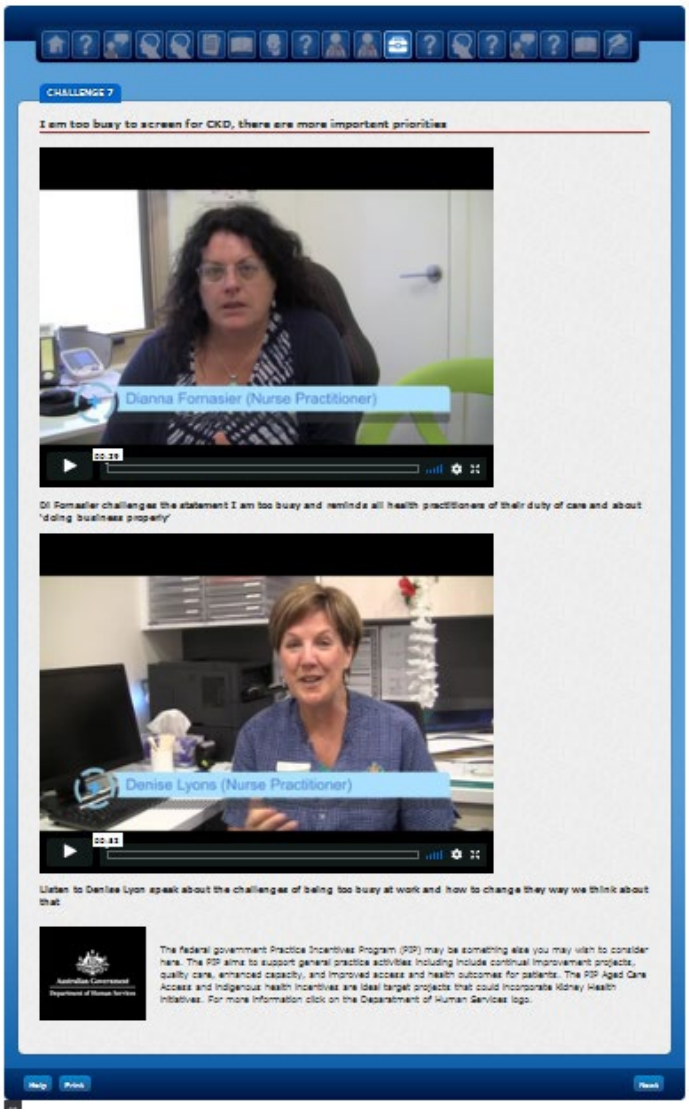

CHALLENGE 6
I can't seem to remember to check for people who are at risk (I need a cue)
Denise Lyons (Nurse Practitioner)
01:53
Listen to Denise Lyons speaking about putting patient's first and some tips to managing colleagues who may be resistant to change. Denise refers to putting up posters about reminders regarding risk factors and kidney health checks.


CHALLENGE 7
I am too busy to screen for CKD, there are more important priorities
Dianna Fornasier (Nurse Practitioner)
Di Fornasier challenges the statement I am too busy and reminds all health practitioners of their duty of care and about 'doing business properly'
Denise Lyons (Nurse Practitioner)
Listen to Denise Lyon speak about the challenges of being too busy at work and how to change they way we think about that
The federal government Practice Incentives Program (PIP) may be something else you may wish to consider here. The PIP aims to support general practice activities including include continual improvement projects, quality care, enhanced capacity, and improved access and health outcomes for patients. The PIP Aged Care Access and Indigenous health incentives are ideal target projects that could incorporate Kidney Health initiatives. For more information click on the Department of Human Services logo.

CHALLENGE 7

I am too busy to screen for CKD, there are more important priorities

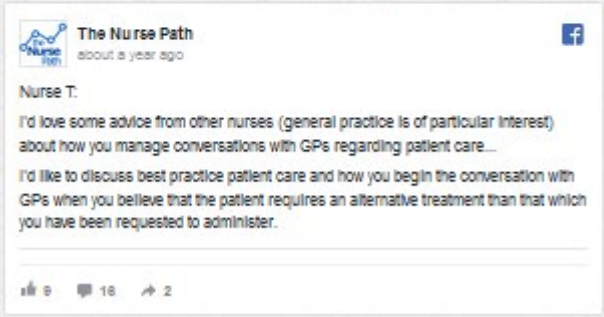
Di Fornasier challenges the statement I am too busy and reminds all health practitioners of their duty of care and about 'doing business properly'

CHALLENGE 8

I am not confident enough to bring up the need for a kidney health check with the GP

This really comes down to the organisational culture of where you work and whether these conversations are considered collegial or collaborative or a threat to one's professionalism. This can be overcome gradually if your workplace agrees that these conversations are considered as part of collaborative patient care (have a look at the Challenge 2 section about organisational buy in).

In August 2017, the popular Facebook page 'The Nurse Path' posted a question from a practice nurse asking how to begin a conversation with GPs regarding patient care. Click on the comment logo to have a read of some of the strategies offered by the pages' followers:



DI Fornasier suggests asking the question 'what do you think?' to start developing confidence and improving communication channels with GPs

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CHALLENGE 9

CKD screening is not part of the practice nurses role

Denise Lyons' believes nurses are "really good at making things happen" have a listen to her position on practice nurses role in CKD screening

Di Fornasier responds to the question of whether it is the nurses role to initiate a Kidney Health Check

Help Print Next

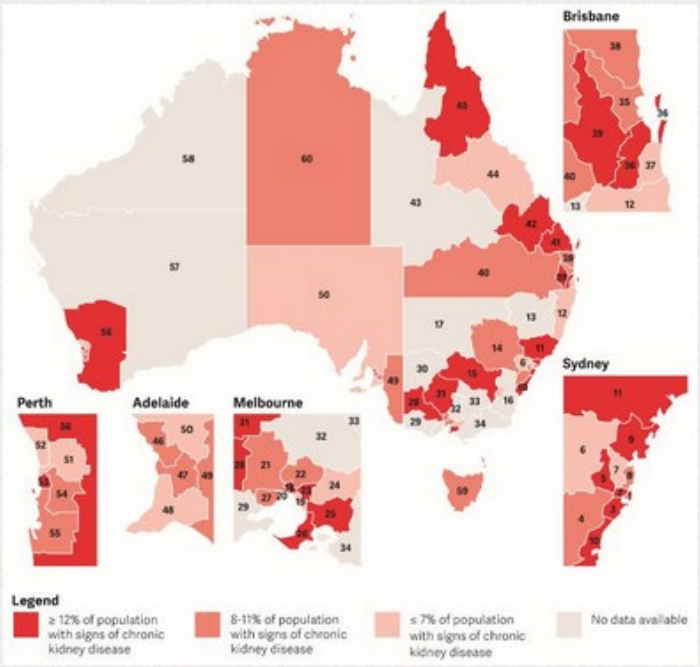
CHALLENGE 9

CKD screening is not part of the practice nurses role

Denise Lyons' believes nurses are "really good at making things happen" have a listen to her position on practice nurses role in CKD screening

LET'S START WRAPPING UP

How many people in your local catchment area are living with biomedical signs of CKD?



PLEASE CLICK HERE to read this important caveat before proceeding

CLICK HERE to find out which number matches your Medicare local catchment area (We acknowledge that these are now superseded by Primary Health Networks)

Source: Ludlow (2016) State of the Nation Report, Kidney Health Australia (Image used with permission) (Download Report Here)

This image profiles Medicare Locals, now superseded by Primary Health Networks, in urban and rural areas with the highest proportions of people living with signs of CKD. The top 20 hot spots are associated with an estimated prevalence of CKD higher than the national average of ten per cent. These hot spots account for an estimated 48 per cent of the 1.7 million Australian adults with signs of CKD. This data draws important attention to priority areas for community and clinical CKD education and awareness. Although Medicare Locals are no longer in operation, the boundary areas remain relevant for analysis of state and federal electorates, and Primary Health Network classifications.

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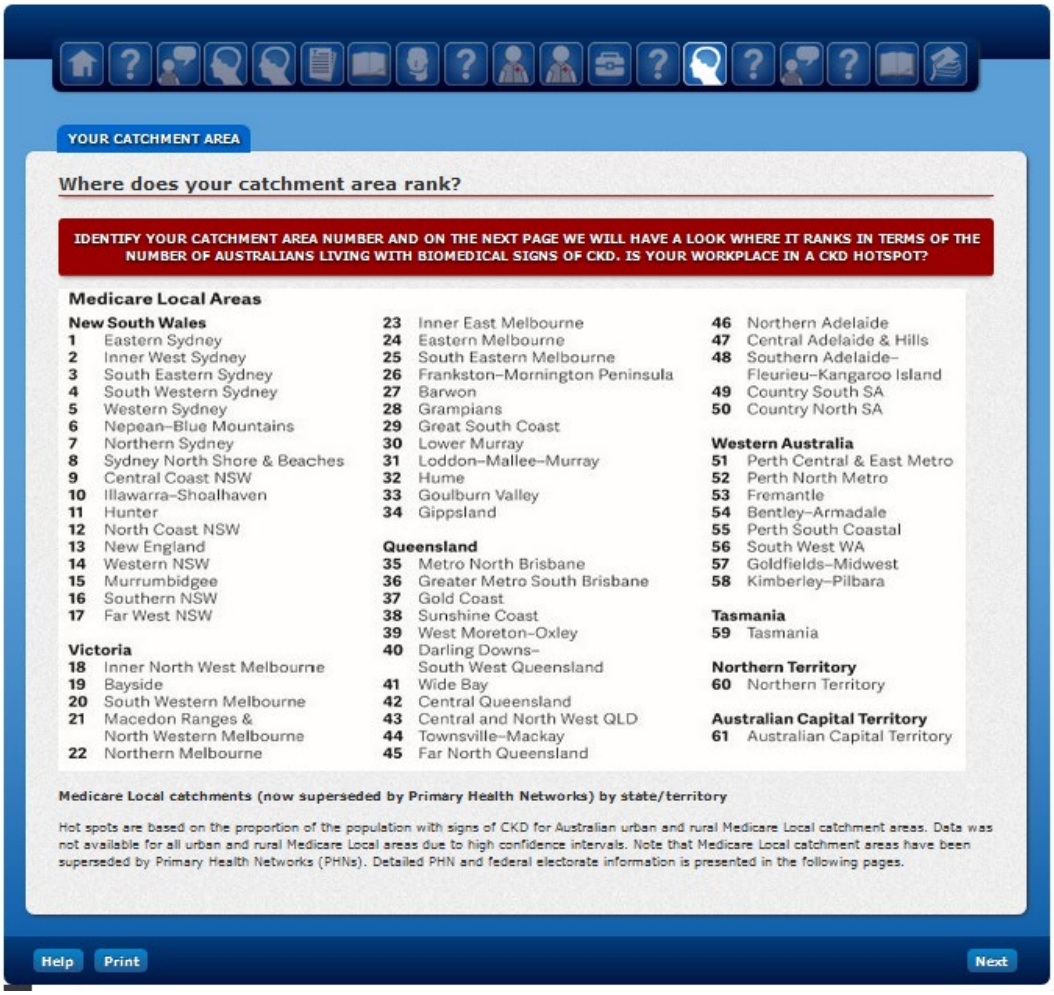

YOUR CATCHMENT AREA

Where does your catchment area rank?

IDENTIFY YOUR CATCHMENT AREA NUMBER AND ON THE NEXT PAGE WE WILL HAVE A LOOK WHERE IT RANKS IN TERMS OF THE NUMBER OF AUSTRALIANS LIVING WITH BIOMEDICAL SIGNS OF CKD. IS YOUR WORKPLACE IN A CKD HOTSPOT?

Medicare Local Areas

New South Wales
1 Eastern Sydney
2 Inner West Sydney
3 South Eastern Sydney
4 South Western Sydney
5 Western Sydney
6 Nepean–Blue Mountains
7 Northern Sydney
8 Sydney North Shore & Beaches
9 Central Coast NSW
10 Illawarra–Shoalhaven
11 Hunter
12 North Coast NSW
13 New England
14 Western NSW
15 Murrumbidgee
16 Southern NSW
17 Far West NSW

Victoria
18 Inner North West Melbourne
19 Bayside
20 South Western Melbourne
21 Macedon Ranges & North Western Melbourne
22 Northern Melbourne
23 Inner East Melbourne
24 Eastern Melbourne
25 South Eastern Melbourne
26 Frankston–Mornington Peninsula
27 Barwon
28 Grampians
29 Great South Coast
30 Lower Murray
31 Loddon–Mallee–Murray
32 Hume
33 Goulburn Valley
34 Gippsland

Queensland
35 Metro North Brisbane
36 Greater Metro South Brisbane
37 Gold Coast
38 Sunshine Coast
39 West Moreton–Oxley
40 Darling Downs–South West Queensland
41 Wide Bay
42 Central Queensland
43 Central and North West QLD
44 Townsville–Mackay
45 Far North Queensland
46 Northern Adelaide
47 Central Adelaide & Hills
48 Southern Adelaide–Fleurieu–Kangaroo Island
49 Country South SA
50 Country North SA

Western Australia
51 Perth Central & East Metro
52 Perth North Metro
53 Fremantle
54 Bentley–Armadale
55 Perth South Coastal
56 South West WA
57 Goldfields–Midwest
58 Kimberley–Pilbara

Tasmania
59 Tasmania

Northern Territory
60 Northern Territory

Australian Capital Territory
61 Australian Capital Territory

Medicare Local catchments (now superseded by Primary Health Networks) by state/territory

Hot spots are based on the proportion of the population with signs of CKD for Australian urban and rural Medicare Local catchment areas. Data was not available for all urban and rural Medicare Local areas due to high confidence intervals. Note that Medicare Local catchment areas have been superseded by Primary Health Networks (PHNs). Detailed PHN and federal electorate information is presented in the following pages.

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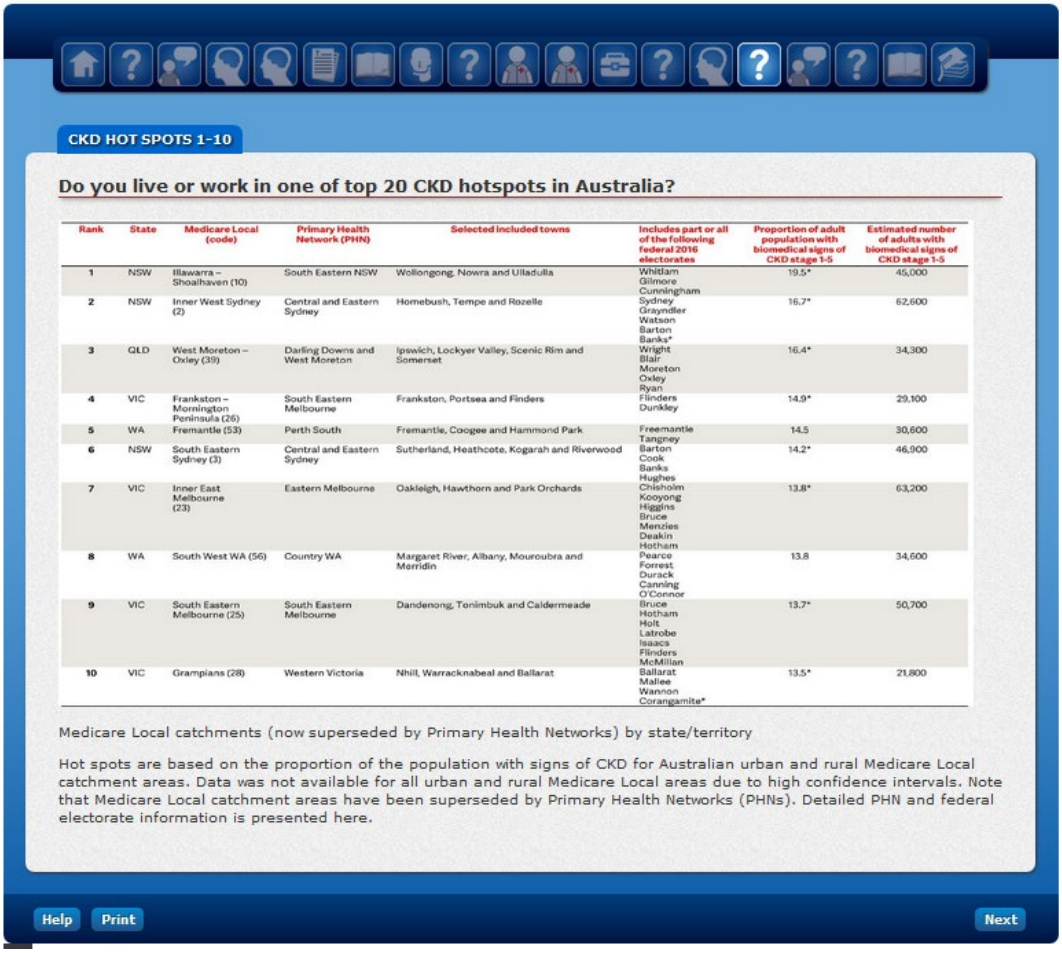

CKD HOT SPOTS 1-10

Do you live or work in one of top 20 CKD hotspots in Australia?

Rank	State	Medicare Local (code)	Primary Health Network (PHN)	Selected included towns	Includes part or all of the following federal 2016 electorates	Proportion of adult population with biomedical signs of CKD stage 1-5	Estimated number of adults with biomedical signs of CKD stage 1-5
1	NSW	Illawarra – Shoalhaven (10)	South Eastern NSW	Wollongong, Nowra and Ulladulla	Whitlam Gilmore Cunningham	19.5*	45,000
2	NSW	Inner West Sydney (2)	Central and Eastern Sydney	Homebush, Tempe and Rozelle	Sydney Grayndler Watson Barton Banks*	16.7*	62,600
3	QLD	West Moreton – Oxley (39)	Darling Downs and West Moreton	Ipswich, Lockyer Valley, Scenic Rim and Somerset	Wright Blair Moreton Oxley Ryan	16.4*	34,300
4	VIC	Frankston – Mornington Peninsula (26)	South Eastern Melbourne	Frankston, Portsea and Flinders	Flinders Dunkley	14.9*	29,100
5	WA	Fremantle (53)	Perth South	Fremantle, Coogee and Hammond Park	Freemantle Tangney	14.5	30,600
6	NSW	South Eastern Sydney (3)	Central and Eastern Sydney	Sutherland, Heathcote, Kogarah and Riverwood	Barton Cook Banks Hughes	14.2*	46,900
7	VIC	Inner East Melbourne (23)	Eastern Melbourne	Oakleigh, Hawthorn and Park Orchards	Chisholm Kooyong Higgins Bruce Menzies Deakin Hotham	13.8*	63,200
8	WA	South West WA (56)	Country WA	Margaret River, Albany, Mouroubra and Merridin	Pearce Forrest Durack Canning O'Connor	13.8	34,600
9	VIC	South Eastern Melbourne (25)	South Eastern Melbourne	Dandenong, Tonimbuk and Caldermeade	Bruce Hotham Holt Latrobe Isaacs Flinders McMillan	13.7*	50,700
10	VIC	Grampians (28)	Western Victoria	Nhill, Warracknabeal and Ballarat	Ballarat Mallee Wannon Corangamite*	13.5*	21,800

Medicare Local catchments (now superseded by Primary Health Networks) by state/territory

Hot spots are based on the proportion of the population with signs of CKD for Australian urban and rural Medicare Local catchment areas. Data was not available for all urban and rural Medicare Local areas due to high confidence intervals. Note that Medicare Local catchment areas have been superseded by Primary Health Networks (PHNs). Detailed PHN and federal electorate information is presented here.

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CKD HOT SPOTS 11-20

Do you live or work in one of top 20 CKD hotspots in Australia?

Rank	State	Medicare Local (code)	Primary Health Network (PHN)	Selected included towns	Includes part or all of the following federal 2016 electorates	Proportion of adult population with biomedical signs of CKD stage 1-5	Estimated number of adults with biomedical signs of CKD stage 1-5
11	VIC	Loddon – Mallee – Murray (31)	Murray	Donald, Echuca and Bendigo	Bendigo Mallee Murray Farrer	13.5*	16,500
12	QLD	Central Queensland (42)	Central Queensland, Wide Bay, Sunshine Coast	Rockhampton, Emerald and Eurombah	Capricornia Flynn	13.0	24,100
13	NSW	Murrumbidgee (15)	Murrumbidgee	Wagga Wagga, Griffith, Hay and West Wyalong	Parkes Hume Farrer Riverina Eden-Monaro*	12.9*	23,900
14	VIC	Inner North West Melbourne (18)	North Western Melbourne	Melbourne CBD, Brunswick and Glenroy	Batman Maribyrnong Melbourne Wills Melbourne Ports	12.5*	47,000
15	QLD	Far North Queensland (45)	Northern Queensland	Cape York Peninsula, Thursday Island and Mission Beach	Kennedy Leichhardt	12.5*	15,700
16	QLD	Wide Bay (41)	Central Queensland, Wide Bay, Sunshine Coast	Bundaberg, Maryborough and Mundubbera	Flynn Hinkler Wide Bay	12.3*	16,100
17	NSW	Hunter (11)	Hunter New England and Central Coast	Forster, Muswellbrook and Cessilis	Hunter Shortland Lyne Newcastle Paterson New England	12.1	74,500
18	NSW	Western Sydney (5)	Western Sydney	Parramatta, Blacktown and Marroota	Berowra Parramatta Greenway Chifley Mitchell Reid Bennelong Blaxland McMahon	12.0*	50,600
19	QLD	Greater Metro South Brisbane (36)	Brisbane South	Woolloongabba, North Stradbroke Island and Beaudesert	Bonner Bowman Forde Griffith Moreton Oxley Rankin Wright	11.9	96,200
20	NSW	Central Coast NSW (9)	Hunter New England and Central Coast	Gosford, The Entrance and Kulnura	Robertson Dobell Shortland	11.9*	32,700

* Estimate has a relative standard error between 25 per cent and 50 per cent and should be used with caution
* Only a small populated area of the electorate falls within the Medicare Local

Medicare Local catchments (now superseded by Primary Health Networks) by state/territory

Hot spots are based on the proportion of the population with signs of CKD for Australian urban and rural Medicare Local catchment areas. Data was not available for all urban and rural Medicare Local areas due to high confidence intervals. Note that Medicare Local catchment areas have been superseded by Primary Health Networks (PHNs). Detailed PHN and federal electorate information is presented here.

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CONCLUSION

Clinical & Moral Imperative

Regardless of whether you work in one of the top 20 CKD hotspots in Australia or not, we hope this e-learning experience has impressed upon you both the clinical and moral imperative that exists to make a focussed effort to improve CKD screening practices in the primary care setting.

PLEASE DON'T FORGET TO COMPLETE THE SURVEYS ON THE NEXT PAGES IN ORDER TO HAVE YOUR CPD CERTIFICATE SENT TO YOU. IN DOING SO YOU WILL BE AUTOMATICALLY ENTERED INTO THE PRIZE DRAW TO WIN ONE OF THREE $100.00 COLES GROUP AND MYER GIFT VOUCHERS

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THANK YOU
Thank you for completing the surveys to evaluate the effectiveness of this e-learning program.
The classification and management of CKD will be discussed in future programs yet to be developed, but in the meantime, refer to the CKD management booklet below to learn more about how your practice can support the evidence based management of people with CKD.
Chronic Kidney Disease (CKD) Management in General Practice
Guidance and clinical tips to help identify, manage and refer patients with CKD in your practice
Kidney Health
Prevent. Detect. Support.
KCAT
CKDDetect
References
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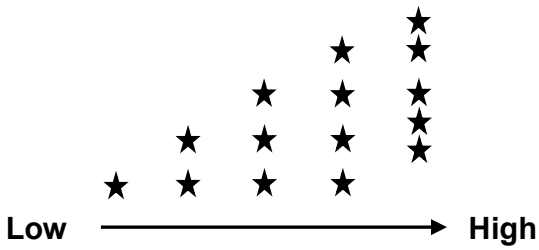
Appendix 20: Learning Object Review Instrument (LORI) Version 1.5 review sheet

Please score each domain by highlighting the number awarded



1. Content Quality: Veracity, accuracy, balanced presentation ideas, and appropriate level of detail	1	2	3	4	5		NA
2. Learning Goal Alignment: Alignment among learning goals, activities, assessments, and learner characteristics characteristics	1	2	3	4	5		NA
3. Feedback and Adaptation: Adaptive content or feedback driven by differential learner input or learner modelling	1	2	3	4	5		NA
4. Motivation: Ability to motivate and interest an identified population of learners	1	2	3	4	5		NA
5. Presentation Design: Design of visual and auditory information for enhanced learning and efficient mental processing	1	2	3	4	5		NA
6. Interaction Usability: Ease of navigation, predictability of the user interface, and quality of the interface help features	1	2	3	4	5		NA
7. Accessibility: Design of controls and presentation formats t accommodate disabled and mobile learners	1	2	3	4	5		NA
8. Reusability: Ability to use in varying learning contexts and with learners from differing backgrounds	1	2	3	4	5		NA
9. Standards Compliance: Adherence to international standar and specifications	1	2	3	4	5		NA

General comments:

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