APPENDIX 1

The Development of Nursing and the Rapid, Cost-Effective expansion of High-Quality UHC

Appendix 1 sets out the evidence base for nurses as determinant of high-quality UHC and its rapid and cost-effective expansion.

A. RAPID

"The current pace of health worker production will need to be significantly accelerated to meet [future] demand…Maintaining the status quo in health worker production and employment is expected to result in too slow a progress (or even a worsening gap, especially in countries that are already lagging behind in their health outcomes) and continuing global imbalances."

This quote, from WHOs Global Strategy on Human Resource for Health: Workforce 2030 (WHO, 2016), highlights the essential mismatch between the rate at which demand for health services is growing, and the rate at which the capacity of the healthcare workforce is able to grow to meet it. For most countries aspiring to Universal Health Coverage (UHC), getting there will require a growth in capacity of the health workforce that exceeds that of demand.

Some of this growth will come from an increased production in the number of health professionals but capacity requirements are unlikely be met by an increase in numbers alone, and in any case "more of the same" is not the most effective response. Health professional numbers are often limited by the high cost of training and employment, and the extended periods of training that make lead-times long. High rates of attrition also contribute to the erosion of workforce growth rates. In the face of such challenges, many health systems are now also looking to expand capacity by improving workforce productivity – the productivity of individuals, teams and health systems.

The development of nursing will be crucial to the speed with which health systems are able, both to accrue numbers, and to improve workforce productivity.

1. Rapidly scaling capacity by unleashing productivity in the existing nursing workforce

One way to more rapidly increase capacity in the healthcare workforce is by maximising the contribution of the existing workforce. There is now a growing body of evidence that the skills of doctors, nurses and other professionals are underutilized and at over 50% of the clinical workforce, nurses represent a significant proportion of that latent productivity.

In 2011/12 for example, the European PIACC study (Programme for the International Assessment of Adult Competencies) reported that of all nurses surveyed, 79% reported performing tasks for which they were overqualified (OECD, 2013). When asked if overall they considered themselves to be

overqualified for their role, the 2010 European Working Conditions Study (EWCS) found that 28% of nurses said they did (Eurofound, 2012).

These findings were corroborated by the European RN4CAST study surveying 33,000 nurses working in 486 hospitals across 12 European countries (Bruyneel, 2013). This study identified a number of tasks commonly performed by nurses for which they were overqualified - delivering and retrieving food trays, transporting patients within the hospital, cleaning patient rooms and equipment and retrieving equipment.

Even in advanced roles, nurses are often unable to practice at their full potential. A 2010 review of Advanced Practice Nursing in the United States Veterans Administration (Faris et al., 2010) found that APNs were still frequently asked to do basic tasks for which they were overqualified – something the report found negatively impacted their job satisfaction. Another 2007 study of APNs found similar results for APNs working in primary care (Hysong, 2007).

It is difficult to extrapolate these findings. All of the studies were conducted in High Income Countries and some sample sizes were small. However, the findings do indicate a latent capacity residing in existing health workforces, and suggests productivity could be improved by health professionals, particularly nurses, working closer to the limits of their professional scope of practice.

The flip side of these findings is that nurses (and other health professionals) sometimes feel simultaneously under-skilled for their role. In the PIACC study for example, 43% of nurses reported they felt they would need further training to cope well with their current duties, and in the EWCS, 17% reported that overall, they felt under-skilled in their job.

Maintaining and updating the skills of clinicians is essential to the quality and safety of the care they provide. It is also, by inference, essential to maintaining the productivity of the workforce. As disease burdens, treatment modalities and health systems evolve, the roles of professionals will too. Continuous Professional Development (CPD) is essential to ensure the workforce is able to adapt and respond so that their skills are matched with the profile of skills required.

The United Nations Educational, Scientific and Cultural Organization have argued (UNESCO, 2015) that traditional pipeline models of clinical education fail in this regard. Being so heavily orientated towards pre-service over in-service training, makes expansion of the healthcare workforce expensive and lengthy. Instead, UNESCO advocate for a switch of focus towards more apprenticeships, more in-work training and more CPD. Such a move it argues, could lead to a more affordable and rapidly expandable workforce. Again, with nurses accounting for over 50% of the professional healthcare workforce, investment in their continued professional development will be crucial to delivering this.

2. **Shifting towards a more rapidly scalable skill-mix in the future workforce**

The skill mix of a workforce, that is the ratio of different healthcare workers and professions to each other within it, can determine how rapidly scalable that workforce is. Those that rely heavily on health workers with long training periods, such as physicians and specialists – will take longer, whereas those anticipating a greater reliance on staff with shorter training periods have the potential to expand more quickly.

Professional scope of practice legislation is a key determinant of the healthcare workforce skill mix (Buchan et al., 2002), determining as it does, the distribution of work between those health professionals. Broadening scopes of practice, particularly for non-physician staff, can facilitate movement to a new skill mix, one that is more reliant on non-medical staff and hence more rapidly scalable.

Brazil is a good example of a country where a changing skill mix has enabled it to increase health coverage rapidly. In 1988, Brazil established its Unified Health System (or SUS, *Sistema Único de Saúde*). It rapidly expanded the training capacity of both physicians and nurses but it disproportionately expanded training of Community Health Workers, which it employed at a ratio of 4:1 to nurses in its Family Health Programme (Buchan et al., 2011). As a result of the reforms, health coverage of Brazil's population grew from around 50% in 1988, to over 75% two decades later (WHO, 2010). Many other countries, particularly Low- and Middle-Income Countries, have utilised CHWs to achieve a more rapid up-scaling of their health workforce capacity (Dahn et al., 2015).

Countries vary widely however, in their scope of practice legislation for non-physician staff and this is especially true for nurses (Maier et al., 2016). This is despite a strong body of evidence supporting the safety and effectiveness of nurse prescribing and advanced nurse practice (see Section C). Similar variations exist in the extent to which countries utilise the services of Community Health Workers (CHWs), again, despite evidence demonstrating their effectiveness in providing essential health services across a range of specialties (WHO, 2018).

The extended use of nurses is central to the achievement of a more rapidly scalable skill mix; they have the potential for relatively rapid additional advanced and specialist training and development , and can play a facilitating role in ensuring successful role out of CHWs.

3. **Scaling the workforce more rapidly by stemming the loss of the existing workforce**

Retention has a profound effect on workforce growth rates. In the UK for example, Health Education England estimate the nurse vacancy rate in 2017 would be halved if retention rates had remained stable in the preceding five years (PHE, 2017).

Turnover rates are rarely measured consistently across the globe as the definition of turnover often varies between countries. Some measurements include movement of nurses internally within an organisation while others do not, and some nurses stop practicing but remain on the nursing register, which can further

complicate measurement. A recent review of studies using the same methodology reported turnover rates of 15% in Australia, 20% in Canada, 27% in the USA and 44% in New Zealand (Duffield, 2014).

With nurses the largest single professional group of clinicians globally, improving their retention rates, even marginally, has the potential to significantly affect workforce growth rates and capacity to deliver UHC. A recent policy brief on nurse retention, published by the International Council of Nurses (Buchan et al, July 2018), summarises the available evidence for effective nurse retention strategies, though the report cautions that, "much of this material is localised, and either descriptive or opinion based; relatively little is devoted to reporting on evaluated impact of well designed policy." It also cautions against extrapolating the findings too widely as solutions are highly context specific.

B. COST-EFFECTIVE

Investment in the development of nursing is a cost-effective means of expanding capacity in the healthcare workforce and in doing so, progressing towards Universal Health coverage (UHC).

1) Investment in nursing as a means to a more cost effective skill mix

Skill mix, that is, the relative ratio of workers and professionals to each other within the healthcare workforce, can have a profound effect on the cost of scaling that workforce. Those relying heavily on professions that cost a lot to train and employ will be more expensive to scale than those that don't.

International evidence suggests that countries vary widely in the skill mix of health professionals they deploy (Fulton et al., 2011). While some variation is to be expected based on differences in factors like disease burden and service structure, evidence suggests not all differences are accounted for by these factors. The implication of this finding is that countries vary too in the allocative efficiency of their workforce and that with a different skill mix, some countries could achieve the same health outcomes at lower cost.

A systematic review by Seidman et al (2017) looks more closely at the impact of skill mix on health system efficiency and cost effectiveness in LMICs. The review found evidence to show that task shifting led to cost savings and efficiency improvements in a number of the countries studied. The evidence was strongest in the management of tuberculosis and HIV/AIDS but malaria, NCDs, NTDs and management of childhood illness also showed potential. These findings were strongest in primary and community care. The study considered health outcomes and cost savings simultaneously to ensure that one was not achieved at the expense of the other.

A rapid review of the evidence for the Commission on Health Employment and Economic Growth took a different approach to evaluating the cost-effectiveness of skills mix (Health Employment and Economic Growth: An Evidence Base, WHO, 2016). While it found only inconclusive data on the cost-effectiveness of different skill mixes at national level (Twigg et al., 2015; Caird et al., 2010), it did find evidence to suggest nurses were as effective as doctors in performing certain tasks and surmised that, "to the extent that one can assume the use of nurses and midwives to be less costly than that of doctors, this would suggest that "some" task shifting towards nurse-provided care could be an efficiency-increasing and hence economically sensible approach, in that it would produce better (health) outcomes for a given budget (or the same outcomes for less resources)" (Goryakin et al., 2011). Evidence for the effectiveness of nurses as substitutes for physicians is presented in Section C of this Appendix.

At a hospital or clinic level, studies have shown a positive impact on cost effectiveness when proportionately more professional nurses are included in the hospital skill mix (Needleman et al., 2002; Cho et al., 2003; Blegen et al, 2011;

Unruh et al., 2003) but these findings are not always replicated and systematic reviews are inconclusive (Butler et al., 2016).

In addition to their own contribution, nurses can help improve the cost-effectiveness of the workforce through their role supervising Community Health Workers. Community Health Workers are a cost-effective means of delivering essential health services (McPake etal., 2015; Vaughan et al., 2015; Dahn et al., 2015) but regular and systematic supervision is required to improve their performance (Yeboah-Antwi et al., 2010; Mogasale et al., 2010; Djibuti et al., 2009; Mbindyo et al., 2009; Källander et al., 2013). Nurses can play an important role in supervising and motivating CHWs.

2) Investment in nursing as a more cost-effective means to up-scaling primary care.

WHO's Global Strategy on Human Resources for Health: Workforce 2030 identifies the expansion of primary care as an essential component of achieving cost-effective Universal Health Coverage. Nursing will be an essential component of delivering cost-effective primary care.

a) Nurses and Health Promotion

Nurses deliver many cost-effective health promotion and disease prevention interventions in primary care. For example, nurses deliver many of WHO's "Best Buy" interventions for NCD prevention such as: hepatitis B immunisation, cervical screening and counselling for people at high risk of developing heart attacks and strokes (WHO, 2011). Nurses also deliver cost-effective interventions to reduce maternal and child mortality such as providing antenatal care and advice and childhood vaccinations (Horton and Levin, 2016).

Addressing NCDs through existing health programmes can maximise reach and reduce the cost of intervention, for example, including smoking cessation as part of Directly Observed Treatment Short-course (DOTS) programmes for tuberculosis patients (Kaur et al., 2013).

b) Nurses as Primary Care Providers

There is now a strong body of evidence to support the effectiveness of nurses as primary care providers as summarised in a recent Cochrane review (Laurant, 2018).

Results for the cost-effectiveness of nurse-led primary care services however, is mixed. Two systematic reviews found them to be cost-effective (Naylor 2010; Newhouse 2011), whereas four others found there to be little or no difference in cost (Hollinghurst 2006; Martin-Misener 2015; Martínez-González 2015b; Swan 2015).

The review explored reasons for this divergence in findings, explaining how "savings on nurse salaries may be offset by nurses' longer consultations and nurse

rates as compared to doctor rates. On the other hand, nurses probably adhere better to guideline recommendations, and their patients are probably more likely to attend return visits, which may positively affect health outcomes and reduce costs over the medium to long term."

The review concluded however, that the quantity and quality of evidence was too low to draw conclusions about cost-effectiveness. The review recommended that future studies of nurse-doctor substitution include comprehensive cost-effectiveness analyses with broader benefits defined and included. For example, it suggested looking at the impact that changes to nurses' working practices have on the behaviours of doctors and on their workload. Only three of the included studies evaluated this and only one study considered savings from the cost of training (Campbell, 2014). In addition, none of the studies considered the effect nurse-led primary care services might have on the cost-effectiveness of the health system as a whole.

c) Nurses in Rural and Remote practice

Nursing may be a more cost effective means of delivering primary care to rural and remote regions. Whilst efforts to encourage more physicians into rural practice have been successful, they are often expensive (OECD, 2016). For countries without the fiscal or financial space to pay doctors to work in those specialties and those regions, development of nurse roles to provide such care may be a cost effective alternative.

A recent study in the United States for instance, showed that Nurse Practitioners are more likely to be located in areas of low socioeconomic and health status than are physicians (Davis et al., 2018) and that those NPs working in rural practice were more likely to practice in primary care (Spetz et al., 2016).

3) Addressing nurse retention as a cost-effective means to increasing workforce capacity

A recent policy briefing from the International Council of Nurses (Buchan et al., 2018) on nurse retention outlines the evidence on estimated cost of nurse turnover, which is thought to be at least several month's wages and considerably more when specialist skills are lost. One US study estimated a turnover cost of between 0.75 and 2 times annual salary for a staff nurse (Bland et al., 2004), with a significant proportion of that thought to be attributable to the cost of temporary replacement (McClure et al., 1983). One paper seeking to make a business case for nurse retention (Bland et al., 2007) acknowledged that while it is a widely held belief that the benefits of nurse retention far outweigh their costs, the evidence to support policy makers in their decisions is lacking due to the difficulty of making a full and accurate assessments of the wider benefits.

C. QUALITY

As well as being able to offer rapid and cost-effective expansion of UHC, nursing is able to ensure the expansion of high-quality UHC too. Demonstrating the impact of nursing on quality of outcomes can be challenging. As nurses often work as part of a multi-disciplinary team, eliciting the contribution of nurses to the outcome of a patient is hard. Some nurse-sensitive indicators exist - rates of falls or pressure sores, for example - but most evidence for the impact of nursing tends to focus on the broader contribution of nursing to quality such as nurse education levels or nurse:patient ratios. For Nurse Practitioners operating more autonomously, patient outcomes can be more directly attributed to the contribution of nursing care.

In general, evidence to support the contribution of nurses to care quality is limited. Much of the evidence originates from high-income countries, particularly the US and Europe and much is hospital based. It was widely acknowledged in the literature that more research, particularly nurse-led research, is required to inform policy makers and drive reform.

The evidence presented in this Appendix is by no means exhaustive. Due to time constraints, evidence was collated from a start set of studies recommended by Advisory Board members, with further studies identified via a snowballing technique. In compiling the evidence, themes emerged, with studies tending to fall naturally into categories. In grouping the findings, we have broadly followed the classification of evidence used by Coster et al. in their recent overview (Coster et al., 2018).

The study presented at the end of this appendix, is an example of the kind of high-quality, condition-specific reviews of the evidence that will be required to demonstrate the impact of nursing on care quality. It reviews the scope, extent, quality and efficacy of nurse-led interventions for type 2 diabetes and permission to publish it prior to journal publication, as part of this report on Nursing and UHC, was granted by the lead author, Professor Helena Legido-Quigley of Singapore University.

1. Nurse density

A rapid review of the evidence on effectiveness of nursing interventions (WHO, 2016) looked at national level data to assess the relationship between nursing density and aggregate health outcomes. The evidence was mixed.

Two studies (Anand et al., 2004; Speybroek et al., 2006) found a significant relationship between increasing combined density of midwives and nurses and reduced maternal mortality. However, the two studies failed to find a significant relationship between combined nurse and midwife density, and other mortality outcomes, including infant and under-5 mortality.

Three further studies also failed to find a link between the combined density of nurses and midwives and national level data on mortality (Carr-Hill et al., 2013),

DALYs (Castillo-Laborde et al., 2011), measles immunisation, TB case diagnosis and care of acute respiratory infection (Kruk et al., 2009).

2. Acute Care Settings

Evidence shows that better educated nurses provide better care. The biggest and most recent meta-analysis to show this (Liao et al, 2017) highlighted a study (Aitken et al., 2017) showing that for every 10% increase in the number of nurses with a university degree, mortality fell by 0.1% and it reduced the odds of Failure To Rescue by 5% (Failure to Rescue is a nurse sensitive indicator related to the quality of nursing observations).

For Nurse Practitioners, five systematic reviews (Carter and Chochinov, 2007; Edkins et al., 2014; Jennings et al., 2015; Kleinpell et al., 2008; Woo et al., 2017) show that in the acute care setting, Nurse Practitioners are able to offer high quality care that is as good or better than usual care (often physician-led care). Common indicators of quality included time to treatment, mortality and patient satisfaction.

Higher nurse:patient ratios in the acute care setting are associated with lower rates of patient mortality (Lang et al., 2004; Kane et al., 2007; Shekelle et al., 2011) and lower rates of complications such as infection (Penoyer, 2010), pressure sores and urinary tract infections (Hart and Davis, 2011).

A Cochrane review of nurse staffing models in hospitals however (Butler et al., 2011), found it was unable to make any firm conclusions about the effect of nurse staffing levels on patient death rates, attendance at the emergency department or readmission rates, because of the paucity and quality of data, particularly for Low and Middle Income Countries. It did however, find more evidence for the addition of specialist nurses to the nursing staff, which it concluded was likely to result in shorter patient hospital stays and reductions in pressure ulcers.

3. Public Health

a. Health promotion

Evidence for the impact of nursing on health promotion tends to look at either individual risk factors, such as smoking and breastfeeding, or on bundles of risk factors, such as those for cardiovascular disease and complications of diabetes. There is also evidence to show that nurses provide more health promotion as part of their consultations.

Smoking, obesity and hypertension are some of the most common modifiable risk factors for NCDs and nurse interventions have demonstrated effectiveness in controlling them. A recent Cochrane review (Rice et al., 2017) found moderate quality evidence that behavioural support for smoking cessation delivered by nurses led to a significant increase in the number of people achieving prolonged abstinence. A meta-analysis looking at control of hypertension (Clark et al., 2010) concluded there was also moderate evidence nurses were more successful than

doctors in controlling blood pressure when guided by clinical protocol. Weight management by nurses in primary care was less effective than other interventions like dieticians and commercial weight loss programmes (Jolly et al., 2011) but there was modest evidence for the effectiveness of school nurses in reducing Body Mass Index (BMI) in obese school children according to one meta-analysis (Schroeder et al., 2016) and three reviews (Schroeder et al., 2016, Katz etal., 2008; Sobol-Goldberg et al., 2013).

Regarding bundles of risk factors, four systematic reviews (Sargent et al., 2012, Halcomb et al., 2007; Fleming and Godwin, 2008; Brown et al., 2009) found moderate evidence that with appropriate training, primary care nurses could safely deliver lifestyle interventions to the same standard as other health professionals for a combination of either weight reduction, blood pressure management, diet, exercise or cholesterol control.

b. Vaccinations and hygiene

There is evidence that uptake of vaccinations in the community is improved when non-physicians provide the service. A meta-analysis by Lau et al. (2012) showed that when non-physicians (especially nurses) switched to providing influenza vaccines in high-income countries, uptake rose by 44%. This is thought to be the result of nurses being able to offer education and reassurance about vaccination.

Bustreo et al., (2015) described how well suited nurses are to improving uptake of vaccines because of their closeness to the community. Health worker understanding of barriers to uptake in the local community is likely to be extremely important in improving uptake of vaccines according to a recent Cochrane review (Oyo-Ita et al., 2016).

c. Outreach and Home Visiting

There is moderate evidence for the effectiveness of home visits to improve morbidity in older people (Stuck et al., 2002; Tappenden et al., 2017) with the evidence best for low acuity populations with rates of morbidity under 6% (Bouman et al., 2008), though some reviews found inconclusive evidence for overall effectiveness (van Haastregt et al., 2000; Bouman et al., 2008).

In visiting mothers and children, health visitors have demonstrated effectiveness at improving rates of breastfeeding, detecting postnatal depression, reducing unintentional injury and improving the intellectual development of low birth-weight infants. There was insufficient evidence in the review to demonstrate impact for longer-term outcomes like child's diet, family planning or child neglect (Elkan et al., 2000).

Early family intervention by nurses have shown mixed results. One review (Olds et al., 2007) found nurses were effective at addressing prenatal health and child development issues in high risk families, while others found inconsistent results (Pontoppidian et al., 2016).

4. Chronic Disease Management

a. Nurse-led clinics

Three systematic reviews (Martínez-González et al., 2014; Newhouse et al., 2011; Allen and Dennison, 2010;) found evidence to show nurses provide good quality secondary prevention of chronic airways disease and heart failure across indices such as blood pressure, lipids, physical activity, dietary intake, cigarette smoking, weight loss, healthcare utilization, mortality, quality of life and psychosocial outcomes. Another review (Al-Mallah et al., 2016) found evidence for the effectiveness of nurse led clinics in the successful management of cardiac disease, reporting lower incidences of morbidity and mortality, including the incidence of further cardiac events.

A Cochrane review (Driscoll et al., 2017) found nurses operating in nurse-led clinics were more effective than primary care physicians at titrating beta-blockers for heart failure patients, resulting in lower rates of patient hospitalisation and Garner et al. (2017) showed nurse-led clinics were successful in managing patients with Rheumatoid Arthritis.

One systematic review looked at task-shifting for cardiovascular risk reduction in low-income and middle-income countries and found positive outcomes for nurses in the secondary prevention of cardiovascular disease (Ogedegbe et al., 2014). Another systematic review looking at nurse management of patients with diabetes, hypertension and hypercholesterolaemia found nurses were marginally more successful than doctors in improving self-management behaviours but that the effects were difficult to maintain (Gorina, 2018).

A review of nurse-led interventions for type 2 diabetes (Tan, 2018) found that nurse management has a positive impact on blood sugar, cholesterol, blood pressure and patient satisfaction levels. It also had a beneficial effect on protocol adherence, diabetes education levels and self-care. These benefits were positively associated with the amount of time nurses spent with each patient. The review also found evidence that nurses involvement in care benefitted minority populations due to the cultural understanding between nurse and patient since the nurses shared similar backgrounds with the patient. Only two out of 17 studies included in the review, found the positive effects of nurse-led care to be short-term.

b. Education and self management

Two reviews (Massimi et al., 2017; Tshiananga et al., 2012) showed low to moderate evidence that nurse-led self-management interventions had a positive impact on NCDs compared to usual care. The condition for which evidence was strongest was diabetes (Welch et al., 2010), with some evidence for the effectiveness of nurse-led care in reducing patient anxiety and physician visits after provision of self-care advice for COPD patients (Baker and Fatoye, 2017). A Cochrane review (Kuethe et al., 2013) found no significant difference in the quality of self care advice provided by nurses or physicians for asthma patients and a

study by Rees et al. (2009) found that patients were more likely to contact a nurse than a doctor for advice on self-management.

A Cochrane review (Weeks et al., 2016) comparing the prescribing practices of physicians and non-physicians found low to moderate evidence that non-medical prescribers were just as effective as physicians at controlling blood pressure, blood sugar levels and cholesterol levels, and achieved similar levels of medication concordance, patient satisfaction and quality of life (incidence of adverse events was not studied).

5. Comparison of Nurse and Physician led care

Most reviews comparing nurse and physician led care focus on primary rather than acute care (Laurant et al., 2018; Maier et al., 2016; Martinez-González et al., 2015; Martinez-González et al., 2014a; Swan et al., 2015; Laurent et al., 2005; Horrocks et al., 2002). The most recent Cochrane review (Laurant et al., 2018) builds on a previous review from 2005 and takes into account all subsequent studies. It found moderate evidence that nurse-led primary care led to slightly fewer deaths among certain groups of patients than physician led care. It also found moderate evidence that blood pressure outcomes were slightly improved in nurse-led primary care though other clinical outcomes are probably similar. Further, the review found that patient satisfaction is probably slightly higher in nurse-led primary care and quality of life may be slightly higher. In addition, the review found little or no difference between doctors and nurses in the number of prescriptions and attendance at Accident and Emergency units and there was little or no evidence of a difference in the number of tests and investigations, hospital referrals and hospital admissions between doctors and nurses. In particular, one study from the Netherlands, concluded that 75-83% of clinical activities in out-of-hours primary care settings (weekend shifts in GP practices) could be performed by nurse specialists (van der Biezen et al., 2016).

Many studies, particularly those comparing doctor and nurse care in Low and Middle Income Countries, look at protocol adherence as a process indicator. A review by Ogedegbe (2014) found nurses in the LMICS studied had a positive impact on secondary prevention of cardiovascular risk factors by adhering to protocols, and a review by Some et al. (2016) found low-grade evidence that nurses were as effective as doctors in providing protocol guided care for NCDs in Kenya.

Joshi et al. (2014) looked at task shifting of NCD management from physicians to non-physicians and found that when using protocols, these health workers (most of which were nurses) were as effective as doctors at screening for and medically managing coronary heart disease, epilepsy, depression and diabetes.

A Cochrane review (Kredo et al., 2014) found no difference in the quality of care provided by physicians and non-physicians (again, mainly nurses) when managing HIV. An earlier review (Callaghan et al., 2010) found moderate evidence that nurses and other non-physicians provide high quality care when managing patients with uncomplicated HIV.

6. Task Shifting to Invasive Procedures

Task shifting of invasive procedures is becoming a more common practice globally, but particularly in LMICs (Federspiel et al., 2015; Hoyler et al., 2015). Evidence for the effectiveness of non-medical staff to perform invasive procedures is still limited however and very little exists to distinguish the effectiveness of nurses from other non-medical personnel. There is some evidence supporting task shifting from doctors to other personnel for male circumcision (Ford et al., 2012), vasectomies and fitting of contraceptive devices (Polus et al., 2015), although the quality of data is low. More published data is required in this area to ensure the safety of staff and patients. Many surgical and anaesthetic procedures carried out by mid-level providers in LMICs are unsupervised compared to 90% in High-income countries (Federspiel et al., 2015).

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Summary of literature review on: Examining the scope, extent, quality, and efficacy of nurse-led interventions on the management and/or care of type 2 diabetes mellitus

Tan, See Mieng; and Legido-Quigley, H.

Aim

This literature review aims to examine the scope, extent, quality, and efficacy of nurse-led interventions on the management and/or care of type 2 diabetes mellitus in selected groups of participants.

Methods

The inclusion criteria for searching for relevant peer-reviewed journal articles in this endeavor were- (1) general populations who are afflicted with type 2 diabetes mellitus with related comorbidities and may be receiving treatment, (2) interventions must be nurse-led, meaning that nurses have to take the lead or are given the responsibility to deliver the intervention, (3) the articles must be published in the year 2000 or after, and (4) reported in English language.

This systematic review presents in detail a subset of the results of a larger systematic review exploring the health system barriers and facilitators to the prevention and treatment and control of type 2 Diabetes (5). The search strategy drew on that used by Maimaris and colleagues (6) in their health systems and hypertension systematic review. Key words (MeSH terms) and free-text terms were identified for each domain of our health systems framework and combined with search terms for T2DM outcomes to generate search strategies for Medline, Embase, and Global Health. In addition, modified searches were performed on Latin American and Carribean Health Siences Literature (LILACS), Africa-Wide, Index Medicus for the South-east Asian Region (IMSEAR), Index Medicus for the Eastern Mediterranean Region (IMEMR), and Western Pacific Rim Region Index Medicus (WPRIM). All databases were searched from inception to 22 February 2017.

Two reviewers independently screened search results by title and abstract for potential eligibility. Full-texts of potentially suitable articles were obtained and further screened by two reviewers. Disagreements were resolved by a third reviewer. To increase the chances of finding other relevant studies focusing on nurse-led interventions, we checked through the reference lists of relevant studies to see if these references include reports of other studies that might be eligible for the review. We also contacted experts for more information on the topic of the review.

Data extraction for study setting, methodology, and findings

A data extraction form was created in Microsoft Excel. Two reviewers independently extracted data on design, setting/context, health system domain/s investigated, outcomes and relevant findings, and checked for disparities.

Database searching identified 6,975 records, with 5,620 remaining after duplicate removal. After screening of titles and abstracts, 175 full-text articles were retrieved. 19 studies were included in the final qualitative synthesis.

Risk of bias assessment

All the articles were appraised for risk of bias. Depending on the nature of study, either the Cochrane Risk of Bias assessment tool or the ROBI risk of bias assessment tool was used. Studies that had a low risk of bias in all domains were classified as having a low overall risk of bias while studies that had a high risk of bias in all domains were classified as having a high overall risk of bias. If the risk of bias varied amongst the domains, the overall risk of bias would be based on majority count. Studies that had an unclear risk of bias in one or more domains would be classified as overall unclear risk of bias. Based on this quality assessment, there were ten studies which attained an overall of low risk of bias [2-5, 7 10, 12, 13, 20 and 22], three studies displayed unclear risk of bias [6, 14-15], two had low to moderate risk of bias [18 and 19], three had moderate risk of bias [1, 21 and 23], and one demonstrated high risk of bias [17].

Characteristics of included studies

19 papers met the inclusion criteria. Six papers originated from the United States of America [1,3,6,14,21-22], six papers originated from the Netherlands [2,5, 13,17,19,23], while four were from the United Kingdom [4,10, 18,20], and the remaining were from other parts of the world such as South Africa [7], Canada [15], and Israel [12]. Eight were randomized controlled trials [2,4,6, 10, 14, 20-22], seven followed observational study designs such as cohort, cross-sectional, and pre-post [1,5,7,13,17-18,23], and the remaining four were a process and outcomes study [3], a prospective controlled randomized single-blinded study [12], a prospective randomized open-label study [15], and a parallel clinical trial [19].

All studies involved nurses in particular levels of responsibility in the administration, deliverance, or provision of type 2 diabetes management or care intervention programs. The nurses took the lead in these programs either solely, in terms of nurse-led clinics, or shared the responsibility unequally with general practitioners and/or other healthcare professionals, taking on most of the responsibility than their healthcare counterparts. The types of nurse roles involved in these programs consisted of the Nurse Practitioner, Practice Nurse, Diabetes Specialist Nurse, and Nurse Case Manager. All of these nurses were existing registered nurses with some amount of job experience and had received formal and/or informal training and/or instructional teaching prior to the commencement of the intervention programs. The training and/or teaching were of varied durations and were conducted by a variety of healthcare professionals who are conventionally involved in diabetes care. These professionals were usually the general practitioners, the diabetologists, and the pharmacists. The population studied included inpatient, outpatient or community-dwelling participants who were afflicted with type 2 diabetes mellitus.

Results

Findings from 17 of the studies consisting of eight randomized controlled trials [2,4,6, 10, 14, 20-22], a retrospective pre-post study [1], a process and outcome study [3], a retrospective cohort study [5], a cohort study [7], a prospective controlled randomized single-blinded study [12], a quasi-experimental pre-post test study [17], a repeated cross-sectional observational study [18], a parallel clinical trial [19], and a prospective observational study [23] demonstrated positive effects of having nurses take the lead in intervention programs. These positive effects included enabling participants to experience lower outcome measurements for HbA1c [for e.g., 7], diastolic and systolic blood pressure [for e.g., 10 and 14], and better patient satisfaction [for e.g. 21] with regards to the diabetes care received. Moreover, more patients in the intervention groups could attain their targets or goals in accordance to set guidelines, protocols or algorithms for glycaemic control, blood pressure, and/or total cholesterol [for e.g. 20 and 22]. The targets were standardized based on established protocols or guidelines specific to the country of study. Furthermore, with the nurses' constant or regular monitoring or assessment, it was observed that more patients could adhere to medical treatment for type 2 diabetes [for e.g. 15], benefit from diabetes education provided by the nurses [for e.g. 22], and gain more self-management or self-care strategies [for e.g. 17]. Adherence to treatment plans was found to be generally high with nurses' involvement primarily because of the higher level of attention and/or focus given to each participant's unique disease trajectory as well as lifestyle and dietary habits and preferences by the nurse-in-charge. The amount of time dedicated by the nurse to consultation with each patient at the initial screening visit, then subsequently on regular assessment visits was found to be positively related to their adherence to their individualized treatment plans that was drawn up with their mutual agreement. Proper documentation of baseline measurements by the nurses and better communication established between nurse and participant were also identified as beneficial to the diabetes management and care rendered. Two studies indicated that their interventions were warmly embraced not only by the patients, but also by their family members and other healthcare professionals [7 and 17]. It was also found that having nurses take on the primary role in rendering diabetes care and/or management could benefit minority populations, such as the African-Americans, to markedly improve on their diabetic conditions [3]. This positive outcome was aided by appropriate cultural understandings between nurse and participant, since the nurses shared similar cultural backgrounds with the participants. Diabetic specialist nurses were also found to be potentially cost-saving by reducing hospital length of stay [4], enabling safe and efficacious care that are comparable to a physician-led intervention [12], bring about better quality of care without increasing the number of physician visits [14], and enable diabetic patients to enhance their levels of diabetes knowledge [17].

Notably, two studies did not find evidence or statistically significant effects arising from nurses' heavier responsibility in the management and/or care of type 2 diabetes mellitus in comparison with the control group [13, 16]. In these studies, it was generally acknowledged that nurses' involvement did bring about noticeable changes or improvements in certain health indicators, such as

reductions in HbA1c. However, these changes remained as short term effects and did not sustain over the long term or gave unclear results in the long term.

Conclusion

In conclusion, the overall findings from these studies are encouraging. The improvements, influences, or reductions noted did provide ample justification that there was considerable value-add when nurses led the interventions or were involved in greater responsibilities in diabetes management and/or care while working in close collaboration with physicians or other healthcare professionals. However, it has to be noted that the positive enhancing effects tended to be context specific, and investigators had recommended for further studies to be conducted to examine particular aspects of nurses' interventions in greater detail. Overall, these findings validated nurses' continued involvement in such areas of responsibility in diabetes management and care.

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Table 1 Table of included studies on nurse-led interventions on Type 2 Diabetes

Nurse Led Activity	Study	Setting and sample size	Study design	Findings (95% CIs Given in Brackets Where Available)	Specific contributions made by nurses
Nurse Practitioner-Based Diabetes Care Management	Chang et al, 2007	USA Patients enrolled in a nurse practitioner-managed diabetes care coordination program N=259	Retrospective pre-post cohort study	Mean reductions in glycosylated hemoglobin (HbA1c) associated with the program were 2.4% for the telehealth intervention and 2.39% for telephone intervention	Assessed patients at enrollment, established individualized treatment goals and plans with patients, coordinated services across the continuum of care, and followed clinical practice guidelines to adjust medications.
Delegation of routine diabetes care to a practice nurse	Cleveringa et al, 2008	Netherlands Patients who were type 2 diabetic and registered with primary care practices throughout Netherlands N=3391	Cluster randomized trial	Delegation of routine diabetes care to a practice nurse combined with computerized decision support and feedback did not improve A1C but reduced cardiovascular risk in type 2 diabetes patients (CI 1.3-2.1)	Practice nurses ran one-hour long diabetic consultation sessions with patients and provided patient-specific treatment advice
Nurse-directed diabetic care in a minority population	Davidson, 2003	Los Angeles Type 2 diabetic patients from 3 county clinics N=711	Process and outcomes study with 1 experimental group and 1 control group (1 clinic closed down abruptly due to administrative reasons)	Nurse-directed diabetes care is effective in markedly improving diabetes in 7 out of 10 outcomes in a minority population.	Manage diabetic patients in experimental clinics by following protocols and algorithms

Hospital diabetes specialist nursing (DSN) service	Davies et al, 2001	UK Diabetic inpatients from the University Hospital of Wales (UHW), Cardiff, Wales. N=300	Prospective RCT	The intervention produced a mean cost per admission of £436 lower than that of the control group (P = 0.19). Patients in the intervention group were more knowledgeable regarding their diabetes and more satisfied with their care.	DSN care included individual structured patient education appropriate to need, and practical management advice including verbal and written case-note feedback to ward-based medical and nursing staff.
Introduction of practice nurse and subsequent evaluation of the quality of type 2 diabetic care rendered	Engelson et al, 2009	Netherlands Type 2 diabetic patients from 5 genera practices N=397	Retrospective cohort study	Findings indicate that delegating diabetes care to a PN leads to significant improvements in diabetes care. All process measures – except performance of funduscopy – improved significantly. Mean HbA1c decreased from 6.8% to 6.5% (2003–2007: ns, 2005–2007: $p < 0.01$), mean LDLcholesterol from 3.2 to 2.7 mmol/L ($p < 0.0001$) and mean total cholesterol/HDL-cholesterol ratio from 4.5 to 3.7 ($p < 0.0001$). For systolic blood pressure, the number of patients reaching targets increased considerably in 2007.	The PN's role in intervention involved her taking over all the annual check-ups for the patients in four of the five general practices. This amounted to approximately half of the quarterly check-ups.
Nurse case manager (NCM) intervention on risk factors for diabetes related complications	Gary et al, 2003	East Baltimore Type 2 diabetic African Americans N=186	RCT	Combined NCM/Community Health Worker (CHW) interventions may improve diabetic control in urban African Americans with type 2 diabetes. Although results were clinically important, they did not reach	NCM interventions were 45-min face-to-face clinic visits and/or telephone contacts. The NCM coordinated care according to the American Diabetes Association (ADA) Clinical Practice

				statistical significance.	Recommendations for all participants assigned to the nursing and the combined NCM/CHW group. She provided direct patient care, management, education, counseling, follow-up, referrals, and physician feedback and prompting, which included advising regimen changes and implementing changes under physician's orders. The goal was to conduct visits approximately three times per year, plus additional contacts as needed.
Diabetes Specialist Nurse (DSN) and locally trained diabetes nurse deliver intervention program	Gill et al, 2008	Hlabisa District, in northern Kwazulu Natal, South Africa Diabetic patients n=284	Cohort study	The outcomes from this intervention were positive; Hb1Ac as the program's main assessment parameter, was taken at three time points- at baseline, at 6 months and at 18 months. Findings showed that Hb1Ac was reduced from 11.6 at baseline to 8.7 at 6 months and finally to 7.7 at 18 months, and there was no increase in hypoglycaemia. The subgroup analysis performed evinced that diabetes education was also effective in controlling Hb1Ac (10.6 at baseline to 7.6 at 18 months). The intervention program also gained popularity amongst the patients, their next-of-kin, and other health workers.	The nurses delivered the intervention, which consisted of an education session, one-to-one consultation, routine measurements of weight, body mass index, urinalysis, and blood pressure, random blood glucose measurements by a monitor, enquiries made to patients concerning their general well-being and hyperglycaemic or hypoglycaemic symptoms, as well as an assessment of the patient's current drug treatment, adherence, and potential side-effects.

Specialist nurse-led intervention to treat and control hypertension and hyperlipidemia in diabetes	New et al, 2003	Hope Hospital, Salford, United Kingdom. Individuals with either type 1 or type 2 diabetes N=1407	RCT	Significant improvements in achieving targets after 1 year (CI: 1.11-1.69). Via secondary analysis, targets were achieved more frequently for hyperlipidemia (CI: 1.25-2.29, p=0.0007) than for hypertension (CI: 0.86-1.51, p=0.37). The intervention group showed a decrease in all-cause mortality (CI: 0.32-0.92, p=0.02).	Ran specialist nurse-led clinics (separate for hypertension and hyperlipidemia) for participants with attendance every 4-6 weeks, provided lifestyle advice according to local guidelines. Different specialist nurses ran the different clinics, and they were disallowed to intervene with medical conditions beyond the focus of their designated clinic.
Nurse-guided insulin treatment protocol	Segal et al, 2015	Israel Adult patients who were not critically ill and afflicted with Type 2 diabetes and were hospitalised N=53	Prospective, controlled, randomized, single-blinded study	Glycaemia deviation from liberal range (60–300 mg/dL) was 7.4% of days for nurse-guided, basal-prandial insulin treatment protocol (NGP) and 7.84% for physician-guided therapy (PGT), P = 0.901. Rate of glycaemia deviation from the strict range (100–180 mg/dL) was 49.76% for NGP and 47.38% for PGT, P = 0.703. Mean range of daily deviation was similar (77.05 mg/dL for NGP and 76.04 mg/dL for PGT, P = 0.93). There were no significant differences in safety parameters.	Nurses contributed in terms of implementing an insulin treatment protocol to hospitalised adult patients afflicted with Type 2 diabetes. They also took and recorded all measurements during the 7-day participation period for each patient.
Role of nurse practitioner (NP) in delivering optimal diabetes care	Spigt et al, 2009	Netherlands Electronic patient records of patients diagnosed with Type 2 diabetes at 1 Jan 2006 were obtained from 10 healthcare centres staffed by 45 GPs. N= 1849	Observational study	Large variations found amongst the 10 selected healthcare centres in the percentage of diabetes patients receiving optimal care. The probability to receive good quality care lay with the provision of diabetes education	Nurse practitioners were involved in diabetes care in these health care centres but their roles were not elaborated in the study

				program, annual check-ups conducted by both GP and a nurse practitioner, opportunity for the patient to consult with the NP whose condition is subsequently discussed with the GP, and the availability of structured follow-up measures to ensure patient adherence. Furthermore, the study found that the provision of diabetes education shared a positive association with the quality of diabetes care. Another finding related to the "relevance of structural cooperation between the GP and the NP" where the quality of diabetes care was demonstrably better when GP and NP engage each other to discuss ways to discuss the patient's care.	
Nurse-care management system to improve outcomes in patients with complicated diabetes	Taylor et al, 2003	Santa Clara, CA, USA N=169 Patients afflicted with diabetes	RCT	The intervention group had more patients (42.6%) who managed to attain their Hb1Ac goals (<7.5%) compared to the control group (24.6%, p<0.03) who had only received standard care. Average reductions in Hb1Ac, total cholesterol and LDL cholesterol were found to be higher in the intervention group than in the control group. No significant changes were found in the patients'	Nurse-care managers met with recruited patients to draw up their individual treatment goals together, facilitated group sessions, and made telephone calls to patients to provide advice on medication management and self-care activities.

				psychosocial variables.	
Nurse-directed hypertension treatment	Tobe et al, 2006	Canada Type 2 mellitus patients who were persistently hypertensive, >18 years old. N=99	Randomized, prospective, open-label study with 2 parallel groups (n=50 for intervention group, n=49 for control group)	Patients in the intervention group experienced a more pronounced reduction in diastolic blood pressure than those in the control group ((by 11.6 [SD 10.6] mm Hg v. 6.8 [SD 11.1] mm Hg respectively; p = 0.05). Although both the intervention and control groups did experience a notable decrease in systolic blood pressure by the last visit, the differences observed between the two groups were not significant. Similarly, both groups did not experience any variations in urine albumin excretion or incidence of adverse events.	The home care nurse assessed all patients from both groups at baseline and then at subsequent designated intervals to record and monitor their hypertensive and diabetic conditions, such as taking their blood pressure measurements, and taking urine and blood samples. The nurse could, with indirect supervision from a hypertension specialist, initiate a stepped up protocol to help the patient attain his blood pressure target.
The nurse specialist as main care-provider for patients with type 2 diabetes in a primary care setting	Vrijhoef et al, 2002	Venlo, the Netherlands Type 2 diabetes patients N=103	Quasi-experimental pretest–posttest study	Findings showed that mean HbA1c of patients from the intervention group had improved from 0.3% to 7.7% (p=0.001). Even when OHA or insulin treatment was levied to patients from the intervention group, their mean HbA1c improved by 0.4% to 8.4% (p=0.008), whereas the same outcome had deteriorated in the control group by 0.3% to 8.5% (p=0.005). Moreover, the intervention group recorded improvements in mean diastolic blood pressure, by	The diabetes nurse provided direct patient care (i.e. taking medical history, physical examination, interpretation of laboratory results, and administration of findings); harmonised and planned the care rendered (documentation of limitations in care, made referrals to and collaborated with other care-providers); provided consultation (i.e. advice to patients and other care providers); and developed expertise (i.e. education of patients,

				4.0 to 80.6mmHg (n ¼ 124; p ¼ 0:000), in total cholesterol concentration, by 0.1 to 5.6 mmol/l (n ¼ 130; p ¼ 0:048), and in the concentration of triglyceride, by 0.2 to 1.8 mmol/l (n ¼ 128; p ¼ 0:005). In terms of patient satisfaction, the intervention group recorded high and fairly constant mean satisfaction rates. Patients from the intervention group displayed a higher level of disease-specific knowledge about diabetes (p=0.000) and demonstrated an increase in mean consultations made with the diabetes nurse (p=0.000). In the area of self-care, patients from the intervention group fared best in bodily observation and conditioning, demonstrating a statistically significant improvement (p=0.000).	themselves and other care-providers).
Specialist diabetes nurses supported 1° and 2° Care, while practice nurses with an interest in diabetes management ran the nurse-led practice clinics	Whitford et al, 2004	United Kingdom N=571 type 2 diabetic patients selected randomly	Repeated cross sectional observational study	<u>Between the years 1991 and 2001</u> Decreases in body mass index (76.8 vs. 71.3%, p= 0.01) and Hb1Ac measurement (92.2 vs. 86.4%, p < 0.001). Improvements in smoking status (72.4 vs. 82%, p< 0.001), and eye screening result (86.1 vs. 91.3%, P< 0.001). The study also recorded notable improvements in systolic blood	No mention made

				pressure, diastolic blood pressure and cholesterol. There was however, a notable decline in HbA1c and creatinine, though there was no change in body mass index.	
Practice nurses who ran the Dutch Diabetes Service	Groenveld et al, 2001	Netherlands N=246 patients afflicted with type 2 diabetes were recruited from 15 general practices	Parallel clinical trial with randomisation at practice level	The trial did not find statistically significant improvements in health outcomes across the board though the Diabetes Service demonstrated a positive influence to fasting blood glucose levels, without affecting glycaemic level and other risk factors. For eg, the final average glycaemic level fell more in the intervention group than in the control group (7.19±1.2%, vs 7.59±1.8%, p=0.06). The intervention group benefitted from a significantly lower final Hb1Ac (p=0.001) and also had a lower number of patients who were referred to hospital specialists (1 vs. 14).	Practice nurses play supportive roles to the GP in delivering the Diabetes Service by counselling, monitoring and educating diabetic patients
Nurse-led hypertension clinic	Denver et al, 2003	London, UK N=120 outpatients referred from the hospital's diabetes clinic	Randomized control trial	Participants in the nurse-led intervention group scored better than those in the control group in terms of systolic blood pressure (5.9-19.3, p=0.0001) and were thrice likely to attain their target systolic blood pressure. Moreover, there were significant decreases in 1-year CHD	Assess patients at first visit by measuring and recording their principal diagnoses, allergies, lifestyle habits, and current treatments received. The nurses also measured blood pressure and collected a urine sample. Subsequently, nurses saw patients monthly

				(p=0.004) and stroke (p=0.000) in the nurse-led group.	over three months and then every six weeks for three months. At each visit, the nurses would measure and record the patient's blood pressure. The nurses also dispensed non-medical advice to patients with regards to healthy lifestyle habits and called for new treatment adjustments for the patients, depending on their unique conditions. All patients from both groups were reviewed by the nurses at the end of the study and had their biometric parameters taken and recorded.
Nurse practitioners responsible for developing treatment regimens that incorporated patient preferences and for assessing treatment adherence, individual barriers to adherence, family support for treatment	Litaker et al, 2003	Cleveland, Ohio, USA N=120 patients diagnosed with mild or moderate hypertension and have non-insulin dependent diabetes without known end-organ complications	RCT	Participants from the intervention group experienced significant improvements in mean HbA1c (-0.7%, p= 0.02) and HDL-c (+ 2.6 mgdL71, p= 0.02). Also, the satisfaction with care improved significantly for these participants in several sub-scales.	During office visits and telephone contact, the nurse practitioner was responsible for developing treatment regimens that incorporated patient preferences and for assessing treatment adherence, individual barriers to adherence, family support for treatment.
Nurse case management (NCM) on blood pressure (BP), hemoglobin A1C, lipids, and diabetes complication screening.	Gabbay et al, 2006	Penn State Hershey Medical Center, USA N=332 Type 2 diabetes patients	RCT	Overall NCM improved blood pressure, diabetes-related emotional distress, and process measures in primary care. Significant decrease in blood pressure in the intervention group from 137/77 to 129/72 compared to a rise in blood pressure in the control group from	Nurse case manager conducted initial appointment with patient by working with the patient to set behavioural goals, establish an individualized care plan, and provided patient self-management education. The NCM also monitored the patients, made appropriate

				136/77 to 138/79 after 1 year. A lowering of emotional stress led to a reduction of PAID score from 23 to 10. Complications screening experienced significant improvements as well.	referrals whenever necessary, arranged for protocol-driven laboratory tests, followed the outcomes, and made beneficial recommendations according to the established diabetes guidelines. Furthermore, the NCM applied particular diabetes management algorithms under the direction of the patient's primary care physician (PCP) (a family physician or an internist).
Diabetes specialist nurse (DSNs) took on extensive or limited task delegations from General Practitioners (GPs)	Ubink-Veltmaat et al, 2005	Netherlands N=2660 type 2 diabetes patients	Prospective observational study	Participation rates were high for the patients, at 90%, and there were no dropouts amongst the participating GPs. The process control results were most pronounced for Intervention A—foot examination, eye examination, HbA1c, blood pressure, total cholesterol, creatinine, body mass index and known smoking status in Intervention A had all improved and were all statistically significant ($p<0.001$ for all factors). Furthermore, all investigations and measurements were conducted more often for Intervention A than B. Targets were better attained in Interventions A and B rather than C. Intervention A demonstrated a high range of 84%	DSNs in Intervention A were responsible for performing annual examinations for patients according to established guidelines, provided customized one-on-one patient education, conducted one-to-one consultations with patients, and arranged for referrals to various specialists whenever the need arose. DSNs in Intervention B could provide on-demand consultations to patients. However, this arrangement could only be initiated by the GP. This arrangement was reportedly to be infrequently utilized.

				to 90% of patients who could attain targets for annual check-ups, whereas Intervention B managed a range of 15% to 85% instead. In contrast, the percentage of patients who could achieve targets in Intervention C stayed constant or decreased (ranging from 2% to 72%). Outcome control results for blood pressure and total cholesterol had both been enhanced in Interventions A & B; both were statistically significant at $p<0.001$. Conversely, there were no changes recorded from Intervention C.	