Hospital nurse practitioners – models, roles and scope of practice: a rapid review

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An **Evidence Check** review brokered by the Sax Institute

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This rapid review was brokered by the Sax Institute.

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EXECUTIVE SUMMARY

A rapid review was commissioned by NSW Treasury in August 2009 to examine the impact of hospital nurse practitioners models and roles. The scope of the review was to identify areas of research that have examined the value of nurse practitioners in hospital settings.

Summary of key findings

- Internationally, there were 95 nurse practitioner (NP) roles found in health related fields. NPs were managing acute and chronic patient conditions within in-patient and/or outpatient settings
- NP areas of practice which extended beyond current New South Wales (NSW) roles and scope included: intensive care services (adult, paediatric and neonatal and retrieval); emergency departments (Minor Injury Units, Walk-in centres); surgical (pre/postoperative roles) and anaesthetic services (pre/postoperative roles); acute cardiology; acute neurological services; general medical (respiratory, chronic disease management); oncology/haematology (transfusions, chemotherapy, post oncology surgery, organ transplantation) and primary health care
- Internationally NPs were conducting or assisting in medical procedures. Australian NPs did not appear to undertake many of these procedures. Nurse practitioner procedures included: chest tube insertion; central line replacement; arterial line insertion; and endotracheal intubation, and as assistants in surgery and assistants for insertion of a pulmonary artery catheters. The research strongly supports the potential direction for NP utilisation within the area of critical care, anaesthetics, clinical procedures, minor surgery, and outpatient services
- No appreciable difference was found between NPs and doctors in patient health outcomes. Patient satisfaction scores, in the majority of studies, were higher for NP care. Adherence to practice guidelines and appropriate medical record documentation was more reliable by NP than medical staff
- Evidence of a positive economic impact by NP models, compared with doctors (routine care), was commonly demonstrated. Observed cost savings flowed from shorter hospital length of stay, reduced investigations and interventions, and reduced patient complication and (re)admission rates
- Regarding NP accountability many doctors perceived that a NP should be accountable to them in keeping with the physician assistant model
- The scope of practice, independence and autonomy of Australian NPs was significantly less than international roles. The NSW emergency department NP role was the most comparable role. International evidence would suggest that an increase of the Australian NP workforce could potentially provide an opportunity for extensive health care reform in both primary care and acute services
- Australian NP barriers are similar to those experienced internationally. Key international NP barriers included: legislation and regulation issues; prescribing restrictions; lack of role knowledge (scope of practice) by hospital administration, physicians and the general public; lack of local mentorship and role support; and poor collaboration with physicians regarding introduction and team development. However, management of these barriers has been ongoing for decades and so political and organisational barriers were less of a focus in recent literature. NPs considered themselves to be supported

- New South Wales barriers focused on professional and authorisation processes, guidelines and formulary requirements, health care provider and patient education issues. There were minimal employment opportunities to obtain the clinical hours (5000 hours) required for NP authorisation. Nurses needed to self fund a university Masters program to attain authorisation. There was minimal evidence of organisational and practice evaluation infrastructure to support NP roles
- It was unclear from the evidence how the Australian consumer would accept NP led health care services. However, a more positive atmosphere of acceptance for NP models may be reliant on changing consumer perception of health care utilisation
- Broadly, medical arguments used to reduce or inhibit expansion of NP health care roles fell into three main categories. Firstly, substitution of care was perceived as a risk to medical workforce opportunity and thereby posed a threat to income and employment. Secondly, that medical care was the 'best care' and so NPs offered less safe and appropriate care. Thirdly, all health disciplines have had different responses to changing health care needs. However, medical staff strategies have remained largely intent on increasing medical trainee numbers. There was little evidence on which to gauge the impact of competition between physician and non physician groups.

Whilst generally many studies were methodologically weak the volume, breadth, depth and consistency of findings provided strong support for NP roles. There were limited randomised controlled trials (RCTs) with the majority of research quasi-experimental, with comparative or before-and-after study designs dominating. Sample populations were usually convenient cohorts (subsequently randomised) and rarely were sample sizes calculated. Data collection was not always comprehensive or systematic and variables were not explicitly measured. Hospital databases or self-reporting tools were commonly utilised. Quantifying interventional outcomes was difficult as the research was often descriptive and failed to detail a statistical significance. Nonetheless, analysis was often reliably measured. Internationally NPs appear sustainable, acceptable, efficient and affordable to lead many acute and chronic health care service models.

1 Background

A rapid review was commissioned by NSW Treasury in August 2009 to examine the impact of hospital nurse practitioner (NP) models and roles. The scope of the review included a focus on national and international studies but excluded published NSW data. The review was conducted in the context of the Garling Commission Report, the National Health and Hospital Review Commission and additional funds to support reform. The review focused on the potential of NP roles within hospital settings that (i) undertake a broader range of tasks than are currently part of approved NSW Health clinical guidelines or (ii) generally increase organisational efficiencies. The review included but was not limited to consideration of wound care, emergency department, and paediatrics.

The review identified areas where research had examined the value of NPs in hospital settings. For each area:

Research objectives	Key questions
1. Identify relevant studies and their quality	i. Identify all relevant peer reviewed papers emerging from Europe, North America, Australia or New Zealand ii. Indicate the methodological quality of identified papers iii. Review the results of the papers with the best available methodologies iv. Review published and grey literature to identify any recent examples of use of the potential reform in Australia or New Zealand
2. Identify examples of the use of NPs in hospital settings in NSW/Australia	i. Reviewed all health department web sites and literature ii. Review key NP Association sites iii. NP reports from governmental agencies
3. Identify examples of the use of NPs (or overseas equivalents) in hospital settings overseas only NP Advanced Practice Nurse (APN) titles	i. Literature search of relevant databases ii. Review by key words/MeSH headings iii. Review of acute and primary health areas
4. Outline where tasks identified overseas or in other states in Australia are additional to those undertaken by NPs in NSW Health	i. Review scope of NP roles within international literature ii. Compare NSW Health NP roles and guidelines
5. Outline the evidence of benefits and downsides of the use of NPs in hospital settings including impacts on quality of care, efficiency gains, and costs	i. Review of methodological value of NP literature ii. Review impact variables for patient outcomes, organisation outcomes, NP outcomes
6. Outline, where relevant, any data relating to the role of information technology, rural and remote care, out of hours care, training issues and modifications to systems or structures required to support the use of NPs in hospitals	i. Examine NP literature ii. Examine for impact on NP role iii. Examine for impact in geographically diverse areas iv. Examine NP utilisation of technology v. Examine grey literature for implementation issues
7. Provide a two sentence summary of the balance of benefits and downsides of the use of NPs in hospital settings relative to medical practitioners	i. Synopsis of most relevant and rigorous study findings

2 Method

Data Sources

Accessing electronic databases was the primary method used to search for relevant literature. Data sources included: General databases – Medical Literature Analyses and Retrieval (MEDLINE), The Cumulative Index of Nursing and Allied Health Literature (CINAHL); PubMED; PROQUEST; and ScienceDirect; Systematic reviews – The Cochrane database of Systematic Reviews (CDSR). Search Engines – Google scholar; and Organisational websites: United Kingdom (UK) – National Health Service (NHS) service delivery; Royal College of Nursing, United States of America (US) – American Nurse Practitioner Association; Canada – Canadian Nurses Association, Canadian Nurse Practitioner Association British Columbia; New Zealand – Ministry of Health, Nurse Practitioners New Zealand, the Nurse Practitioner Advisory Committee of New Zealand; Australia – NSW Health; South Australia Health; Victoria Health; Western Australia Health; Tasmania Health; Commonwealth Department of Health and Ageing; Australian Primary Health Care Research Institute.

Data extraction

The literature review extracted data from 1980–2009. NP studies which examined the impact on acute services, emergency care and primary health care were sought. The search was conducted with key words which were combined with nurse practitioner (Table 1). The setting (acute and chronic care, hospital, outpatient, inpatient), and design (RCT, controlled, before-and-after study, quasi-experimental, comparative), and role (e.g. skills, staff mix) were used as further search criteria. Physician assistants were captured within the review. Specified Medical Subject Headings (MeSH) were used for the search (Table 2). A search was undertaken for systematic reviews and RCTs. Hand-searching of reference lists from significant articles was also undertaken and electronic links to additional related materials were accessed. No language restrictions were applied.

The search identified 3248 studies and all titles and abstracts were reviewed. There were 1048 studies considered relevant. Literature was categorized into RCTs (35) or quasi-randomised (7), comparative studies (94) (retrospective or prospective) or descriptive, policy or professional studies (864), Cochrane reviews (25), systematic reviews (18) with meta-analysis (6). Fifty-one of the included studies compared NP and physician assistant. Where no RCTs were available, non-randomised research designs were included. There was minimal evidence of technology impact for NP. The grey literature was examined and included. Two hundred and thirty-four were found to be relevant and included in the reference list. Of these, 49 were considered to be the most relevant and have been summarised in the tabulated reference list.

Much of the evidence lacked a strong research design. The majority of studies varied in settings and methodology (heterogeneous sample, small sample, short study period, short follow-up) variables were not explicit, often descriptive in nature; single site samples; and/or only measured a single variable outcome such as patient satisfaction.

Studies noted an impact on services but often failed to show a statistical difference to confirm findings.

3 Nurse practitioner: a contextual perspective

Internationally, 95 NP roles were identified, which were located or colocated within hospitals inpatient or outpatient services (Table 3). The NP was defined as an advanced, clinically experienced registered nurse, who holds an academic postgraduate degree (Masters level). The NP role included patient diagnosis (disease, condition, injury), investigations (order and interpretation), management (and referral) and prescribing medication (unrestricted and restricted medication) (ANMC, 2002). NP roles were framed within a collaborative model but with varying levels of autonomy and independence.

In 2005 there were 64 NPs authorised in NSW. Of which 38 were working in 15 clinical areas with 58 approved guidelines. However, 19 nurses were also in 'transitional/candidate NP positions' (in an approved NP position but working towards authorisation). In Victoria, there were four NP 'transitional NP positions' (three Women's Health & one Emergency) and four Palliative Care candidates. In Western Australia, there were 23 NPs in 25 designated areas with 10 NP approved guidelines. South Australia had 28 endorsed NPs. Queensland had implementation processes in place and authorisation has begun, although numbers were difficult to obtain. For Northern Territory and Tasmania implementation processes were in place but there were no authorised NPs (National Nursing & Nursing Education Taskforce, 2005).

While many NSW NP roles existed within the international literature, the scope, independence, autonomy and range of activities was significantly less. Hence, despite the broad disciplinary similarities, studies have been included where the NP's scope, practice and procedural roles varied from the 58 NSW NP guidelines.

The NP role was well established in the US (1960s), UK (1980s), Canada (2000) and to a lesser extent Australia (1995) and New Zealand (2000). In the 2005 US Census survey there were 2.4 million registered nurses (2005) and 141,209 (5.8%) were NPs. There are 6,000 NPs educated annually. Within the role, 39% hold hospital privileges, and 13% have long term care privileges, 96.5% usually prescribe medications and write 19 (mean) prescriptions/day (The US Census Bureau 2005). In Canada by 2005, there were 1,026 licensed NPs. A 2005 survey identified 75% of NPs were employed full-time (compared to 51%–54% of registered nurses). Within Australia there are 202,735 registered nurses (Australian Institute of Health and Welfare, 2006) and approximately 350 (0.17%) authorised NPs (National Nursing & Nursing Education Taskforce, 2005). In New Zealand by 2006 there were 25 NPs authorised (Ministry of Health New Zealand, 2006).

NPs in the US have prescriptive privilege, including controlled substances (excluding four states). Annually NPs write over 513 million prescriptions. A national self-reported survey identified 62% of NPs managed three to four patients/hour, while 12% see more than five patients/hour. Twenty percent of NPs practiced in rural or remote areas, while 66% practice in primary care health sites and acute care areas. Malpractice rates remained low (1.4%) (American Academy of Nurse Practitioners, 2009).

The average US full-time NP base salary was USD81,060 across all specialties and settings, average full-time NP total income is USD87,400 (Becker et al., 2006; Jamesetta, 2006; Loman and Hung, 2007; Pulcini, Vampola and Levine, 2005; The American Academy of Nurse Practitioners, 2009). NSW NP base salaries range from AUD95,388.80–102,138.40 (Workplace Relations & Management, 2009) and for UK NPs from UK £24,831–33,436 (NHS Health, 2009a). By comparison, US trainee specialist junior medical officer (postgraduate from first to fifth year) annual salary ranges were from USD51,540–652,340 (MD Salaries, 2009) and in the UK from £43,464 to £68,343 (NHS Health, 2009b). Salary comparisons were difficult to interpret as oncost, inflation and

standard of living varied across countries. Alternatively, health care salary comparisons were examined as a percentage of Gross Domestic Product (GDP). For example, the US health care expenditure constitutes 15.3% of GDP; Australia 9.6%; UK 8.1%; Canada 9.9%. In 2006 data, total health care costs for medical specialist, GPs and nurses (as a percent cost ratio per capita of GDP) respectively were 5.7:4.1;1.4 (US); 4.9:3.9;1.4 (UK); 5.1:3.4; unknown (Canada); 7.6:2.8;1.5 (Australia) (Peterson and Burton, 2007).

Within Australia the title Nurse Practitioner is protected, with only those authorised able to use it (Gardner et al., 2006). Australian nursing and midwifery regulatory bodies authorise NPs individually within each state, raising issues for consistency. However, not all state professional jurisdictions require the recording of the practice area (such as Queensland and Western Australia), rather an individual is authorised and the role undertaken is often inconsistently defined or developed by the NP, department and/or institution. NP national competencies have been developed, although application of these within authorisation processes remains unclear (Gardner, et al. 2006). In contrast, New Zealand has one authorisation process regulated by one professional board (Lund, 2004; Ministry of Health New Zealand, 2006).

Internationally some confusion in nomenclature surrounds the nurse practitioner name. Nurse practitioner names were often used interchangeably with clinical nurse specialist, clinical nurse consultant, advanced practice nurse (Duffield & O'Brien-Pallas, 2002; Duffield, Pelletier and Donoghue, 1995). In the US clinical nurse specialist, and in the UK clinical nurse consultants, were further examples of NP roles (Glover et al., 2006). Consequently, for consistency within this review, the title nurse practitioner (NP) will only be used.

4 Physician assistants

In the US, Canada, and UK, physician assistants (PAs) and NPs developed as a result of workforce issues, service delivery needs, medical training regulations and availability of clinical physician hours (American Academy of Physician Assistants, 2008). In 2008 there were 79,980 Physician Assistants practising in 60 different specialty fields (American Association of Physician Assistants, 2008). The course of this role has followed much the same trajectory as that of the NP, driven by service inefficiencies, inequitable physician distribution and efforts to reduce costs. Unlike the NP role, educational standards were not nationalised and training was largely provided by medical schools. Qualifications ranged from medical school certificates (6,843; 26.7%), associate degrees (1,469; 5.7%) Bachelor degrees (10,302; 40.3%) to Masters Degrees (10,887; 42.5%) (American Academy of Physician Assistants, 2008). The physician assistants annual income was USD85,710 (median) and the mean was USD89,897. The mean age of students is 25 years and the majority (71%) are female (American Academy of Physician Assistants, 2008).

In the US physician assistants were reported to manage around 257 million patient visits and prescribed or recommended approximately 332 million medications. A US survey identified physician assistants were involved in family/general medicine (26%), general internal medicine (5%), general paediatrics (3%), and obstetrics/gynaecology (2%); surgery/surgical subspecialties (25%), emergency medicine (11%), the subspecialties of internal medicine (10%), and dermatology (4%) (American Academy of Physician Assistants, 2008).

A 2008 annual survey conducted of Physician Assistants (n=27568; 34.5%) identified the majority of respondents (93%) were directly involved in clinical practice. The specific work settings reported by 20% of respondents were hospital inpatient units (35%), emergency departments (30%), specialty physician practices (31%), intensive care/critical care units (23%), surgical services (22%), and hospital outpatient clinics (21%).

5 Findings of the literature review

The extent of NP involvement in health care delivery was significant. The majority of the NP research originated from the UK, the US, Canada, and to a lesser degree, Australia and New Zealand. The role has more recently expanded into clinical procedural clinics and outpatient care services. Today NP positions are located within all health care disciplines, although the research in terms of rigor was varied. NP models had varying levels of medical involvement from independent to close medical supervision (surgical assistant NP). Despite mixed findings and methodological issues, the evidence supported and confirmed that NPs provided a significant contribution to health care. NPs are an integral member of the international health workforce.

The need to meet service demand and control health care costs had largely driven the development of NP roles (Ettner et al., 2006; Mundinger et al., 2000). The following review highlights that the impact of the international NP workforce on health care was significant. Given the international experience an increase in the Australian NP workforce could potentially provide an opportunity for extensive health care reform in both primary care and acute services.

The following NP areas, which extended beyond current NSW NP roles and scope, intensive care services (adult, paediatric and neonatal); emergency department (Minor Injury Units, Walk-in centres); surgery (pre/postoperative roles) and anaesthetic services (pre/postoperative roles); acute cardiology; acute neurological services; general medical (respiratory, chronic disease management); oncology/haematology (transfusions, chemotherapy, post oncology surgery, organ transplantation) and primary health care provided the greatest evidence of health care service impact. There was minimal evidence of NPs and the role of technology and impact for rural and remote care. National and international literature detailed similar barriers to the implementation and sustainability of NP roles within health care.

6 Intensive care services

Summary: The NP had equivalent or better patient outcomes than physicians. NPs improved patient clinical outcomes by reduced patient complication and mortality rates. Studies demonstrated more often positive financial outcomes with reduced intensive care unit (ICU) length of stay, hospital length of stay and (re)admission rates. Patients managed by NPs had significantly shorter hospital length of stay (P=.03), shorter mean length of stay in ICU (p<.001), and lower patient complication rates (p<.05). One study reported the NP patient group was hospitalised for 2,306 fewer days than the medical group (total cost saving of USD2,467,328). Neonatal NP infant costs were USD18,240 less per infant than those managed by doctors. In contrast, another study identified neonatal NP group costs were higher (USD141,624) compared with the medical group (USD139,388) (median hospital charges). There was evidence that intensive care physicians believed that NPs should have a supervising physician.

In Australia there was minimal evidence of NP impact on adult, paediatric or neonatal ICUs. In the 1990s the intensive care NP role began to develop first in the US followed by the UK, Canada, Australia and New Zealand. The NP was specifically educated to manage critically ill patients. From 1995 national NP authorisation was available in the US. By the year 2000 there were more than 5,000 NPs (Ford, 1981). The NP developed largely due to the clinical needs of the critically ill patients and had extended into all intensive care fields (adult, neonatal and paediatric) (Caserta, Depew and Moran, 2007). In the US, PA roles began at the same time as the NP role. Given the scope of the review, PAs have only been discussed relative to outcomes from comparative NP studies. Many NP studies compared NPs with PAs and or medical officers (routine care). For the most part they examined patient management outcomes and complications.

Kleinpell-Nowell (2001) conducted 5 year longitudinal survey of NP role development. Responses (545 NPs) from one year identified that the role included: assessment, diagnosis and management, coordination of patient care, interactions with family members, consultation, and discharge planning. The survey identified 68% were based in ICUs or undertaking acute care procedures.

Adult intensive care services

Within NSW and Australia there was no evidence of NP impact within adult intensive care services. In the US, Hoffman et al. (2003) compared NP and trainee physicians (pulmonary/critical care fellows) in the management of ICU patients. The 12-month comparative single site study was set in a high dependency medical unit. NP work activities were examined (direct management of patients, coordination of care and non-unit activities). Comparisons between NPs and physicians identified both spent half their time in activities related to patient management (40% vs. 44%, not significantly different). However, NPs spent more time in coordination of care (p<.001), less time in non-unit activities (p<.001); and more time interacting with patients and collaborating with health team members. Physicians spent more time in non-unit activities.

A study by Rudy (1998) compared NPs (n=11) and PAs (n=5) with medical officers (MOs) (n=unknown) for care activities and patient outcomes in one ICU. The US study had a large sample size and lasted 14 months. The NPs/PAs had 187 patients and the trainee physician group

had 202 patients. Again no difference in clinical outcomes was identified between patient groups.

In the US, Kirton et al. (2007) investigated the 'mid level' practitioner (NPs/PAs) staffing for the Department of Surgery (five surgical services: general surgery, vascular surgery, cardiothoracic surgery, plastic surgery, and transplant surgery, and three ICUs: neurointensive care, cardiac, and general surgery). Data was extracted from clinical decision software, hospital staff and financial databases. The study demonstrated improvement in clinical coverage and workload staffing efficiency with NP/PA staff. Two of the three surgical ICUs (neurointensive care and cardiac units) had NPs/PAs, while the general surgical ICU had mixed coverage consisting of ICU fellows and postgraduate trainee physicians. The addition of NP/PAs in combination with medical staff ensured better clinical coverage of the critically ill patients across all surgical services. The study reported (although not defined) a significant reduction in medical staff overtime costs.

An additional role demonstrated by UK NPs in 2001 was management of ICU patient discharges. Increasingly critical care areas needed to discharge patients resulting in highly dependent patients being monitored and cared for by general ward staff. Within the UK national recognition of the changing ward requirement led to strategies to improve the continuity and quality of care for critically ill patients. The monitoring and management of post-ICU patient discharges reduced the potential for deterioration and adverse outcomes (Caserta et al., 2007; Haines and Coad, 2001). Evidence of a similar role was piloted in Australia between 1997 and 2002. In Victoria the ICU 'Liaison Nurse' was to 'oversee' the transition of ICU discharged patients. The outcome measure was ICU readmissions. Evidence of reduction was found although only percentages were provided 2.3 to 0.5% (Green and Edmonds, 2004).

The national US survey undertaken by Kleinpell and Goolsby (2006) identified NPs were involved in procedural medical roles. Australian NPs did not appear to undertake any of these procedures. The US NP procedural role included: chest tube insertion, central line replacement, arterial line insertion, and endotracheal intubation, and as assistants in surgery and physician-assisted insertion of a pulmonary artery catheters.

A study by Russell et al. (2002) in the US explored NP patient complication rates compared with routine surgically directed care in two critical care units. The six month study enrolled 402 patients. Patients managed by NPs had significantly shorter hospital length of stay ($p=.03$), shorter mean length of stay in ICU ($p<.001$), and lower patient complication rates ($p<.05$). The NP patient group was hospitalised 2,306 fewer days than the other group (total cost saving of USD2,467,328). The study provided statistical evidence of positive clinical and financial outcomes. Similarly a retrospective study by Meyer and Miers (2005) identified gains when NPs directed postoperative care (a collaborative team model) with cardiovascular surgeons compared to cardiovascular surgeon only directed care. Findings showed patient length of stay reduced by 1.91 days at an estimated cost of USD5,038.9 per patient. NP-physician coordinated teams demonstrated improved hospital costs and patient length of stay.

Other studies have demonstrated improvement in patient length of stay for critically ill trauma patients. In the US, Spisso et al. (1990) compared trauma NPs with routine MO care. The findings (19868–7), while old, identified trauma NPs were associated with a decrease in length of stay from 8.10 to 7.05 days (mean). Length of stay for other hospital patients remained the same during the study period. Medical record documentation improved substantially. Randomly sampled discharge summaries were completed in more than 95% of NP notes compared with MOs (75%). The trauma complaint rate decreased from 16 to 7 per year. When NPs were rostered to shifts medical staff time saved was 352 minutes per day (mean). With the introduction of the NP into the outpatient clinic, waiting times decreased from 41 to 19 minutes. However statistical relevance was not provided.

NPs had widely demonstrated reduction in hospital length of stay through good guideline adherence. A recent US study by Burns et al. (2003) conducted in a university hospital used a before-and-after study design across five adult ICUs (coronary care, medical, neuroscience, surgical trauma and thoracic cardiovascular). The 12-month prospective longitudinal study reviewed hospital and clinical databases. Four NP managed (with evidence-based protocols) patient sedation and mechanical ventilation weaning for ICU patients. The patient sample was large and included 595 pre NP patients and 510 NP patients. The patient ventilator duration reduced (p=.0001), ICU length of stay reduced (p=.0008), hospital length of stay reduced (p=.0001), and mortality rate reduced (p=.02). The use of the evidenced based protocol by the NP group achieved total savings of USD3,000,000 compared with the previous year's medical approach. While the study was not a RCT, the longitudinal approach added rigor to findings and compared previous routine medical care. Similar NP findings are supported by Meyer (2005) with decreased length of stay by 1. 91 days per patient; and Russell (2002) with reduced ICU length of stay (p<.001) and hospital length of stay (p=.03). All variable outcomes improved with NP care after the introduction of a systematic, comprehensive, multidisciplinary approach.

Marelich et al. (2000) also conducted a prospective 12-month RCT of respiratory PAs and NPs in a medical and surgical ICU. While the US study aimed to support a protocol, the outcomes of NPs were significant. Again NP managed ICU patients had a reduced mechanical ventilation period (p=0.0001). Interventions were required for 12 patients in the surgical control group compared with five in the NP group (p=0.061). NP pneumonia rates were reduced. Mortality and ventilator discontinuation failure rates remained unchanged. Positive clinical outcomes were achieved with no variance in adverse events.

Hoffman (2005) more recently compared NP and physicians in a 31-month study. The large American study involved 526 consecutive patients (admitted for more than 24 hours to an ICU). At baseline groups were similar. There was no difference in readmission rate to the high acuity unit (p=0.25) or subacute unit (p=0.44) within 72 hours of discharge or in mortality rate with (p =0.25) or without (p=0.89) treatment limitations. No length of stay difference was found for patients having mechanical weaning (subacute unit (p=0.42) or duration of mechanical ventilation (p=0.18), weaning status at time of discharge from the unit (p=0.80) or discharge (p=0.28). However, patients managed by physicians were reintubated more frequently (p=0.02). The NP had equivalent or better patient outcomes than physicians.

Another NP role involved responding to emergency medical inpatient hospital activations compared with the traditional medical response. Pirret (2008b) examined the NP led critical 'outreach' role in a 12-month before-and-after study. Management of critically ill ward patients was targeted. NPs had access to ICU physicians through the hospital paging system. The large study described 525 patient consultations with NPs primarily ordering diagnostic tests and medications (not explicit). While the study resulted in a reduction in ICU readmissions (less than 72 hours), statistical significance was not provided. Nonetheless, the author described a positive impact on patient outcomes and demonstrated a positive response time (five minutes) for critically ill ward patients.

Given the collaborative relationship of the US NPs with intensive care physicians there was evidence that many believed NPs should have an assigned supervising physician. This was also supported within the Canadian literature.

Paediatric intensive care services

A paediatric critical care NP role had also developed. Within NSW the scope of paediatric NPs was limited to minor respiratory conditions (asthma, bronchiolitis and croup). In the US the majority

of states (31) required NPs to undertake Acute Care certification with the rest having some variation in requirements (Percy and Sperhac, 2007). There were a number of professional surveys conducted of the NP role, scope and activities. The bulk of the research was descriptive (Kelly, Sweet and Watson, 2001).

An early study by Pitts (1998), which surveyed 49 institutions across the US, provided an indication of the potential scope of NP. The response rate was good 86% (n=42/49). The survey identified NPs were working in neonatology, haematology/oncology and primary care. Given the age of the survey only 22% had prescriptive authority and 88% practiced in paediatric hospitals.

Two years later, Derengowski et al. (2000) introduced the NP into a university paediatric ICU. The NP role was similar to adult NPs. The implementation study identified barriers which related to educational needs, scope of practice, daily role activities and professional practice.

A more recent study by Fanta et al. (2006) compared trauma NP and resident medical officers (RMOs) caring for injured children. The prospective comparative study identified that the NP group had shorter length of stay and received higher patient satisfaction scores. Clinical outcomes were equivalent although the study was small and no statistical data was provided. However, Schweer et al. (2004) in the US conducted a retrospective analysis and identified no difference in length of stay, clinical and functional outcomes for trauma NP patients compared with medical care. The statistical evidence was weak.

More recently US NPs were expanding into ward based chronic care areas. Kathy (2007) conducted a six-month before-and-after study to evaluate NP care for hospitalised children with cystic fibrosis compared with routine medical care. Data collection involved assessment procedures and patient and family surveys. While the study was small (21 patients) the time to complete an assessment was shorter for NP consultations compared with routine medical care. The length of stay was reduced by 2.47 days (p=.06). Parent/patient satisfaction was higher and health care provider satisfaction was extremely positive. Although findings were positive the study lacked rigor.

At the same time in the UK, US and Canada, NPs were leading inter-hospital transfers of critically ill children. Traditionally medical staff led critically ill children transfer teams. However, Davies and Lynch (2007) in London conducted a pilot study to introduce NP led transfer teams. While the study was descriptive in nature NPs were undertaking transportation of critically ill children with no evidence of inadequate or poor outcomes. The role was too new to determine significant impact or patient outcomes.

In summary the evidence from individual NP studies, while they may be methodologically weak, provided overall good evidence of positive outcomes. There was no doubt NPs were contributing to health care in paediatric acute care areas. The evidence of impact should increase as the role more fully develops.

Neonatal care intensive care services

Acute neonatal ICU NPs were evident in the UK, Canada and the US while there was no evidence of the role within Australia. There was greater evidence of practice scope, activities and patient outcomes in this field. However, the evidence comprised largely of descriptive, comparative, or before-and-after studies. For the most part the comparative studies compared junior medical officers with NP knowledge, skills and interpersonal communication.

The neonatal intensive care role was developing broadly across the US (Bissinger RL et al., 1997). Beal et al. (1999) conducted a survey of NPs working in five neonatal ICUs. NPs were involved in:

neonatal ICU management, ante partum consultations, delivery room management, transport and outpatient follow-up. NPs also provided parent support and teaching, post-neonatal ICU follow-up care, and professional education and research.

In terms of role acceptance, a survey was conducted in the UK by Redshaw et al. (2002). They investigated the views of neonatologists. Sixty-six neonatal units with one or more qualified NPs were surveyed. The response rate was high (86%; n=57). Role activities were in keeping with Adult and Paediatric NPs. While neonatologists were less likely to see case-load management, involvement in ward round, accepting referrals and leading emergency transfers as core to the NP role, generally the role was strongly supported. A similar survey was conducted across Canada and the US by Hunsberger (1992). The sample targeted university neonatal ICUs and sampled 665 NPs (n=655). The early findings supported the role comprised advanced practice, management, education, research, and administrative responsibilities.

An earlier study by Mitchell (1991) compared the knowledge and communication skills of recent neonatal NP graduates with RMOs. NP graduate (n=10) knowledge was compared with 13 (87%) second year paediatric residents. Each group was tested using a 100 multiple-choice examination, 20 radio graphical films and oral Viva Voce. Statistical findings were similar for the two groups although sample size was small. The NP's knowledge, clinical skills and communication was equivalent with second year paediatric residents.

A large number of comparative studies of medical staff and NPs were undertaken. In the UK Lee et al. (2001) conducted a prospective comparative study of NPs and MOs in two acute hospitals. The outcome variable measured was neonatal assessment skill. The sample was large (527 infants enrolled). NPs were better at detecting hip abnormalities ($p<0.05$) and eye abnormalities ($p<0.05$). However, for the identification of cardiac abnormalities or underlying incidence of abnormalities no significant difference was found. Practice outcomes were more favourable for NPs.

Luyt et al. (2002) conducted a RCT to compare NP and registrar level MOs' practices for weaning neonates from ventilators. The study was conducted in one neonatal ICU and the sample was small with only 48 infants. The outcome measure, ventilator weaning time, was less for NPs than medical staff ($p=.0458$). NPs significantly reduced the time (median) from admission to the first ventilator change compared with doctors. On average, the NP made ventilator setting changes every 4.5 hours compared with 7.2 hours for doctors ($p=.003$). The impact on clinical outcomes was greater for the NP group with no adverse outcomes identified.

There was a significant RCT conducted in Canada by Mitchell-DiCenso et al. (1996). They also compared NPs with MOs. The study enrolled 821 infants (admitted to neonatal ICU) then randomised them to NPs (n=414) or MOs (n=407). The 12-month trial was conducted in one neonatal ICU. Mortality and complications rates were not significant between groups. Average length of stay was reduced in the NP group, although statistically not significant. There was a slight trend towards better documentation by the NP group. Parent satisfaction scores were higher in the NP group (not statistically significant) and the cost per infant was higher for the NP group (not statistically significant). Care outcomes were comparable between groups.

Another comparative study compared the care of low-birth-weight infants by NPs and MOs in one neonatal ICU over two years. The US study by Karlowicz et al. (2000) compared the outcomes of 201 infants. The findings identified mortality rates were not statistically significant ($p=0.87$). There were no significant care differences (pathology, radiology, or medications). There was no statistically significant difference for length of stay or patient complication rates. NP costs while not statistically relevant ($p=0.89$) had a slightly higher but narrower range than the medical group. NP group costs were USD141,624 while the medical group was USD139,388 (median hospital charges). Outcomes for both groups were comparable.

In a more recent UK study Woods (2006) aimed to investigate whether the quality of care or clinical outcomes for premature birth babies was affected by practitioner (NP or MO). Assessment, treatment and management of neonates following admission to ICU (during the first 6-12 hours) were compared. The mixed method approach combined a retrospective examination and quality assessment of nursing and medical records. A random sample of 61 sets of medical records was analysed. The results suggested NPs did not do as well as medical staff (undefined), although they still performed to an acceptable medical standard.

Bissinger et al. (1997) in the US compared neonatal intensive care NPs with medical staff using an 'intention to treat' design. The sample included 187 infants, although a sample power calculation was not evident. Health outcomes included: length of stay, days on oxygen, days on ventilation, morbidity and mortality, hearing loss, retinopathy and intra ventricular haemorrhage. Group baseline details were comparable. Clinical outcomes were comparable between groups. However, NPs were significantly more cost-effective. NP infant costs were USD18,240 less per infant than those managed by doctors. It was difficult to determine whether charges represented total hospital costs as the formula for economic analysis was unclear.

Similar to the adult intensive care discharge NP role, NPs were also exploring discharge follow-up from neonatal ICUs. Beal et al. (1999) undertook a descriptive survey to examine NP follow-up post-neonatal intensive care discharge perspectives. A random sample of 505 NPs agreed the role would be beneficial to hospital services and patients (96%). However only 52% of NPs perceived they were qualified to undertake the role. While 22% were currently in the role. Those involved in the role were more likely to have had previous primary care experience (p=0.010). NPs with additional certification (p=0.016) or previous primary care experience (p=0.003) were perceived appropriately qualified.

NP led infant retrieval and transfers services were evident in the UK. Leslie (2003) compared the safety and appropriateness of NP led transfers with paediatric registrars. The four year study examined transport times, transport interventions and physiological variables. The NP led team was more responsive to requests but took longer to stabilise infants. Both groups performed similar rates of procedures and no differences were evident in ventilator patterns. The doctor led group had worse values for pH and arterial oxygen (p=0.008) before transfer, suggesting medical staff transferred sicker infants. NP infants showed significant improvement in temperature and in oxygen saturation (p=0.01). There were no clinical differences between groups, which suggested that NP led neonatal retrieval and transport teams were safe and appropriate.

In the UK, Wolke et al. (2002) conducted a 12-month RCT and compared MO and midwife NP routine newborn examinations. The researchers enrolled 826 mother and baby pairs from a district hospital. The findings identified that the NP group had higher levels of mother satisfaction (81%) (p<0.001). Factor analysis identified that NP examiner (p<0.001) and continuity of care (p<0.01) were both related to enhanced satisfaction. NPs (61%) were more likely than doctors (33%) to discuss health care issues (e.g. breast feeding, sleeping and skin care). Comparable care was offered although evidence of higher NP satisfaction rates was reported.

In the UK, the Northumberland Care Trust (2004) conducted a prospective comparative five year audit of the quality of care by NPs and medically only staffed units. The method was largely descriptive based on hospital databases, patient assessment and documentation, intrapartum and neonatal mortality rates, and cost. Of significance was the finding related to intrapartum and neonatal deaths which fell 39% between 1991–1995 and 1996-2000 (5.12 vs. 3.11 deaths per 1,000 births), the decline for the whole region was 27% (4.10 vs. 2.99). The study was large and there was evidence to support that all NP quality care indicators were as good or better compared to medically staffed units.

In summary, NPs were located within all intensive care areas caring for neonatal, paediatric and adult patients. Role activities involved direct patient management, assessment, diagnosis,

monitoring and procedural activities. Additional role expansion has included post intensive care discharge follow-up, intensive care patient retrieval and transfers, and follow-up outpatient care. Research outcomes were variable and could be challenged methodologically. Nonetheless, positive trends or statistical significance was demonstrated in relation to patient outcomes (complication rates, morbidity and mortality rates, patient satisfaction, length of stay and readmission rates). The evidence supported NP models of care were cost-effective.

A significant volume of evidence has been presented that examined ICU NP outcomes. The majority of studies identified a measurable reduction in hospital costs due to reduced length of stay and patient investigations, patient complication rates (infection, morbidity and mortality) and reduced (re)admission rates. Generally patient investigations, prescription and referral rates of NPs were similar to medical staff although NPs often achieved higher patient/family satisfaction rankings.

7 Emergency services

Summary: NP led Walk-in centres (WiCs) and Minor Injury Units (MIUs) manage safely, quickly and appropriately up to 50,000 patients annually. WiCs and MIUs significantly reduced patient waiting times, improved patient satisfaction, increased health promotion screening, improved communication and provided more appropriate primary care referrals. MIUs may benefit the Australian context given patients with minor injuries or illness comprise a significant proportion of emergency department presentations. The research identified that primary care NPs provided similar care to doctors for a range of acute and chronic conditions while higher patient satisfaction ratings were frequently achieved.

There was a significant amount of research dating from the 1970s that had examined emergency department NPs. Within NSW and Australia there was evidence of a broad scope of practice for emergency department NPs with significant evidence of autonomy and independence. NPs were taking responsibility for first patient contact and ongoing management. Emergency NPs in the US are known as 'Acute Care Nurse Practitioners' which were largely inpatient based and educated specifically to work in the area. Kleinpell (2001) surveyed 545 NPs and reported that 5% worked in major trauma and 9% in emergency areas. The NP has changed the landscape of emergency care services. There was national and international evidence of the impact of the NPs in relation to contribution to work load (Chang et al., 1999; Fry M and Rogers FT, 2009), appropriate care (Ball, Walton and Hawes, 2007; Chang et al., 1999; Sakr et al., 1999), patient satisfaction (Barr, Johnston and McConnell, 2000; Byrne, Richardson, Brunsdon and Patel, 2000; Cooper and Kinn, 2000; Powers, Jalowiec and Reichelt, 1984; Thrasher and Purc-Stephenson, 2008), documentation, guideline adherence (Considine et al., 2006; Cooper and Kinn, 2000; Cooper et al., 2002), and, efficiency and timeliness (Allerston and Justham, 2000a, 2000b; Considine et al., 2006; Rogers and Davidson, 2005).

A number of RCTs conducted demonstrated no discernable clinical difference for emergency NP led services when compared with medical staff (Brown and Grimes, 1995; Bunn, Byrne and Kendall, 2008; Laurant et al., 2004). This said all the studies can be methodologically criticised.

Within the UK, US and Canada emergency NP evidence of economic impact was mixed. Authors demonstrated either cost savings (Heaney and Paxton, 1997b; Lattimer et al., 1998), no economic gains achieved (Venning et al., 2000) or an escalation in costs compared to physicians (Carter and Chochinov, 2007; Kinner, Cohen and Henderson, 2001; Kinnersley et al., 2000; Sakr et al., 2003a; Shum et al., 2000). The findings highlighted when duplication was minimised (only NP care or medical care), length of stay, investigations and referrals were reduced, cost reductions were more likely to be achieved. In contrast cost increases were associated with salary increases, NP longer consultation time, duplication of services and increased investigation rates.

While the emergency NP role was evident in NSW and Australia two models were absent within Australia, the MIU and WiC. These two models originated in the UK. The research demonstrated reduced demand on hospital activity, emergency care demand, and emergency physician and General Practitioner workload. The Australian emergency 'Fast Track' service most resembled these models (although often managed by one NP and medical staff) but lacked the organisational characteristics, NP workforce volume and service impact demonstrated in the UK literature.

Diverting primary health care patients

MIUs and WiCs were established in a variety of settings but were developed to service primary care patients. These models were often located within Primary Care Health Centres (PCHC) or colocated with an emergency department. Primary Care Health Centres often also comprised telephone triage advice services and or deputizing services (medical locum). For the most part GPs and NPs worked well together and were supportive of each others' contribution (Cowan et al., 2006; Moore, 1996; Skalla and Caron, 2008). Generally operation hours were between 0700–2200 hours (seven days/week). The Primary Care Health Centres were either NP or GP led. Two UK studies found when a Primary Care Health Centre was located near an emergency department or on main transport line a higher attendance rate would result and greater reduction in emergency department activity achieved (Broga et al., 1998; Hallam, 1994).

Evidence from the US suggested a NP workforce was less expensive than a medical workforce in primary health care. One study examined NP costs per visit and total labour costs per visit and identified statistically relevant cost savings ($p<.01$ and $p=.08$, respectively) among the centres that used NPs (Roblin et a., 2004). A significant advantage noted by the introduction of NP led services was the reduction in GP workload (Lattimer et al., 1998). The research left little doubt that primary care NPs provided similar care to doctors for a range of acute and chronic conditions while higher patient satisfaction ratings were frequently achieved (Christensen and Akcasu, 1999; Dulko et al., 2008; McKenna et al., 2004; Mitchell, 1993; Rosenzweig, 2006).

In the UK Horrocks et al. (2002) conducted a systematic review to determine the impact of NPs working in primary care areas. No differences were identified for patient outcomes, prescribing, readmission or referrals patterns. However the authors noted NP consultations were longer (weighted mean difference 3.67 minutes, 2.05 to 5.29) and ordered more investigations (odds ratio 1.22, 1.02 to 1.46) when compared to doctors. Patients' rated NP care higher than medical care (standardised mean difference 0.27, 95% CI 0.07 to 0.47). NP consultations were also perceived to be better for Quality of Care, although this was undefined. Increased NP availability in primary care was likely to result in higher levels of patient satisfaction and quality care, with no discernable difference in health outcomes. Cost implications may result from longer consultations (3.6 minutes) and the ordering of one extra investigation than doctors. Minimising investigations is important (potential guideline adherence may reduce over investigation) and early evidence presented suggested that consultation time was likely to improve with experience.

The evidence suggested that there was no statistical difference in patient health outcomes, resource utilisation, investigation and referral requests or cost with 'doctor-nurse' substitution in primary care found (Kinnersley et al., 2000; Laurant et al., 2008; Miranda et al., 2004; Shum et al., 2000). The findings suggested primary care NPs delivered quality care with positive patient satisfaction ratings.

Minor injury unit

Minor Injury Units (MIUs) have been implemented in the UK, Canada and US and have reduced demand for emergency care services. In the UK these units were implemented as either nurse led, GP led or in collaboration with emergency physicians (Paxton and Heaney, 1997; Roberts and Mays, 1998; Shum et al., 2000). Within the UK, emergency department patients could choose or were triaged to a MIU. In contrast to the UK model, the US and Canadian MIUs were primarily GP led (Hutchinson, 2000; Salisbury et al., 2002).

The UK MIUs provided timely, free, non-appointment and after hours options. The presentation rates were between 25,000–50,000 patients annually. Minor musculoskeletal trauma and illnesses, with clear diagnostic pathways, were targeted. Hence, redirection of minor trauma and illness patients to MIUs were considered safe and appropriate by triage nurses.

Much of the evidence demonstrating impact involved research at one site and compared NPs with emergency medical staff in the management of patients with minor injuries or illness. The UK MIUs study by Heaney and Paxton (1997) identified a 24% reduction in emergency department demand in three months of opening. Over the initial two years 20,000 patients attended the service (mean cost per patient UK£33). Waiting times were lower than emergency departments and 67% of patients were discharged. Patients treated in the MIUs would have previously sought emergency department care. While total patient numbers were significant it was often unclear the ratio of NP staff numbers. It also appeared that patient numbers managed by NPs increased as models became established.

In the UK Beales and Baker (1995) and again Beales in (1997) conducted studies and found the MIUs had exceeded expectations with a significant reduction in patient waiting times, more standardised clinical practice, improved patient satisfaction, increased health promotion screening, improved communication and more appropriate primary care facilities referrals. Similarly, a large RCT by Sakr (1999) assigned 1,453 minor injury patients to either a NP or junior doctor. Compared with the experienced accident and emergency research registrar, NPs and junior doctors made clinically important errors in 65 (9.2%) of 704 patients and in 80 (10.7%) of 749 patients, respectively although the difference was not significant. The NPs were better than junior doctors at recording medical history and fewer patients seen by a NP had to seek unplanned follow-up advice about their injury. The study found that NPs were better than junior doctors at recording medical history and had less unplanned patient follow-up. There was no significant difference between groups for assessment accuracy, appropriateness of treatment, radiology rates, interpretation of radiology films or planned follow-up. The NP study demonstrated safe appropriate care and reduction in emergency department activity.

While there were stand alone MIUs, those colocated near or within an emergency department had increased presentation rates. The variation of staffing (NP or GP led) did not appear to influence the impact of patient utilisation or emergency department activity rate. The high patient presentation rate indicated broad consumer acceptance and satisfaction for this model (Roberts & Mays, 1998).

Similarly, Shum et al. (2000) conducted a multicentre RCT which examined the impact of UK NP working in a GP clinic. The model enabled NPs to manage minor illnesses. The average medical consultation was two minutes shorter than NP consultations. However, patient satisfaction was slightly greater for the NP group. Prescription rates were similar for both groups. NPs managed 73% of patients (577/790) without any medical consultation. The study provided evidence that minor injury and illness patients could be redirected and managed by NPs.

There was strong evidence that NP led MIUs redirected patients groups that would have used other acute services. Many NP led MIUs were managing up to 90% of patients without referral to an emergency department (Heaney and Paxton, 1997; Sakr et al., 2003). If MIU patients were appropriately managed with minimal duplication, cost reductions were likely to be a significant (Snooks and Nicholl, 2007). This model may benefit the Australian context given that patients with minor injuries or illness comprise a significant proportion of emergency department presentations (Booze Allen and Hamilton, 2007).

Walk-in centres

In the 1990s Walk-in Centres (WiCs) began opening across the UK as part of primary health care reform largely staff by emergency department NPs. These centres were drop in, nurse led primary care services and usually open seven days a week (from 8am–10pm). However, patients accessed WiCs more frequently after hours (Rizos et al., 1990). WiCs were located in shopping centres, near emergency departments or in Primary Care Health Centres (Hurst, 2006). Frequent attendees of WiCs were found to be parents with children or young adults. Two years after implementation two million people had utilised WiCs in the UK (Dale and Salisbury, 1999; Salisbury et al., 2002; Salisbury and Munro, 2003). In the US within seven years 53 million people had been treated in WiCs (Hellstern, 1987). Similar findings were evident in Canada (Hutchinson, 2000; Szafran and Bell, 2000).

WiCs were having an impact on acute service utilisation. A two-year before-and-after study conducted by Chalder et al. (2003) using a large sample reported a decrease in emergency department presentations and GP workload although not statistically significant. The study used a large sample (10 WiC; 20 EDs; 40 GP clinics). While emergency department activity was noted to be reduced if the WiC was located nearby findings were not statistically significant. WiCs delivered appropriate and safe care for a range of primary care patient conditions.

A UK study by Salisbury et al. (2002), surveyed patients to compare WiC (n=38) and GP clinic (n=34) clients. Findings reported WiC patient attendees were home owners (55% versus 49%; P<0.001), with higher education qualifications (25% versus 19%; p=0.006), and were white (88% versus 84%; p<0.001) compared to routine GP presenters. Reasons given for attendance were: low waiting times and convenient non-appointment systems. Patients were likely to attend on the first day of illness (p<0.001), did not expect a prescription (p<0.001), and continuity of care was less of a concern. There was good evidence of active consumer choice for WiC attendance. It was reasonable to consider that this group may have previously used acute services for health needs. In support, a Canadian study examined WiC patient preference and found 83% of the users would have sought medical attention at an emergency department, another WiC or from their regular GP (if open) (Rizos et al., 1990). The survey identified that the majority of WiC visits were outside weekday business hours. The extended hours, non-appointment system of WiCs along with increasingly limited GP hours made these clinics an attractive option.

There was mixed evidence of WiC impact on GP services. Maheswaran (2007) in the UK undertook a review of WiCs and identified minimal GP waiting time improvement. While high WiCs patient satisfaction levels were reported GP workload remained unchanged. However, there was evidence to suggest that WiCs reduced emergency department activity (Hurst, 2006; Munro, Nicoll, O'Cathain and Knowles, 2000). Chalder et al. (2007) surveyed WiC patients and 66% would have attended acute services if the centre was not available.

Concerns were raised by medical professions that patients might be accessing WiCs to obtain a second opinion. The evidence was inconclusive and further it was unclear whether a second opinion may still have been sought from other health agencies. Generally in the UK patients found non-appointment systems more convenient than the appointment based GP clinic, and shorter waiting times appealed particularly to parents with children and young adults (Paxton and Heaney, 1997; Szafran and Bell, 2000).

In summary, WiCs and MIUs satisfied a primary health care need and represented an innovative model to improve health care access. There was strong evidence that WiCs and MIUs had redirected patient groups that would have used acute services (Rizos et al., 1990). Reduction in GP workload and gains in hospital efficiencies were considerable. In the UK, NP led WiCs and MIUs managed patients safely, efficiently and appropriately (Sakr et al., 1999; Sakr et al., 2003).

These models would have application for geographically isolated regions and targeted after hours need areas.

8 Surgical services

Summary: Surgical NPs achieved high patient satisfaction and compliance, optimised surgical rates, reduced complications and cancellations, and patient length of stay with no change to adverse event rates. Surgical anaesthetic NPs in one study decreased day-of-surgery cancellations in the year by 87.9%. Investigations were reduced from 17,192 (patients=3576) to 9474 (patients=4313) and demonstrated significant statistical difference (p<000.1). Cost reductions were also identified across the 11 specialties for patients from USD188.91 to USD76.82 per patient (p<0.01). Total hospital costs were reduced by 59.3% (USD112.09 to US$76.82) (p<0.01). Cost savings were achieved across numerous NP surgical specialties. NPs roles were identified in anaesthesia (pre-operative consultations) and post surgical follow-up care for surgical patients. NPs were undertaking minor invasive surgical procedures with surgeon supervision.

Within NSW and Australia there was little evidence of NP impact or involvement in surgical or anaesthetic services. Internationally NPs were undertaking a diverse range of roles within the majority of surgical specialties including anaesthetics. The evidence of impact on surgical services was varied and involved adult and paediatric care. The key roles undertaken by surgical NPs included patient management and monitoring of post surgical procedures/ operations, education, referrals and post hospital discharge follow-up. The majority of studies were descriptive and had short follow-up periods, which could bias application of findings.

A US survey of surgical NPs identified many were conducting preadmission clinics, performing anaesthetic ward consultations, premedical discharge patient management, performing invasive procedures and assistants in surgery (Kelly et al., 2001; Kleinpell and Goolsby, 2006; Russell et al., 2002).

A recent study by Varughese et al. (2006) in the US compared prospectively over 12 months paediatric NPs preoperative anaesthesia clinics compared with previous medically run clinics. The sample was large; 1509 children (aged 1 month–18 years), 463 parents and 20 preoperative NPs. Collections of data were gathered for one week every three months. While statistical evidence was unclear, outcome variables included patient complications (respiratory), patient preoperative preparation time, and parent and staff (anaesthetists and preoperative clinic nurse) satisfaction for each group. The results identified no difference in health outcomes or satisfaction between anaesthetist and NP groups for the selected patient cohorts. Similar studies support these findings (Davies, 2005).

In another more significant study, Fleisher and Anderson (2002) established a hospital anaesthetic unit (led by anaesthetist director) the 'Preoperative Nurse Practitioner clinic' in which hospital preoperative consultations were coordinated across 11 hospital specialties. The model reduced hospital anaesthetist consultations by 73%. The two year retrospective study involved 14,207 patients. Results identified an 87.9% decrease in cancellation of day-of-surgery cases (first year). Investigations were reduced from 17,192 (patients = 3576) to 9,474 (patients=4313) and was significant (p<000.1). Cost reductions were also identified across the 11 specialties for patients from $US188.91 to US$76.82 per patient (p<0.01). Significant patient cost reductions across the 11 specialties was noted (p<0.01). Total hospital costs were reduced by 59.3% (USD112.09 to USD76.82) (p<0.01). NPs would order investigations and provided educational information during the preoperative assessment. Similar findings were cited by Hoffman et al. (2006) with no difference noted in adverse events.

Surgical NP roles continued to expand in the UK. Shepperd et al. (1998) compared outcomes (at three months) of patients cared for at home, 'Hospital at Home', postoperatively with standard hospital treatment. The small RCT enrolled patients post hip replacement (n=86), knee replacement (n=86), and hysterectomy (n=238); elderly medical patients (n=96); and those with chronic obstructive airways disease (n=32). No difference in clinical outcomes between groups was identified. Patient satisfaction was high for all groups except those with chronic obstructive airways disease. Hip replacement patients perceived greater improvement in quality of life with NP 'Hospital at Home'. However a significant proportion of knee replacement patients remained in hospital (30%). No details explain this phenomenon and no cost comparisons were made. In the 12-month evaluation led later by Shepperd et al. (1998) they concluded for the elderly and hip replacement group no cost differences. However, 'Hospital at Home' significantly increased health care costs for patients recovering from a hysterectomy (0.009) and for those with chronic obstructive airways disease (p=0.01). GP costs also increased for the elderly medical 'Hospital at Home' group (p<0.01) and for those with chronic obstructive airways disease (p=0.02). The evidence suggested patient cohorts need to be well considered for model optimisation.

In the UK and the US, NPs were assistants in surgical teams. However the descriptive nature of many studies limited the impact evidence. This said the endorsement of NPs in this role was widespread amongst professional organisations such as the Royal College of Surgeons in the UK. In the US NPs were undertaking minor invasive surgical procedures with surgeon supervision. For example Sturgess et al. (1996) evaluated NP success and complication rate for percutaneous endoscopic gastrostomy (PEG) insertion. An endoscopy NP assisted with the minor surgical procedure rather than a resident. The prospective study evaluated one NP's 50 PEG insertions compared with medical personnel. The NP was successful (100%) in PEG tube placement. Two patient complications in both groups were noted. These were directly related to the gastric puncture in only one patient in each group and respiratory complications related to the gastroscopy (resulting in the death of one patient). Mortality (30 day) rate was 8% in the NP-assisted group and 12% following doctor-assisted PEG. Outcome at three months were similar, except for a smaller incidence of stomal infection in the NP group (not statistically relevant). The endoscopy NP was considered safe, efficient, effective and provided continuity of care for patients. Similar endoscopy NP positions were developing in Ireland (Nevin, 2005).

In ophthalmology, NPs were also undertaking minor surgical procedures. Waterman et al. (2002) evaluated the administration of local anaesthesia to 106 consecutive patients preoperatively who were about to undergo cataract surgery. Surgeons identified that few patients showed eye movement, anaesthesia was adequate (92.9%), and pain management was adequate (92%). Top up of anaesthesia was unnecessary in 94.7% patients and 51 (39.8%) patients developed conjunctival chemosis. Normal outcomes were not provided to gauge NP outcomes. However the surgeons interpreted the results as effective, safe and within normal limits. The surgeons recommended NPs routinely deliver local anaesthetic for all cataract surgical patients.

Diversity of NP roles was further noted in the field of interventional cardiology. Harvey (2003) in the US developed a role for NP in interventional radiology team. The descriptive study (of limited value) demonstrated that the NP was involved with 95% of interventional radiology procedures. The evidence provides potential direction for NPs within Australia.

NP roles were established for outpatient management. McCorkle et al. (2009) undertook a six month, before-and-after study and compared NP management of postoperative women (gynaecological cancers) undergoing chemotherapy treatment. While a small sample, patients were randomised into two groups NP care and routine medical care. The intervention outcomes were only determined by a self-reporting Quality of Life (QOL) instrument. The tool was well validated for Health care QOL (Short-Form Health Survey SF-12). Measurements were taken in the first, third and sixth months. Women experienced significantly less uncertainty, less symptom distress, and better SF-12 mental and physical QOL outcomes compared to the medical group. NPs had a positive impact for post surgical patients groups.

In a similar study, Tranmer and Parry (2004) examined the role of the NP for postoperative cardiac surgical patients. The follow-up period was short (5 weeks post hospital discharge) and only involved telephone survey follow. Although sample size was large with 200 patients randomly allocated to routine or telephone follow-up, there was no difference between groups. While the follow-up was short, the lack of evidence that the strategy (patient telephone survey follow-up) improved surgical outcomes would suggest this model may have minimal impact on patient outcomes. Consequently, the model would be difficult to justify given NP costs.

Recently in the acute surgical setting, transplantation NP roles were evident. However, there was minimal impact evidence. Of interest was that the models appeared more collaborative in design and followed a case management model. In 2005 Kirton et al. (2007) in the US identified NPs were working with physicians in the areas of transplantation and plastic surgery services. However, the NP role, protocols, function, competency or costs were not provided.

NPs were independently managing a range of outpatient clinics often in collaboration with, but independent of, a doctor. This was particularly evident within the US literature. A survey of NPs by Lin et al. (2003) identified, using the National Hospital Ambulatory Medical Care Survey (1997–2000), NP outpatient clinics involved general medicine, paediatrics, and obstetrics/gynaecology clinics. Over the three years NP patient visits increased from 5.9% (1997) to 7.3% (2000). For 82% of consultations only a NP was present. The NP outpatient model may be useful for nonmetropolitan areas where patient screening, and/or pre or postoperative follow-up might be required. The survey did not provide any costing details.

While the majority of studies were methodologically weak, they consistently demonstrated positive patient and hospital service outcomes. The research strongly supports the potential direction for NP utilisation within the area of anaesthetics, minor surgery, outpatient services and potential for non-metropolitan services. There was no doubt that surgical NPs achieved high patient satisfaction and compliance and optimised surgical rates with no difference in adverse event rates.

9 Acute coronary care services

Summary: Cardiology NPs involved in outpatient clinics and ward inpatient areas had substantially reduced hospital admission rates and length of stay. Cost savings were often achieved although, not always found to be statistically significant. In one study demonstrated NPs reduced the admission rate by 17% (odds ratio 0.50, 95% CI 0.39 to 0.65, p<0.001) and the proportion discharged with acute coronary syndrome from 14% to 6% (8%, -7% to 23%, p=0.264). Rates of cardiac events were unchanged. However another study identified a decrease in total hospital costs (USD6,659+/-5,843 vs USD5,211+/-4,137 (p<0.03), length of stay was trending down (4.0+/-3.0 vs 3.4+/-2.4 days (p=0.13)), although there was no significant change in readmission rate (30 day; 13% of patients vs 16% of patients). Again cost savings were identified (UK£78 per patient) although not significant (p=0.252). There were trends for improved health related quality of life outcomes. NP care improved quality of life during follow-up (0.0137 quality adjusted life years gained, (p=0.022)). NPs provided a safe, effective, well tolerated and cost-efficient service. For example, elective cardioversion outpatient services.

While cardiology NPs were authorised in NSW, the scope and independence of practice was limited compared with international evidence. The international literature demonstrated cardiology NPs were involved in all aspects of patient management (inpatient and outpatient settings) and inclusive of procedural clinics (Bakker et al., 2007; Broers et al, 2006; Roschkov et al., 2007). Of interest was NP involvement in heart failure management given the condition is a major public chronic health problem and a leading cause of morbidity and mortality for many developed countries (Bakker, et al., 2007; Dahle et al., 1998).

In the US, Dahl and Penque (2000) conducted a study to determine the impact of NPs on heart failure inpatients. The NPs followed a national, evidenced-based protocol. Significant improvement in patient outcomes was identified. Total hospital costs decreased (p<0.03), length of stay trended down (p=0.13), although readmission rate was unchanged. Similar cost findings were identified by Paul (2000) but the sample was small (38 patients). While not statistically significant, clinically there were reductions in length of stay (4.3 days to 3.8 days mean) and emergency department visits. Also inpatient hospital charges decreased from USD10,624 to $5893 per patient (mean). Similar cost reductions were identified (Dougherty et al., 2000; Manuela, 2003; Martensson et al., 2005; McCauley, Bixby and Naylor, 2006).

In Denmark NPs were managing stable post myocardial infarction patients. The 12-month randomised control study enrolled 200 consecutive infarction patients. Inpatients were randomly allocated to NPs (n=97) or doctors (n=103). Broers (2006) demonstrated no difference in clinical outcomes for either group (mortality (0%), re-infarctions (2%) or length of stay. However, significantly higher satisfaction scores were reported for NP patients.

Inpatient NP led chest pain clinics were also being established in the US and UK. Goodacre et al. (2004) in the UK conducted a RCT of one NP chest pain observation unit comparing it to routine care. The study had 972 patients with acute, undifferentiated chest pain. Follow-up was limited to six months. Nonetheless, NPs reduced the admission rate by 17% (odds ratio 0.50, 95% confidence interval 0.39 to 0.65, p<0.001) and the proportion discharged with acute coronary syndrome from 14% to 6% (8%, -7% to 23%, =0.264). Of significance were the unchanged cardiac event rates. NP

care improved quality of life during follow-up (0.0137 quality adjusted life years gained; 95% CI 0.0030 to 0.0254, p=0.022). Cost savings were noted (UK£78 per patient) although not significant (p=0.252). NPs improved patient outcomes in one chest pain unit compared with routine care. Similar results were supported Tranmer and Parry (2004).

Again NP postoperative outcomes were shown to improve hospital cost and reduce length of stay. Meyer and Miers (2005) introduced a postoperative NP model of care. The model more typically resembled case management as a cardiovascular surgeon/NP team was compared with cardiovascular surgeon only. The team approach significantly reduced hospital length of stay (decreased by 1.91 days); and cost (USD5,038.91 per patient). A similar comparative study had shown a reduction in ICU admissions less than 72 hours (Pirret, 2008a).

Murchie et al. (2003), evaluated primary care NP led clinics across Scotland for coronary disease patients. A stratified random sample of 19 general practices was used. Data collection involved questionnaires, case notes and national datasets. The study enrolled 673 patients in the NP group and 670 in the control. Mean follow-up was at 4.7 years. Significant improvement was identified in the NP group in all components of secondary prevention (except smoking at one year). Mortality rate at 4.7 years for the NP group was better than medical care (p=0.038). Coronary events occurred in fewer NP patients (p=0.052). Adjusting for age, sex, general practice, and baseline secondary prevention, proportional hazard ratios for the NP group were less, 0.75 (p=0.036) and 0.76 for coronary events (p=0.049). NP led clinics improved patient outcomes for secondary prevention, mortality rate and trended towards fewer coronary events. The positive evidence supported NP led clinics for primary coronary disease patients. Similar NP studies have reported no appreciable difference in patient or hospital outcomes (Broers et al., 2006).

Within acute services NPs were providing thrombolysis medication to treat acute myocardial infarction (AMI). Lloyd et al. (2000) in the UK aimed to reduce 'door to needle time' for AMI. This was a single study site using a prospective six-month before-and-after study design. One hundred and fifty-one consecutive patients (undergoing 163 thrombolysis episodes) received treatment. The median 'door to needle' time fell 30 minutes (p<0.01). Patients eligible for thrombolysis and treated within 30 minutes increased from 10/58 (17%) to 48/64 (75%) (p<0.01). Inappropriate thrombolysis treatment fell by 43% (73% to 30%). Cardiac NPs demonstrated more appropriate, timely and safe practices in treating acute cardiology patients. Similar models supported these findings (Qasim et al., 2002) (80% of patients treated within 30 minutes). Within rural and remote areas of Australia experienced nurses, under GP supervision, provided thrombolysis medication to this cohort of patients.

NP roles had extended to preadmission/procedural clinic involvement. A RCT conducted by Stables et al. (2004) in the US compared NP and doctor prepared patients for cardiac catheterisation. The 12-month study enrolled 339 patients. No adverse clinical events occurred in the NP group, while 2/161 occurred in the resident medical group. Appropriate care was comparable for both groups (p=1.0). Patient satisfaction was greater in the NP group (p=0.04). The median duration of the preadmission clinic visit was lower for the NP group (p=0.01). NP led preadmission clinics were associated with improved patient satisfaction and reduced assessment consultations.

In relation to other procedural tasks Boodhoo et al. (2004) in the US examined the safety and effectiveness of a nurse led elective cardioversion service. The prospective, longitudinal study enrolled 300 patients. Cardiology NPs were required to conduct pre-procedural evaluations, consent, sedation administration, cardioversion and post-procedure monitoring until discharge. A doctor was available if required. NP cardioversion success rate was 87% at discharge and at six weeks 48% (benchmark criteria unclear). No reversal of sedation, airway support or medical intervention was required. Ninety eight percent of patients had no pain or recall of the procedure. Elective cardioversion waiting times fell and procedural costs were reduced (p<0.001). NPs provided a safe, effective, well tolerated and cost-efficient elective cardioversion service.

Similar studies have been conducted for outpatient cardiac stress testing clinics. Maier et al. (2008) in the US conducted a comparative study with 100 consecutive patients. Findings again were supportive of NP led clinics. Concordance between NPs and cardiologist for diagnosis, and interpretation of heart arrhythmias and electrocardiograph stress readings was high. The evidence suggested that NPs were appropriate and safe. There was some concern in the US that as the range of technological interventions and pharmacological treatments increased, NP led service savings may be eroded (Paez and Allen, 2006).

There was no doubt that NPs were contributing to the management of acute and chronic conditions within the field of cardiology. The evidence provided sufficient impact of cardiology NPs. The anticipated rate rise in chronic conditions supports greater involvement of cardiology NPs in outpatient, inpatient and primary care areas.

10 Neurological services

Summary: NP care was equal to or better than routine care and achieved hospital savings. There were no discernable differences in patient outcomes or adverse events. NPs demonstrated statistically significantly shorter mean length of stay in the ICU ($p<.001$), and lower patient complication rates ($p<.05$). The outcomes of one study for NP-physician managed teams reduced patient days by 2306 days compared with the routine medical managed group, at a total cost savings of USD2,467,328. NPs demonstrated shorter length of stay, lower patient complication rates and reduced patient hospital days.

NP role diversity was demonstrated within neurological, medical and surgical hospital services. There was some evidence of NP involvement in NSW neurological services. One NSW NP works within a collaborative team model with a moderately broad scope of practice although independence and autonomy was limited. Internationally within this field NPs were taking responsibilities for adult and paediatric patients from ward areas to ICUs (Caserta et al., 2007; Rimel and Langfitt, 1980). In addition, neurological NPs were assigned patients based on specific neurological disorders (e.g. head injury, Parkinson, headache, dystonia) (Abram et al., 2007; Whitaker et al., 2001; Whitehouse, 1994).

An early study by Russell et al. (2002) in the US compared the impact of an adult neurological NP model. In the before-and-after study, outcomes were measured at six months. A random selection of 122 patients admitted to the neuroscience ICU or the acute care neurosurgery unit provided the comparative baseline data. The prospective sample included 402 patients admitted to either unit. The NPs used an evidence-based multidisciplinary plan to manage patients. There was no difference found in age, sex or ethnicity between groups. NPs demonstrated significantly shorter mean length of stay in the ICU ($p<.001$), and lower patient complication rates ($p<.05$). NP patients were hospitalised for fewer days with cost savings of USD2,467,328. NP care was equal to or better than routine care and achieved significant hospital savings.

The neurological NP role delivered care through outpatient clinics. The role would involve procedures, and monitoring of chronic conditions and medication administration. The evidence supporting this new role was weak or very case specific. For example, in the Netherlands Zwinkels et al. (2009) examined neurological-oncology NP management of patients on Temozolomide. The comparative study enrolled a small sample of patients to receive an alternative drug treatment regime. The study demonstrated that NPs effectively monitored and managed drug toxicity for this group of outpatients.

In summary, there has been expansion of the NP role into neurological services (acute and chronic disease management, inpatient and outpatient setting) and it was clear that further expansion of NPs in this field was likely.

11 General medicine services

Summary: There was no significant difference between physician and NP care in mortality, readmissions, adverse events or complication rates. NP led services improved patient compliance and outcomes. In one study the NP led outpatient clinic group identified (compared with Consultant Rheumatologist care) significant improvement in pain, morning stiffness, psychological status, patient knowledge and satisfaction ($p=0.001$, $p=0.028$, $p=0.0005$, $p<0.0001$ and $p<0.0001$ respectively). By the 48th week the NP patient group experienced lower levels of pain ($p<0.05$) and patients were more satisfied ($p<0.0001$). Another NP-physician team model study reduced inpatient intervention costs (USD1,187 per patient) and savings were USD3,331 per patient resulting in a base benefit per patient of USD1,484. Of the total savings amount (USD3,331), USD1,947 was due to reduced cost during the inpatient stay and the remainder was due to decreased hospital utilisation post discharge. Overall shorter length of stay and acute hospital care costs were significantly lower for NP/physician teams.

There was minimal evidence of impact within Australia of NP roles within the general medicine field. Internationally NPs were involved with acute and chronic medical patients in the inpatient and outpatient, primary health care, and residential care settings (Stolee et al., 2006).

Evidence of NP led outpatient clinics was extensive and added to the range of roles within the field of general medicine. Two UK studies by Hill et al. (1994) and Hill et al. (1994) randomly allocated 70 patients with rheumatoid arthritis to either a NP or consultant rheumatologist (CR). At three months both groups demonstrated significant improvement in relevant blood profiles. However the NP group demonstrated significant improvement in pain ($p=0.001$), morning stiffness ($p=0.028$), psychological status ($p=0.0005$), patient knowledge ($p<0.0001$) and satisfaction ($p<0.0001$). By the 48th week the NP group maintained lower levels of pain ($p<0.05$) and higher satisfaction rates ($p<0.0001$). In addition NP knowledge level had significantly increased ($p<0.0001$). Similar outpatient clinic studies have been conducted for a range of respiratory medicine conditions. For example asthma, pneumonia and chronic lung conditions, whereby NPs undertook disease screening, monitoring and management of conditions (Gross et al., 2004; Hooker, 2008; Hoskins et al., 2001; Linda, 2002). NPs could provide opportunity for greater expansion of outpatient clinic services specifically in areas of need and for strategically targeted population health conditions (Hooke et al., 2001).

Similarly in the US Mundinger et al. (2000) conducted a four year RCT to determine the difference between primary care physicians and NPs conducting primary care outpatient clinics. Four community-based primary care clinics (17 physicians) and one primary care clinic (7 NPs). The sample was large with 1,316 patients (mean age, 45.9 years; 76.8% female; 90.3% Hispanic) Patients were randomised to NP (n=806) or physician (n=510). No appreciable differences were found in patients' health status (NPs vs. physicians) at six months ($p=.92$). Physiologic test results for patients with diabetes ($p=.82$) or asthma ($p=.77$). For NP patients with hypertension, the diastolic measure was clinically lower for (82 vs. 85 mmHg; $p=.04$). No significant differences were found in health services referral patterns. In primary care clinics where the NP had the same authority, responsibilities, productivity and administrative activities as physicians then patient outcomes were comparable.

NPs were monitoring and managing a range of patient chronic conditions within primary care outpatient clinics. Common medical conditions monitored within the outpatient clinics were

broad but included conditions such as hypertension, asthma and diabetes. There were examples of collaborative and/or NP led models. Scisney-Matlock et al. (2004) in the US designed a comparative study (physician only versus physician/NP team) to determine the impact on hypertension care. Only adult women were enrolled and randomly assigned to groups. The physician/NP team had positive outcomes involving lower systolic and diastolic blood pressure compared with the physician-only group. The physician/NP team had higher scores for medication education. Similar models were evident internationally (Barkauskas, Pohl, Benkert and Wells, 2005; Benkert, Buchholz and Poole, 2001; McClellan and Craxton, 1985). Respiratory outpatient clinics were frequently managed by NPs. In the UK, Caine et al. (2002) examined the benefits of an NP led bronchiectasis clinic using a before-and-after single sited study design. Eighty patients in a crossover design were randomly allocated to NPs (n=39) or routine medical (n=41) clinics. Patient antibiotic compliance improved with NP care (p=0.024). Satisfaction was statistically higher in the NP group, although the statistics are not provided. No statistical difference was identified between groups for respiratory function (p=0.83), a 12-minute walk regime (p=0.304) or infective patient condition exacerbations (p=0.34). In the first year NP care increased cost, although the trend was downwards in the second year. Increased costs were related to antibiotic prescribing and readmission rates (although not specified). The increased cost may have been due NPs undertaking a new role. Nonetheless, the NP model was supported and considered safe and appropriate for this patient group.

Again in the US one hospital divided a ward into two sections in which to compare a collaborative NP-physician model of care with routine medical care. Ettner et al. (2006) employed for the intervention ward an NP for each of the two general medical teams. The results identified a reduction in intervention costs resulting in a base benefit per patient of USD1,484. Of the total savings amount (USD3,331), USD1,947 was due to reduced cost during the inpatient stay and the remainder was achieved through decreased hospital utilisation post discharge. The study provided evidence to support multi-disciplinary NP-physician teams. However, in these collaborative models it was difficult to determine if the savings were attributable specifically to the NP role or more effective management.

Alternatively in the US Pioro et al. (2001), sought to have NPs admit and manage general medical patients (unselected). The study enrolled 381 patients who were randomised to general medical wards staffed either by NP/medical director or medical-only staff. Data were obtained from medical records, interviews and hospital databases. Outcomes at discharge and at six weeks after discharge were similar (p>0.10) for both groups (length of stay, costs, consultations, complications, readmission to intensive care, 30-day mortality rates, patient assessment of care and patient perception of daily living activities (SF-36).

NPs were involved in geriatric patient management. The comparative study by Lambing et al. (2004) was undertaken in three hospital inpatient units over one month. NPs and junior medical officers were compared for activities and clinical outcomes of patients (n=100). There was no difference in readmission or mortality rates. Self-reports for 10 primary activity categories indicated that NPs spent a higher percentage of time documenting and planning care than did physicians (28% versus 15%, p=.011), while residents spent more time on literature reviews (5% versus 1%, p=.008). NPs ranked patient discussions higher than doctors (2nd vs 7th, p=.036). Doctors rated functional status (1st vs 3rd, p=.023) higher than NPs. However NP referral documentation identified greater utilisation of physical and occupational services (p=.001). Diagnostic groups for NPs included musculoskeletal (p=.036) and psychiatric (p=.005), while residents were more likely to manage cardiac patients (p=.001). NP patients were older (p=.022) and sicker at admission (p<.001) and discharge (p<.001). NPs demonstrated effective and appropriate care for older and sicker patients but achieved a shorter length of stay (p<.001).

Similarly in the US, Burl et al. (1998), investigated the impact of utilising geriatric NP/physician teams for long-term care facilities. The one year retrospective study collected data from 45 facilities. The large study randomly allocated patients to a NP/physician (n=414) or physician-only

(n=663) team. Acute care and emergency department costs were significantly lower for the NP/physician team. NP/physician team cost savings included reduction of USD72 per resident per month compared to physician-only (USD1,97). A similar study by Cowan et al. (2006) supported the positive gains (patient outcomes and economic benefits) by a NP/physician team. The comparative quasi-experimental design enrolled 1,207 general medicine patients (n=581 in the NP/physician group and n=626 in the physician-only group). No significant difference in mortality or readmission rate was identified. The average length of stay was significantly lower for patients in the NP/physician group than the physician-only (5 vs. 6 days; p<.0001) group. The hospital saving was USD1,591 per patient in the physician only (SE, USD639). Collaborative physician/NP teams reduced length of stay and had a positive economic impact. This study provided further evidence that physician-only outcomes can be improved on with a collaborative NP model, although no comparison could be made of the likely impact of a NP only service. There was further evidence to support these findings (Ettner et al., 2006).

There was no doubt that the health needs of Australians could be met through the expansion of NP roles within general medical fields. To improve outcomes initially in the medical field, NPs may need to target areas of specific inequity where care options are reduced or high areas of chronic conditions exist. Within the general medical field inpatient physician/NP teams and NP led outpatient service models enhanced service outcomes.

12 Oncology services

Summary: NPs employed in oncology settings (inpatient and outpatient settings) were more likely to be located in tertiary hospitals. NPs were managing oncology paediatric and adult patients. NPs were also involved in oncology screening clinics. NP patient management was found to be more consistent than physicians. NPs were more consistent with guideline adherence, although evidence of statistical impact was difficult to determine. However, evidence was primarily descriptive and measurable data on cost-effectiveness, quality of care and patient satisfaction was not yet evident.

There was limited evidence of NP involvement in NSW oncology services. One oncology NP in NSW works within a collaborative team model with limited autonomy and scope of practice. The role largely monitors patient management. In contrast there was good international evidence of NPs working within the oncology field. However it was largely descriptive in character. Therefore identifying the impact of oncology NPs was difficult. The descriptive research demonstrated NPs were working in outpatient and inpatient areas and provided care to adult and paediatric patients. In the US Kinney et al. (1997) conducted a survey of 129 NPs employed in oncology settings. The majority were located in university hospitals. There was also descriptive evidence of 'outreach' or palliative care clinics managed by NPs. A national US survey of 'Acute Care NPs' (n=423) identified 9% were employed in oncology settings which included procedural and outpatient clinics (Kleinpell-Nowell, 2001). In Denmark descriptive evidence identified that oncology NPs were managing paediatric inpatient and outpatient services in a university hospitals (Christensen and Akcasu, 1999). In Canada, while NP legislation and regulations developed more slowly (from 2000), they had extended into all acute and chronic oncology and palliative care services (Williams and Sidani, 2001). However the evidence was primarily descriptive and measurable data on cost-effectiveness, quality of care and patient satisfaction was not yet evident.

NPs were also involved in oncology screening clinics. Morris et al. (1998) conducted a retrospective comparative documentation audit of cervical dysplasia evaluation and treatment techniques in the US. The sample group compared 11 gynaecologists and six NPs. Performance variations were greater for the medical group. NP management was within the medical care range, although when statistically different NPs were more consistent with guideline adherence. Other oncology outpatient clinics included breast cancer (Geller et al., 1998), oral cancer (Meng and Tomar, 2008) and cervical cancers (Murphy and Musters, 2007; Murphy and Schwarz, 2007).

NP roles in oncology while well established did not provide high level evidence of outcomes. However given the anticipated rise in Australian cancer rates the oncology NP potentially could play a significant role in screening and prevention, monitoring, management and quality of life outcomes for those recovering from cancer.

13 Technology and nurse practitioners

Summary: Minimal evidence was available.

Little evidence was available relating to technology and NPs. Technology was shown to be utilised by NPs and specifically within educational programs. There was some evidence relating to telemedicine which is out of the scope of this review (Palmas et al., 2006). There were descriptive studies referring to the utilisation of different pieces of equipment which again exceeded the scope of this review. There was increasing evidence of utilisation of technology at the bedside, such as personal digital assistants (PDAs). Also wireless technology will redesign health care borders particularly for rural and remote NPs (Garrett and Klein, 2008). In addition technological equipment such as bladder scanners and ultrasound machines were opening portals for the development of new roles and physician collaboration opportunities.

In Canada Garrett and Klein (2008) explored NP perceptions of wireless PDA technology and impact on care. Utilisation of PDAs was limited and criticised due to expense and the short life cycle of devices. Nonetheless NPs demonstrated a complex understanding of wireless technologies and perceived benefit for greater integration within their practice. PDAs were viewed as a potential opportunity to increase the use of clinical reference tools (protocols, drug and diagnostic/laboratory guides).

In 2006 innovative strategies were undertaken to further support NP students in the use of technological advances in the provision of health care to overcome PDA inhibition. The study resulted in greater integration of PDA technology into educational curriculums and the development of online educational programs. Future implication of PDA at the bedside would potentially save time for the busy clinicians and enable monitoring, adherence to guidelines and recording of performance. PDA applications have the potential to enhance practice (Krauskopf and Wyatt 2006).

The Health Human Resources Planning Simulation Model for Nurse Practitioner in Primary Health Care™ is a software program developed to determine current and future NP requirements in area health services. The tool was developed for health human resources planners in federal, provincial and territorial governments in Canada but could be applicable for other countries. The software went beyond traditional planning models that are based on supply, utilisation or projected population-to-provider ratios. The software was a NP needs-based planning tool that factored in various elements such as education/training, retirement and movement, future population health needs and the level of service required. It allowed planners to test various policy scenarios before implementation (Canadian Nurses Association, 2009a, 2009b).

14 Rural and regional services

Summary: Minimal evidence was available.

There was limited research on the different impact of NPs in rural, regional and metropolitan services. The lack of research made it difficult to gauge the outcomes of NPs operating in different geographical locations. The NP research primarily explored metropolitan and primary care GP based NP services. Many of the models highlighted could be implemented in geographically isolated areas. International research supported that geographically isolated groups continued to have limited health care options compared with metropolitan and urban consumer groups (Knox, 1979; Knudtson, 2000; Sibthorpe, 2008).

Many of the NP models highlighted in the review could potentially be implemented to improve rural and regional health services. Internationally the implementation of NP models had been formally structured and largely consistent across geographical areas.

15 Barriers

Summary: Strategies to manage barriers identified for international NPs: strategies that built effective collaboration between NPs and physicians, public education campaigns, targeted employment opportunities, national role standardisation, eliminated restrictive practice legislation, and NP mentorship programs and evaluative teams to support integration. Hence barriers need to be considered on three levels. Micro-issues included: cooperation, and interpersonal team player factors. Meso-issues: organisational and administrative infrastructure, educational availability and opportunities. Macro-issues: employment opportunities, public opinion, professional authorisation, government processes and legislation practice limitations.

Nationally and internationally similar barriers were identified, which influenced the implementation and sustainability of NP services. Internationally NP barriers evident in the literature included legislation and regulation issues, prescribing restrictions, lack of role knowledge (scope of practice) by hospital administration, physicians and the general public, lack of mentorship and role support locally, and poor collaboration with physicians regarding introduction and team development (Clarin, 2007; Gould, Johnstone and Wasylkiw, 2007; Hurlock-Chorostecki, van Soeren and Goodwin, 2008; Kaasalainen et al., 2007; Kaplan and Brown, 2004a, 2004b; Linda, Angelynn and Angela, 2004; L. Lindeke, Jukkala and Tanner, 2005; Lindeke LL, Bly and Wilcox, 2001; Lindeke LL and Jukkala, 2005; Thrasher and Purc-Stephenson, 2007; van Soeren and Micevski, 2001; Wand and White, 2007).

Internationally the management of these barriers has been ongoing for decades and so fewer political, organisational and inter-professional barriers were evident in recent literature. Instead international NPs considered themselves to be well supported by key stakeholders (Stanley, 2005). However to build capacity and a sustainable NP workforce, effective collaboration between NPs and physicians was essential (Kinner, Cohen and Henderson, 2001). Other strategies identified to manage or reduce barriers included public education campaigns, targeted employment opportunities, national standardisation of the role and elimination of restrictive practice legislation, and NP mentorship programs and evaluation teams to support effective integration. In Canada mentorship programs were viewed as necessary to ensure the continued success of the advanced practice role (Gould et al., 2007).

Similar Australian barriers were noted and included: professional and authorisation processes, guidelines and formulary requirements, health care provider issues and patient education issues.

Professional and authorisation processes

Compared with the UK, Canada and US, Australia has struggled to expand NP numbers (in 10 years the NP workforce is approximately 350). The NSW NP authorisation process (and generally throughout Australia) inhibits the potential growth of the NP workforce. NPs are required to obtain a Master degree and secondly 5,000 advanced practice hours (three years full time) in addition to an undergraduate Bachelor degree to become registered. The educational requirements may inhibit many nurses from pursuing a NP career.

Achieving 5,000 hours for NSW NP is challenging as there are limited work opportunities. For example, there was minimal evidence of 'transitional/candidate NP positions' in which clinical

hours could be acquired within NSW Health. In addition there appeared little organisational support for 'transitional/candidate NP positions' (Fry and Rogers, 2009). Potentially, greater employment opportunities for NP and or 'transitional/candidate NP positions' would reduce a significant impediment to achieving the 5,000 hours of advance practice required for authorisation.

The Medical Benefit Schedule Rebate Scheme needs review to enable items to be independently billed as they relate to NP roles or to create incentives for GPs to use NPs.

The afterhours care medical rebate items need to be more inclusive of other health providers (for example NP, dieticians, dental, physiotherapy, mental health services etc). The recent medical rebate items for practice nurses only enabled simple procedures and assessments to be undertaken as directed by a GP (Burns et al., 1998).

Nurse practitioner guidelines and formulary approval process

NSW NP roles are made more difficult given the guideline and formulary approval processes. While the medical director of a field (for example an emergency director) may approve the NP's guidelines, approval by other stakeholders can impede or completely block the guideline process. Within NSW, individual NP guidelines and formulary need to be approved by all relevant hospital specialists physician/surgeon, radiologists, pharmacists, pathologists, hospital management, hospital committees and Area Health drug committees. The guideline process delays the operationalisation and expansion of NP services within particular fields of practice. The NP role would benefit from greater national consistency and clarity of responsibilities and guidelines (Gardner et al., 2008; Gardner, Carryer et al., 2006; Gardner et al., 2006).

Additional potential professional impediments impacting on NP led services included the lack of prescribing, specialist medical referrals and hospital admission rights (Laurant et al., 2008). There was no doubt that a lack of these rights reduced the potential impact of NP services. This has been recognised nationally and internationally (Berry and Dahl, 2007; Cipher, Hooker and Guerra, 2006; Kennedy-Malone, Fleming and Penny, 2008; Latter et al., 2007; Ryan-Woolley, McHugh and Luker, 2007). If these key factors were addressed the potential of this workforce to impact on primary health care and acute care services may be significant (Modell et al., 1998).

Medical response to nurse practitioner roles

The research identified mixed views within and across medical disciplines as it related to the NP role. Many medical professionals agreed that NP roles should be supported and utilised to assist service reform and improve medical work satisfaction (Cheng and Chen, 2008; Damon, 2002; Murphy et al., 1996). Internationally there was significant evidence of doctor satisfaction and value for NP roles (Brown and Grimes, 1995; Horrocks, et al., 2002; Venning et al., 2000).

NPs were identified in 95 health related fields, which suggested there was more positive than negative support. However the arguments used to reduce or inhibit expansion of NP health care roles fell into three main categories. Firstly, substitution of care was perceived as a risk to medical workforce opportunity and thereby posed a threat to income and employment. Secondly, that medical care was the 'best care' and so NPs offered less safe and appropriate care. Thirdly, all

health disciplines have had different responses to changing health care needs. In response to service demand nurses have largely championed health care change, and it was in this context that advanced practice roles have increased nationally and internationally. In contrast medical staff strategies have largely remained reliant on increased medical trainee numbers (Murphy et al., 1996).

Internationally and nationally there were mixed views regarding NP accountability as many doctors perceived that a NP should be accountable to them in keeping with the physician assistant model (Copnell et al., 2004). Gaining more consistent support for the independent NP role may be challenging.

Patient education

It was unclear from the evidence how the Australian consumer would accept NP led health care services. However a more positive atmosphere of acceptance for NP models may be reliant on changing consumer perception of health care utilisation. Greater consumer utilisation of NP led services was demonstrated in the UK, Canada and US through educational campaigns and communicative strategies (Boyle and Kochinda, 2004; Clayton and Dudley, 2009; Lawson, 2002; Munro and Taylor-Panek, 2007). For NPs to work effectively to reduce health care costs and increase access to health care, they need to be accepted by both the public and the other health care professionals.

Public relations campaigns had significantly influenced and altered consumer opinion and choice (Hogan and Hogan, 1982; Mackey, Cole and Lindenberg, 2005). Confusion and misunderstanding regarding perception of medical need can lead consumers to select traditional health care services (Anantharaman, 2008; Grumbach et al., 1999; Salisbury and Munro, 2003; Shah, Shah and Jaafar, 1996). Patients, generally when asked, preferred their own GP although, patient outcomes were no different with deputised medical services (McKinleyet al., 2002). For health care reform and the development of new resource utilisation patterns it may be necessary to influence patient perception and behaviour in relation to health care utilisation and perception of urgency (Hooker, Cipher and Sekscenski, 2005; Mitchell et al., 2001; Shipman et al., 1997; Shipman et al.
, 2001). A media campaign may be a key strategy in broadening patient choice and assisting to sustain NP services. Salisbury and Munro (2003) were critical of the implementation of some Walk-in Centres in the UK as lower activity levels were viewed as the result of poor advertisement. Similarly studies suggested ongoing education campaigns were needed to sustain new health care models and to educate the general public regarding appropriate utilisation of health care resources. (Darnell et al., 1985).

16 Conclusion

In conclusion, the evidence suggested NPs were caring for patients across the lifespan, from neonatal to aged care, and managing acute and chronic conditions. The majority of these NPs were colocated within hospital services, although descriptive evidence of 'outreach' clinics was present. Many NPs had ongoing responsibility of managing patients with chronic conditions often through an outpatient model (cardiac failure, post myocardial infarct, asthma, oncology). NP led patient screening clinics appeared to be a recent area of expansion. The evidence, although largely descriptive, was of NPs conducting breast, colorectal, deep vein thrombosis and bowel screening clinics. In addition NPs were involved in procedural inpatient and outpatient clinics. Few studies provided details of the NP implementation process, protocols, educational framework or primary data sets to enable secondary analysis.

NPs were involved in intensive care services, emergency services, surgical services, cardiology services, neurological services, general medicine services and oncology services. NPs were managing acute and chronic patient conditions within inpatient and/or outpatient and primary care settings. Whilst studies were often methodologically weak, the volume, breadth, depth and consistency of findings provided strong support for NP roles.

Table 1: Relevant key word search terms unspecified

Nurse practitioner	Critical care	Cardiology nurse practitioner	Minor injuries units	Emergency department and primary care attendees	After hours care GP clinic cooperatives
Nurse practitioner competencies	Primary health care	Acute care utilisation and emergency	Walk-in centres and emergency care	Impact outcomes and emergency, ambulance, GP	Neurological nurse practitioner
Nurse Practitioner Association	Emergency	Community health	Disease management programs	Primary health care utilisation patterns	Randomised control trials and emergency, ambulance, rural
Nurse practitioner acute	Ambulatory care facilities	Surgical nurse practitioner	Emergency reconfiguring remodelling	Ambulatory care models	Primary health care and randomised control trials
Paediatric nurse practitioner	After hours care nurse practitioner	Non urgent utilisation of hospitals and emergency	Polyclinics	After hours and primary care health centres	Case management nurse practitioner
Adult nurse practitioner		Oncology nurse practitioner	Medical nurse practitioner	Out of hours care	Disease management nurse practitioner

Table 2: Specified medical subject headings search strategy

MeSH terms	Tree structure
Nurse Practitioner	(MM "Emergency Nurse Practitioners") or (MM "Gerontologic Nurse Practitioners") or (MM "Neonatal Nurse Practitioners") or (MM "OB-GYN Nurse Practitioners") or (MM "Pediatric Nurse Practitioners") or (MM "American Academy of Nurse Practitioners") or (MM "American College of Nurse Practitioners") or (MM "National Alliance of Nurse Practitioners") or (MM "National Association of Nurse Practitioners in Reproductive Health") or (MM "National Association of Pediatric Nurse Associates and Practitioners") or (MM "Acute Care Nurse Practitioners") or (MM "Adult Nurse Practitioners") or (MM "Family Nurse Practitioners") or (MM "Nurse Practitioners+") or (MM "Infection Control Practitioners") or (MM "National Organization of Nurse Practitioner Faculties")

Table 3: Nurse practitioner roles

Nurse practitioner role			NSW/Australia
1.	Aged care (Incl. Aged care rehab)	(outpatient/ inpatient)	
2.	Alcohol and other drug clinics	(outpatient)	NSW*
3.	Anaesthetic services	(outpatient/ inpatient)	
4.	Anticoagulant clinics	(outpatient)	
5.	Armed Forces Veterans' facilities	(outpatient/ inpatient)	
6.	Asthma clinic	(outpatient)	
7.	Authority transplant care	(inpatient)	
8.	Bone marrow transplant	(outpatient/ inpatient)	
9.	Bowel screen care clinics	(outpatient)	
10.	Bowel care clinics	(outpatient)	
11.	Breast care haematology	(outpatient)	
12.	Bronchietasis-respiratory	(outpatient)	
13.	Cardiac catheterization	(procedural)	
14.	Cardiology services	(outpatient/ inpatient)	
15.	Cardiac heart failure	(outpatient/ inpatient)	NSW*
16.	Cardiothoracic	(outpatient/ inpatient)	
17.	Cardioversion clinics	(procedural)	
18.	Cervical screening	(outpatient/procedural)	
19.	Chemotherapy/oncology	(procedural)	
20.	Chemotherapy/oncology	(outpatient/ inpatient)	NSW*
21.	Chronic disease pain management	(outpatient/ inpatient)	
22.	Chronic diseases	(outpatient/ inpatient)	
23.	Colorectal screening	(procedural)	
24.	Community paediatrics	(outpatient)	
25.	Community renal/nephrology	(outpatient)	
26.	Congestive heart failure	(outpatient/ inpatient)	
27.	Continence care	(outpatient)	
28.	Continence care remote and rural	(outpatient)	
29.	Correctional facilities	(inpatient)	
30.	Counselling exercise	(outpatient)	
31.	Deep vein thrombosis clinics	(outpatient)	
32.	Diabetes	(outpatient/ inpatient)	NSW*
33.	Dialysis clinics	(outpatient)	
34.	Emergency adult	(inpatient)	NSW**
35.	Emergency adult and paediatric	(inpatient)	NSW**
36.	Endoscopy	(outpatient)	
37.	Fertility sexual health clinics	(outpatient)	
38.	Gastroenterology Women's health	(outpatient/ inpatient)	

Nurse practitioner role			NSW/Australia
39.	Generalist stomal therapy	(outpatient/ inpatient)	
40.	Gerontology	(outpatient/ inpatient)	
41.	Haematology adult/paediatric	(outpatient/ inpatient)	
42.	Health maintenance organisations	(outpatient)	
43.	Hepatology aged care	(outpatient/ inpatient)	
44.	High dependency	(outpatient/ inpatient)	NSW*
45.	HIV	(outpatient/ inpatient)	
46.	Hypertension	(outpatient/ inpatient)	
47.	Incontinence clinics	(outpatient)	
48.	Lactation	(outpatient/ inpatient)	
49.	Long-term care facilities/hospices	(inpatient)	
50.	Lung transplantation	(outpatient/ inpatient)	
51.	Lymphadema	(outpatient/ inpatient)	
52.	Maternal and child health	(outpatient/ inpatient)	NSW*
53.	Medical surgical	(outpatient/ inpatient)	NSW*
54.	Medical ward emergency teams	(inpatient)	
55.	Mental Health	(outpatient/ inpatient)	
56.	Cardiology myocardial infarct clinics	(outpatient/ inpatient)	
57.	Neonatal ICU	(inpatient)	
58.	Neurological epilepsy	(inpatient)	
59.	Obesity clinics	(outpatient)	
60.	Occupational health	(outpatient)	
61.	Ophthalmic clinics	(outpatient/ inpatient)	
62.	Orthopaedic	(outpatient/ inpatient)	
63.	Paediatric diabetes	(outpatient/ inpatient)	
64.	Paediatric ICU	(inpatient)	NSW*
65.	Paediatric oncology	(outpatient/ inpatient)	
66.	Paediatric acute	(outpatient/ inpatient)	
67.	Paediatric chronic	(inpatient)	
68.	Pain management	(outpatient/ inpatient)	NSW*
69.	Palliative care	(outpatient/ inpatient)	
70.	Pharmacology clinics	(outpatient/ inpatient)	
71.	Pneumonia respiratory	(outpatient/ inpatient)	
72.	Postoperative otolaryngology	(outpatient/ inpatient)	
73.	Pre/post operative neurosciences	(outpatient/ inpatient)	NSW*
74.	Pre/post operative ophthalmology	(outpatient/ inpatient)	
75.	Primary care community clinics	(outpatient)	
76.	Rehabilitation	(outpatient/ inpatient)	
77.	Remote/generalist	(outpatient/ inpatient)	
78.	Renal/nephrology	(outpatient/ inpatient)	NSW*

Nurse practitioner role			NSW/Australia
79.	Renal dialysis	(outpatient/ inpatient)	NSW*
80.	Respiratory	(outpatient/ inpatient)	NSW*
81.	Rheumatology	(outpatient)	
82.	School-based clinics	(outpatient)	
83.	Sedation/preoperative	(outpatient/ inpatient)	
84.	Sexual health	(outpatient/ inpatient)	
85.	Sigmoidoscopy clinics	(outpatient)	
86.	Stomal clinic	(outpatient)	
87.	Stroke units	(outpatient/ inpatient)	
88.	Surgical /postoperative	(outpatient/ inpatient)	
89.	Thrombolysis for cardiology	(inpatient)	
90.	Thrombosis/vascular	(outpatient)	
91.	Transfusion clinics	(outpatient/ inpatient)	
92.	Transplant care	(outpatient/ inpatient)	
93.	Wound management	(outpatient/ inpatient)	NSW*
94.	Minor injury units	(outpatient/ inpatient)	
95.	Walk in centres	(outpatient/ inpatient)	

*NSW/Australia: limited role and scope

** NSW/Australia: comparable role and activities

17 Tabulated relevant reference list

The tabulated references are listed alphabetically

NP - Nurse practitioner
ICU- Intensive care unit

Relevant methodological criteria

1	High	Randomised control trial-- most relevant to review aims
2	Good	Quasi experimental comparative, prospective before-and-after design studies
3	Medium	Cohort, Case study
4	Fair	Descriptive survey self-reporting tools: descriptive studies of interest to review aims
5	Poor	Professional opinions

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Beal et al., 1999) US Massachusetts and Rhode Island	• ICU • Neonatal • NP	• Non experimental prospective descriptive survey • Metropolitan-based	• Five regional level II/III neonatal ICUs • 22 NP • 2,146 infants • Review of hospital data	• NPs were equally involved with all patients • No difference in care was noted • NP roles included: Neonatal ICU care antepartum consultation, delivery room management, transport, and outpatient follow-up	• Clinical outcomes were all comparable • NP working in the neonatal ICU provided an invaluable contribution in terms of parent support and teaching • Post-neonatal ICU follow-up care, and professional education and research	4
(Bissinger et al., 1997) US	• ICU • Neonatal • NP	• Retrospective comparative study • Two matched groups of infants • One received neonatal care by NNPs vs care by medical staff	• One ICU • 18 NPs • 35 infants • Variables • Length of stay, days on ventilator, days on oxygen, mortality, morbidity rates, hospital costs, quality of life outcomes were compared	• This study showed that in the 35 cases cared for by NPs, in collaboration with neonatologists, neonates equal clinical outcomes • Cost- effectiveness of the NNP group was USD18,240 less per infant than those managed by medical staff	• Clinical outcomes were comparable • NP care reduced costs • Difficult to determine whether charges represented total hospital costs • Formula for economic analysis and variable components unclear	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Boodhoo et al., 2004) US	• Cardiology NP • Procedural • Outpatient clinic	• Prospective comparative longitudinal study • Cardioversion for chronic atrial fibrillation under sedation	• 300 patients for elective cardioversion for chronic a trial fibrillation • Cardiology NPs were required to conduct pre-procedure evaluations • (history, physical examination, blood tests), consent, sedation administration, cardioversion and post-procedure monitoring until discharge	• Cardioversion success rate was 87% at discharge and at six weeks 48% (benchmark criteria unclear) • No reversal of sedation, airway support, or medical intervention was required • 98% of patients had no pain or recall of the procedure • Four patients who were adequately anticoagulated experienced embolic phenomena. Ninety eight percent of patients were satisfied • Elective cardioversion waiting times fell from 3 months to less than 4 weeks • The estimated cost of the procedure was reduced from UK£337 to UK£130 with NP led sedation and cardioversion ($p<0.001$)	• NPs led a safe, effective, well tolerated, and cost efficient elective cardioversion service • No discernable difference in patient outcomes • Hospital costs reduced • Waiting lists reduced	2
(Broers et al., 2006) Denmark	• Acute Coronary Care • NP	• RCT • 12 months • NP-led clinic for stable patients recovering from a recent myocardial infarction, vs. doctor-led clinic	• Both groups under direct supervision of the attending cardiologist • 200 consecutive infarction patients • NP patients (n=97) or by a resident (n=103) • Patient satisfaction was scored	• Patients in both groups were predominantly men (75%) with a mean age of 63 years • Risk factors and cardiac histories comparable in both groups • No significant differences were found for mortality (0%), re-infarctions (2%) or length of stay. However, patients treated by the NP reported higher scores	• Clinical outcomes were comparable • The treatment of stable post myocardial infarction patients by NPs was feasible and effective • NPs had significantly higher level of patient satisfaction	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Burl et al., 1998) US	• General • Medical • NP • Aged residential care	• Retrospective • Comparative study • 12 months • 45 facilities • Compared geriatric NP/physician vs. physician-only	• 1077 residents, 414 were cared for by NP/physician. 663 by physician-only • Data collected retrospectively cost, revenues, ED transfers, hospital, and subacute days	• Acute care and ED costs were significantly lower for the NP/physician group • Cost reduced by NP/physician patient $72/resident/ month compared with physician-alone $197 • There were no significant differences in ancillary services or prescriptions	• Clinical outcomes were comparable • The use of NPs/physician teams reduced ED and acute care costs • NPs/physician reduced overall costs for patients in long term care • HMOs supported that all long-term care should be covered by NP/physician teams • This study further supported that physician only outcomes can be improved within a collaborative NP model	3
(Burns et al., 2003) US	• ICU • ADULT • NP	• Before-and-after longitudinal study • 12-month prospective • Outcome management • Team process • University hospital	• Five adult ICUs: coronary care, medical ICU, neuroscience ICU, surgical trauma ICU, and thoracic cardiovascular ICU • Trauma patients • Four NP • Vs. routine physician care	• Ventilator duration reduced (median days declined from ten to nine; p=.0001) • ICU length of stay reduced (median days went from 15 to 12; p=.0008), hospital length of stay reduced (median days from 22 to 20; p=.0001) • Mortality rates reduced (from 38% to 31%, p=.02) • Economic impact achieved total savings of $3,000,000 by the NP group	• NP group had better clinical and financial outcomes • Significant cost savings; LOS reduced; mortality rates reduced; ventilator rates reduced	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Caine et al., 2002) UK St George Hospital	• General • Medical • NP • Respiratory outpatient clinic	• A randomised controlled crossover trial • NP vs. physician – led outpatient care in a bronchietasis clinic	• Single site • 80 patients • NP (n=39) • Physician clinic (n=41)	• Patient antibiotic compliance improved with NP care (p=0.024: CI 95%) • Satisfaction was statistically greater in the NP group • No statistical difference between groups for respiratory function (p=0.83: CI 95%); a 12 minute walk regime (p=0.304: CI 95%); or infective patient condition exacerbations (p=0.34: CI 95%) • NP increased cost in first year related to antibiotic prescribing and readmission rates. • For the first year NP cost (UK £2,625 versus £1,498 per patient mean doctor cost), although, trending downwards by the second year (UK£411)	• Clinical outcomes were comparable • Increased cost may have been due to the NP undertaking a new role • The NP model was supported and considered safe and appropriate for this patient group	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Chalder et al., 2003) UK	• Walk in Centre (WiC) • Emergency • NP	• Time series before-and-after study • Two years • Impact on emergency department, general practitioner and out of hours services	• 10 WiCs and matched control towns without WiC • 20 Emergency departments • 40 GP Co-operatives • Short period of follow-up	• Reduction in emergency department, and general practitioner consultations was apparent (not statistically significant) • Emergency department, consultations (-175 (95% CI -387 to 36) per month • GP consultations (-19.8 (-53.3 to 13.8) per 1000 patients per month • Shared sites larger impact (p=0.18) (not statistical) • Walk in Centre shared location with an emergency department, showed larger impact (264 (-651 to 122) fewer consultations per month), but was not significant (p=0.18)	• Clinical outcomes were comparable • Geographical location not specific to after hours • Colocation with emergency department increased presentation rate • Reduced GP work load	2
(Dahl and Penque, 2000) US	• Acute coronary care • NP	• Prospective comparative study • Heart failure patients • Protocol evidence based – (Clinical Agency for Healthcare Research and Quality (AHRQ) 1994 guidelines for HF) Metropolitan	• One hospital site • One ward area • NP vs. routine MO care	• For NP-led care no significant change in readmission rate (30 day; 13% of patients vs. 16% of patients) • NP care: Total hospital costs decreased • (USD6,659+/-5,843 vs. $5,211+/-4,137 (p < 0.03)) • NP care: LOS trended down (4.0+/-3.0 vs. 3.4+/-2.4 days (p = 0.13))	• Significant improvement in patient outcomes was identified • Length of stay trended down • Hospital savings achieved	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Fanta et al., 2006) US	• ICU • Paediatric • NP	• Prospective comparative study • Paediatric trauma centre • Metropolitan	• One hospital • 76 children • NP vs. resident physician	• No missed injuries or readmissions • The NP group had a significantly shorter length of stay • Received significantly higher satisfaction survey scores with regard to information or injuries, tests and treatment, and frequency of visits provided to the patient/family	• No difference in clinical outcomes • NP significantly shorter length of stay • Higher patient satisfaction • In-patient trauma NPs provide added value to the care of the injured child in the area	2
(Fleisher and Anderson, 2002) US	• Surgical Anaesthesiology Adult • NP	• Comparative retrospective before-and-after study • Two-year • Medical director of unit • Preoperative consultations	• One hospital • Across 11 specialties • 14,207 patients • NP vs. resident doctor	• Reduced anaesthesiology consultations by 73% • Decrease in day-of-surgery cancellations: 87.9% • Investigations reduced from 17,192 (patient =3576) to 9,474 (patients=4313) (p<000.1) • Cost reductions were across the 11 specialties USD188.91 to USD76.82/patient (p<0.01) • Total hospital costs were reduced by 59.3% (USD112.09 to USD76.82) (p<0.01)	• NPs safely and appropriately conducted preoperative clinics • NPs reduced perioperative testing rate • Surgical cancellation reduced • Total hospital savings	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Goodacre et al., 2004) UK	• Acute coronary care NP	• Cluster RCT • To measure the effectiveness and cost effectiveness of providing care in a chest pain observation unit compared with routine care for patients with acute, undifferentiated chest pain • Metropolitan	• One unit • 972 patients with acute undifferentiated chest pain • Patients enrolled • NP=479 • Physician=493 • Six-month follow-up	• NP reduced the proportion of patients admitted from 54% to 37% (difference 17%, odds ratio 0.50, 95% confidence interval 0.39 to 0.65, p<0.001) • NP – proportion discharged with acute coronary syndrome from 14% to 6% (8%, -7% to 23%, =0.264) • Rates of cardiac event were unchanged • NP care was associated with improved health during follow-up (0.0137 quality adjusted life years gained, 95% confidence interval 0.0030 to 0.0254, =0.022) • Cost saving of UK£78 per patient (–pound 56 to pound 210, P=0.252)	• NP care may improve clinical outcomes • NP chest pain observation units improved outcomes and may reduce costs to the health service • NPs were cost-effective	1
(Hill et al., 1994) UK	• General • Medical • NP	• RCT single-blind • 48-week study • To compare the effectiveness, safety, and acceptability of a rheumatology NP with a consultant rheumatologist	• One clinic • 70 patients • (mean age, 56 years; 52 women) • Patients were randomly assigned to the care of a rheumatologist (n=35) vs.NP (n=35)	• At 48 weeks the NP group had a better mean pain score (2.2 vs. 2.7; P for the 0.5 difference=0.05) • Increased knowledge of their disease (p< 0.001) • Higher overall satisfaction with their care (p< 0.001) • Both groups of patients had a similar reduction in mean blood screen results and duration of morning stiffness as well as similar improvements in physical function scores, and psychological assessment scores	• NP care demonstrated comparable patient outcomes • Groups did not differ for safety outcomes • NP patients had improved measures in pain scores, knowledge, and satisfaction	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Hoffman et al., 2005) US	• ICU • Adult • NP	• Comparative • Prospective • Comparing ventilation weaning management for intensive care patients	• 31 month period, in seven month blocks of time • Metropolitan • Single site • Patients= 526 consecutive • NP vs. resident doctors • Patient criteria admitted to ICU unit >24 hours	• No difference in baseline demographic or medical condition variable • No difference in readmission to the high acuity unit (p=.25) or sub acute unit (p=.44) • No difference in discharge or in mortality rate with (p=.25) or without (p=.89) treatment limitations • Among patients who had multiple weaning trials, patients managed by the two teams did not differ in length of stay in the sub acute unit (p=.42), duration of mechanical ventilation (p=.18), weaning status at time of discharge from the unit (p=.80), or disposition (p=.28). Acute Physiology Scores were significantly different over time (p=.046) • Patients managed by MOs had more re-intubations (p=.02)	• There was no discernable difference in clinical outcomes • No difference in outcomes for length of stay • Mechanical ventilation weaning • Discharge • Doctors had a greater rate of re-intubation	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Karlowicz and McMurray, 2000) US	• ICU • Neonate • NP	• Retrospective cohort study • Two years • To compare outcomes and charges of health care delivery to NP and paediatric residents	• One 56 bed Neonatal ICU • n=201 extremely low-birth-weight infants (<1000grams) • The NP team cared for 94 infants • Medical team cared for 107 infants	• There were no differences between groups for Neonatal ICU charges for laboratory, radiology, or pharmacy services • Survival to discharge occurred for 71 NP team infants (76%) and 82 medical infants (77%) (p=.87). • The median total length of stay was 87 days (range, 39–230 days) for NP team infants and 88 days (range, • 41–365 days) for doctor infants (p=.54) • There were no significant differences between groups for the prevalence of severe intracranial haemorrhage, threshold retinopathy of prematurity or chronic lung disease at 36 weeks post conceptual age • Median total neonatal ICU hospital charges were $141,624 (range, USD52,020-693,018) for NNP team infants and USD139,388 (range, USD50,178–990,865) for medical team infants (p=.89)	• There was no appreciable difference between the two groups for patient or cost outcomes for extremely low-birth-weight infants	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Kathy, 2007) US	• Paediatric • NP	• 6 month before-and-after study • Compared to the patient's previous admission	• 21 patients • Cystic Fibrosis patients • Children/adolescents/ young adults • NPs vs. previous routine medical care	• Significant reduction in the time to complete consultations by ancillary services • The differences between predicted length of stay and actual length of stay was reduced by 2.47 days (p=.06) • Actual length of stay was decreased by 1.35 days • Parent/patient satisfaction with new model remained high and health care provider satisfaction was overwhelmingly positive	• An inpatient NP care coordinator reduced ancillary service consultations • Length of stay was reduced • NP improved patient satisfaction ratings	2
(Kinnersley et al., 2000) UK	• PHC • Emergency • NP	• RCT • GP led model	• Patients=1368 • 10 general practices in South Wales and southwest England • Compared patients requesting same day consultations	• Generally patients consulting NP patients were significantly more satisfied with their care • For children, the mean difference between general and NP in percentage satisfaction score was -4.8 (95% confidence interval -6.8 to -2.8) • For adults the differences ranged from -8.8 (-13.6 to -3.9) to 3.8 (-3.3 to 10.8) across the practices • Resolution of symptoms and concerns did not differ between the two groups (odds ratio 1.2 (95% CI 0.8 to 1.8 for symptoms and 1.03 (0.8 to 1.4) for concerns)	• NP provided appropriate care to patients requesting same day consultations • NP provided significantly more information in all but one practice • No difference in prescriptions issued, investigations ordered, referrals to secondary care, and re-attendances were similar between the two groups • In one centre NP consultations were longer which may impact on cost	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Kirton et al., 2007) US	• ICU • Surgical • NP	• Prospective comparative study • Data extraction hospital database • Staffing efficiency • (NP/ Physician Assistants) compared with physicians and trainee physicians • Metropolitan teaching hospital	• The three surgical ICUs staffed: NPs, physician assistants (PAs), physicians • 12 months • Volume of patient care – self-reporting tool • Two units are managed entirely by (NP/PAs) (neurointensive care and cardiac units) • One unit – the general surgery ICU – had mixed MO coverage consisting of ICU fellows, postgraduate year 1 general surgery residents, postgraduate year 2 anaesthesia residents	• The NP/PA annual staffing hours available (the number of potential hours of coverage) were based on the number of budgeted full-time equivalents in fiscal year 2005 • These hours were computed by the following calculation: (number of full-time equivalents (2080 hours per year) [0.12 (vacation sick time holiday time replacement factor)] • The overall annual staffing hours available also include the hours spent on the patient care units by the residents and subspecialty fellows • The annual physician-directed coverage hours needed for 24 hours of operation per day, seven days a week for each clinical service was determined by multiplying the number of available staff by the number of hours in a shift and the number of days per year	• There were no appreciable clinical care differences between mixed ICU staffing • Greater clinical coverage and efficiency was gained with a mixture of staff MOs NP/ PAs • Physician's overtime was reduced • Tools that review volume and workload direct and indirect care enable better prediction of clinical cover	

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Lattimer et al., 1998) UK	• PHC • Emergency • NP	• Block RCT • Rural and metropolitan • Telephone advice centre • Nurse managed • The out of hours period was 615 pm to 1115 pm from Monday to Friday, 1100 am to 1115 pm on Saturday, and 800 am to 1115 pm on Sunday	• 12-month study • NP vs. MO • 14,492 calls received	• GP work load reduced 50% • Nurses managed 49.8% of calls without referral 69% • Reduction in telephone advice from a GP, 38% • Reduction in patient attendance at primary care centres • 23% reduction in GP home visits	• NPs provided safe, appropriate care to patients • NPs reduced GP home visits • High after hour utilisation • Callers perceived faster access to health information and advice • Experienced nursing staff provides better advice • Telephone advice can meet the needs of a primary care patients • Increased accessibility to health worker	1
(Lee et al., 2001) UK	• ICU • Neonatal • NP	• Prospective comparative cohort study • To compare the effectiveness of routine neonatal examination performed by senior medical officers and advanced neonatal NPs	• Two hospitals • 527 infants enrolled	• Practice outcomes were better for NPs • NPs were better at detecting hip abnormalities (96% v 74%; $p < 0.05$); eye abnormalities (100% v 33%; $p < 0.05$) • No significant difference for cardiac abnormalities or general abnormality detection	• NPs were significantly more effective in detecting abnormalities during neonatal checks	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Leslie and Stephenson, 2003) UK	• ICU • Neonatal • NP	• Prospective comparative study • Four-year study • To evaluate the safety and practicality of using advanced neonatal NPs to lead acute neonatal transfers	• University hospital • NP led team vs. senior medical officer led team • Critically ill Infants< 28 days n=51 • Metropolitan	• The NP led team responded more rapidly but took longer to stabilise babies • No difference between groups for number of procedures or ventilation patterns • The infants transferred by the senior medical officer led group had worse values for pH (doctor led, 7.31 (6.50–7.46); NP led, 7.35 (7.04–7.50), p=0.02) and PaO_2 (doctor led, 6.7 (2.4–13.1); NP led, 8.7 (3.5–17.0); p=0.008) before transfer (median (range). • NP> better transfer temperatures infants (36.8 degrees C (34.0–37.8) v 37.0 degrees C (34.6–38.0), p=0.001) and in oxygen saturation (96% (88–100) v 98% (92–100), p=0.01)	• Clinical condition on completion of transport was similar for both teams for all variables • NP led transport appeared to be appropriate and safe • There were no differences between the NP and doctor led groups in the values obtained	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Luyt et al., 2002) US	• ICU • Neonatal • NP	• RCT • Prospective • Compare clinical practice issue – weaning infant from ventilator • Metropolitan	• One NICU • 48 infants • NP=25 • Doctor=23	• NPs median weaning time, was 1,200 mins (95% confidence interval [CI], 621–1779 mins) • Doctor group median weaning time, was 3015 mins (95% CI, 2,650–3,380 mins) (p=.0458) • The median time from treatment assignment to the first ventilator change was 60 mins (95% CI, 52–68 mins) in the nurse group and 120 mins (95% CI, 103–137 mins) in the registrar group (p=.35) • On average, the nurses made ventilator changes every 4.5 hrs (95% CI, 2.9–6 hrs) and the registrars every 7.2 hrs (95% CI, 5.4–9 hrs; p=.003) • The median number (range) of backward steps taken per infant was 0 (0–5 steps) in the NP group and 1 (0–5 steps) in the doctor group (p=.019)	• No adverse outcomes were identified for either group • The findings of this study suggest NP appropriately provide infant weaning ventilator practices	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Maier et al., 2008) US	• Acute coronary care • NP	• Comparative design • NP managed exercise stress testing for cardiology patients • Metropolitan	• One unit • NP vs. cardiologist • Outcome determining ST – segment depression, detecting arrhythmias, and making a diagnostic assessment • One NP and 2 cardiologists (C1 and C2) • 100 consecutive patients enrolled	• Similar concordance between the NP and cardiologists measured by Kappa coefficients (rhythm: NP vs. C1=.92, NP vs. C2=.84, C1 vs. C2=.84; arrhythmias: NP vs. C1=.77, NP vs. C2=.73, C1 vs. C2=.75; EST diagnosis: NP vs. C1=.75, NP vs. C2=.73, C1 vs. C2=.75) • Pearson correlations demonstrated concordance for baseline ST levels (NP vs. C1=.86, NP vs. C2=.86, C1 vs. C2=.90) peak exercise ST levels (NP vs. C1=.58, NP vs. C2=.48, C1 vs. C2=.67	• NP appropriately managed and interpreted care in this outpatient cardiology clinic • Similar clinical outcomes were identified • High concordance in ECG reading support NPs interpreting heart rhythms	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Marelich et al., 2000) US	• ICU • Adult • NP	• RCT • A prospective 12-month • To determine the effect of a single ventilator management protocol on the incidence of ventilator-associated pneumonia	• 385 patients • One medical and surgical ICU • Compared doctor and NPs	• NP and doctor groups were comparable with respect to age, sex, severity of illness and injury, and duration of respiratory failure at the time of randomisation • The duration of mechanical ventilation for patients was decreased from a median of 124 h for the control group to 68 h in the ventilator management protocol group (p= 0.0001) • Thirty-one total instances of ventilator management protocol were noted. Twelve patients in the surgical control group had ventilator-associated pneumonia, compared with 5 in the surgical ventilator management protocol group (p= 0.061) • The impact of the ventilator management protocol on ventilator-associated pneumonia frequency was less for medical patients • Mortality and ventilator discontinuation failure rates were similar between control and ventilator management protocol groups	• There was no discernable difference in clinical patient outcomes • NPs can reduce ICU length of stay and patient ventilator days • NP application of ventilator management protocols are highly effective means of improving care, even one university ICU • The ventilator management protocol was associated with a decrease in incidence of ventilator-associated pneumonia in trauma patients	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(McCorkle et al., 2009) US	• Surgical • NP • Oncology • With a psychiatric consultation-liaison nurse (PCLN)	• Six-month before-and-after study • Patients were randomised into two groups • Outcome measures included length of stay and cost for an episode of care • Patient quality of life self-reporting tool	• One unit • 123 patients x three • post surgery • randomised into two • NP • Women with high distress were evaluated and monitored by a PCLN • Vs. routine care	• NP group had higher quality of life scores than those in routine care	• NP tailored physical and psychological interventions produce stronger outcomes than interventions that targeted solely quality of life alone	4
(Meyer and Miers, 2005) US	• Acute coronary care • NP • Collaborative team model	• Retrospective, two group comparison study	• Examined patient and economic outcomes between two groups of adult patients for whom postoperative cardiovascular care was directed by either cardiovascular surgeons - alone or cardiovascular surgeon/NP	• Cardiovascular surgeons/NP, team. • Reduced length of stay by 1. 91 days • Reduced total hospital cost by USD5,038.91 per patient	• NP/cardiovascular surgeons' teams improved outcomes • Reduced hospital length of stay and cost • No difference in clinical outcomes	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Mitchell et al., 1991) US	• ICU • Neonatal • NP	• Comparative study • Paediatric resident doctors vs. NP • To compare the knowledge, problem-solving, communication and clinical skills of graduating NPs and paediatric residents	• 10 NP graduates • 13 paediatric residents	• NPs scored similarly to the paediatric residents on the multiple-choice questions (difference -3.4%; 95% CI around difference -9.7, 2.9) • Radiographs (difference -1.4%; 95% CI -11.5, 8.7) • Oral examination (difference 2.8%; 95% CI -11.1, 16.7) • Communication skills (simulated parents assessment: difference 0.8%; 95% CI -4.2, 5.7; expert observer assessment: difference 5.8%; 95% CI -2.8, 14.3), clinical skills (difference 7.4%; 95% CI - 5.5, 20.2)	• The NPs were equivalent to second year paediatric residents in knowledge, communication, problem solving and clinical skills	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Mitchell-DiCenso et al., 1996), Canada	• ICU • Neonatal • NP	• RCT • 12-month trial • Critically ill neonates	• One site 33 bed university neonatal ICU • 821 infants • NP (n=414) • Medical officer (n=407) • Clinical nurse specialist (CNS)/NP team with a vs. paediatric resident team	• There were 19 (4.6%) deaths in the CNS/NP team and 24 (5.9%) in the resident group (relative risk [RR], 0.78; confidence interval [CI], 0.43 to 1.40) • In the CNS/NP team, 230 (55.6%) neonates had complications • Doctors: 220 (54.1%) (RR, 1.03; CI 0.91 to 1.16). • Mean lengths of stay were 12.5 days in the CNS/NP group and 11.7 days – doctor group (difference in means, 0.8 days; CI, -1.1 to 2.7). • Mean scores on the Neonatal Index of Parent Satisfaction were 140 in the CNS/NP group and 139 in the resident group (difference in means, 1.0; CI, -3.6 to 5.6) • In the CNS/NP group, 6 (2.6%) infants performed 30% or more below their age level in the Minnesota Infant Development Inventory, in comparison with 2 (0.9%) in the resident group (RR, 2.87; CI, 0.59 to 14.06) • The cost per infant in the CNS/NP group was $14,245 and in the doctors' group $13,267 (difference in means, $978; CI, -1303.18 to 3259.05)	• There was no discernable difference in clinical outcomes • Except for except for two instances, jaundice and charting, was better in the CNS/NP group • Cost was > in the CNS/NP team	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Morris et al., 1998) US	• Oncology • NP	• Retrospective comparative audit • This study compared cervical dysplasia evaluation and treatment techniques	• 11 Gynaecologists compared to six NPs • Data collected from patient records • 10 practice criteria evaluated	• Statistically NP practices were more consistent with generally accepted medical practice • The gynaecologists showed a greater variation in performance than NP colposcopists • NP practices fell within the range of gynaecologists	• These data suggest that NPs were more likely to adhere to a consistent set of practices • NPs were a viable alternative provider in the evaluation and treatment of cervical dysplasia	2
(Munro et al., 2005) UK	• PHC • Emergency • NP	• Before-and-after • 24-month observational • Three areas in England and three nearby GP cooperatives as controls • Free national service • Extended after hours of operation • Trained nurse and utilisation of decision support computer software	• NHS Direct telephone after hours service • 24-hour service	• After-hour telephone rate 68,500 per 1.3 million • Minimal impact noted on ED and ambulance services • 72% calls out of hours • GP workload reduced • May have restrained ED attendance rate (unproven)	• NP appropriately and safely managed and referred care via telephone • Minimal impact on ED • 8% reduction in emergency calling ambulance rates • Reduced GP workload	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Murchie et al., 2003) Scotland	• Acute coronary care • NP • Follow-up primary care	• RCT • Four-year follow-up criteria • <80 years with a diagnosis of coronary heart disease but without terminal illness or dementia and not housebound	• 19 general practices • 1,343 patients • (673 NP vs. 670 medical care) • Aim of clinics to promote medical and lifestyle components of secondary prevention and offered regular follow-up for one year	• Mean follow-up 4.7 years • Significant improvements were shown in the NP group in all components of secondary prevention except smoking at one year • These were sustained more than four years (except for exercise). The control group, most of whom attended clinics after the initial year, caught up and group differences no longer significant • At 4.7 years, 100 patients in the NP group and 128 in the doctor group had died: cumulative death rates were 14.5% and 18.9%, respectively (p=0.038) • 100 coronary events occurred in the NP group and 125 in the doctor group: cumulative event rates were 14.2% and 18.2%, respectively (p =0.052) • Adjusting for age, sex, general practice, and baseline secondary prevention, proportional hazard ratios were 0.75 for all deaths (95% CI 0.58 to 0.98; p=0.036) and 0.76 for coronary events (0.58 to 1.00; p=0.049)	• NP appropriately managed and this outpatient cardiology clinic with suggestion for improved outcomes • NP led secondary prevention improved medical and lifestyle components of secondary prevention • NP group had significantly less deaths and probably fewer coronary events	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Northumber-land Care Trust, 2004) UK	• ICU • Neonatal • (Midwife practitioner)	• Prospective comparative audit • Five-year • Quality of neonatal care by NP vs. medically staffed units • Data on intra partum and neonatal mortality is reported. A review of resuscitation at birth, and a two-tier confidential inquiry into sentinel events in six units were carried out. The reliability of the routine pre discharge neonatal examination was studied and, in particular, the recognition of congenital heart disease	• One maternity unit • The audit includes 11 separate comparative studies supervised by a panel of independent external advisors • A review of the quality of post discharge letters was undertaken alongside an interview survey to elicit parental views on care provision • An audit of all hospital readmissions less than 28 days of birth is reported • Other areas include management of staff stress, perceived adequacy of the training of NPs coming into post, and an assessment of unit costs	• Intra partum and neonatal death among women with a singleton pregnancy originally booked for delivery in Ashlington fell 39% between 1991–1995 and 1996–2000 (5.12 vs. 3.11 deaths per 1000 births) • The decline for the whole region was 27% (4.10 vs. 2.99) • All other indicators the quality NP managed unit was as good as, or better than, that in the medically staffed comparator units	• NP care was as good as or better than medical staff unit care • An appropriately trained, stable team with a store of experience can deliver cot-side care of a higher quality than staff rostered to this task for a few months to gain experience, and this is probably more important than their medical or nursing background • Limiting onsite availability of medical staff with paediatric expertise should not determine future disposition of maternity services	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Paxton and Heaney, 1997) UK	• Minor Injuries Unit • PHC • Emergency • NPs	• Before-and-after study • Two-year study • Independent clinical audit rated	• One Minor injuries unit • Not specific to after hours • Urban	• Reduced ED activity by 24% in the three months • Waiting times were low 67% of patients were discharged • 98% cases satisfactorily treated • Ambulance unknown impact • 21% of patients attended a GP within 14 days unclear reason for re-attendance • 20,000 patients/2 years • Patients managed by NPs reported receiving significantly more information about their illnesses	• NPs appropriately and safely managed and referred patients • Extended opening times appealing • Non appointment system convenient appealed to patients • Mixed locations improved public access convenience • Engagement with local medical community enhanced acceptance	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Pioro MH et al., 2001) US	• General • Medical • NP	• RCT • Study compared care delivered by NPs or medical staff to admit and manage unselected general medical patients	• One site • 381 patients • Data were obtained from medical records, interviews and hospital databases. Outcomes were compared on both an intention to treat (i.e. wards to which patients were randomised) and actual treatment (i.e. wards to which patients were admitted) basis	• At admission, patients assigned randomly to NP-based care (n=193) and medical staff care (n=188) were similar with respect to demographics, co-morbidity, severity of illness and functional parameters • Outcomes at discharge and at 6 weeks after discharge were similar (p >0.10) in the two groups, including: length of stay; charges; costs; consultations; complications; transfers to intensive care; 30-day mortality; patient assessments of care; and changes in activities of daily living, SF-36 scores and symptom severity • After randomisation, 90 of 193 patients (47%) assigned to the NP ward were actually admitted to MO wards, largely because of attending physicians and NP request • Outcomes of patients admitted to NP and medical wards were similar (p >0.1)	• NP-based care can be implemented successfully in teaching hospitals and, compared to medical care, may be associated with similar costs • There was no difference in NP outcomes for clinical and functional items • There may be obstacles to increasing the number of patients cared for by NPs, including physician concerns about NPs' capabilities • NPs' limited flexibility in managing varying numbers of patients • Ability to accept after hour admissions	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Rizos et al., 1990) Canada	• Walk in Centre (WiC) • PHC • Emergency • NP	• Descriptive survey study • Metropolitan • Attendance of WiC patient utilisation patterns • After hours access	• 16-day period • 321 patients surveyed	• Reasons for attending the clinic were: convenient location (in 33% of the cases), inability to see their regular physician soon enough (in 16%). and no appointment needed (in 13%) • The majority of patients (80%) felt that they needed medical attention within 24 hours after the onset of their problem • 83% of the respondents would have sought medical attention at another WiC, from their regular physician or ED had the clinic been closed	• There was no difference in NP outcomes for clinical and functional items • High satisfaction for NP same day service if needed • Extended opening times appealing • Non appointment system convenient • Mixed locations improved public access convenience	4
(Rudy et al., 1998) US	• ICU • Adult • NP	• Comparative prospective design • 14-month	• 202 patients • One ICU • 14 months • 16 NP/Physician assistant • 16 doctors • NP (n=11)/ PA (n=5) compared with doctors • Metropolitan	• NP/PA were more likely to discuss patients with bedside nurses and to interact with patients' families. They also spent more time in research and administrative activities. Few of the acute care NPs and physician assistants performed invasive procedures on a regular basis • Doctors cared for patients who were older and sicker, cared for more patients, worked more hours, took a more active role in patient rounds, and spent more time in lectures and conferences	• No difference between groups for clinical outcomes or adverse events • Roles well established and supported	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Russell et al., 2002) US	• ICU • Adult • ACNP • Neurology	• Comparative prospective time series study • Six-month study • Compared previous patient data by medical staff prospectively with NP data	• One university teaching hospital • One ICU/high dependency • 402 patients adult patients • Two ANP	• ACNPs had significantly shorter hospital length of stay (p=.03) • Shorter mean length of stay in ICU (p<.001) • Lower rates of urinary tract infection and skin breakdown (p< .05) • Shorter time to discontinuation of the Foley catheter and mobilization (p<.05) • The outcomes-managed group was hospitalised 2,306 fewer days than the baseline group, at a total cost savings of USD2,467,328	• There were improved clinical outcomes for NP patients • NP decreased patient length of stay • Cost savings significant • Clinical and financial outcomes improved significantly by identifying patients at risk, monitoring for complications, and having acute care NPs manage the patients	2
(Sakr et al., 1999) UK	• Minor Injuries Unit • Emergency • NP	• Comparative prospective three-part study • A city emergency department that was closing was replaced by nurse-led minor injuries unit • Metropolitan	• Random sample of patients attending the emergency department • Nurse-led unit • Minor injuries unit (MIU) – extended hours of operation • No out-of-pocket expenses for patients	• Waiting times were much better at the MIU • Mean MIU 19 minutes, emergency department 56.4 minutes • Significant process errors were made in 191 of 1,447 (13.2%) patients treated by emergency doctors vs 126 of 1,313 (9.6%) of patients treated by NP – MIU • Reduced GP work load • Costs were greater in the MIU • (MIU UK £41.1, vs emergency department UK£40.01) • Increased follow-up by NPs 47% of patients for follow-up • Emergency department referring only 27%	• Care was equal to or in some cases better than the emergency care • There were less process errors for MIU NP patients • MIUs accessed more outpatient services • MIU cost was higher than the emergency sample of patients • NP minor injury service can provide a safe and effective service for the treatment of minor injury • Shorter waiting times improved patient satisfaction	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Salisbury et al., 2002) UK	• Walk-in centres (WiCs) • Emergency • NP	• Mixed methods • Interview questionnaires • Review and analysis of patient numbers, characteristics, and consultations	• Walk in Centre n=36 • Nurses 6–14 FTE in each centre	• Increase after-hours access choice • Clear diagnostic pathway patient group • Impact WiCs on emergency not addressed • WiC users were young adults 17–35 years and children • Greatest numbers presented after hours • Good links with GPs	• There was no difference in NP clinical outcomes • Increased utilisation due to easy access and convenient location • Potential Emergency department and GP patients choose WiCs	3
(Scisney-Matlock et al., 2004) US	• Medical • NP • Outpatient clinic • Collaborative model • Physician/NP team	• Comparative study • To determine whether the type of health care provider (i.e. physician versus physician/NP) • Affected the quality of hypertension care given to two groups of randomly selected adult women	• One hospital • Only adult women were randomly selected for the study • Compared physician-only vs. physician/NP	• The physician/NP team demonstrated <means for 24 hour systolic blood pressure and diastolic blood pressure (systolic: M=132, SD=14.9; diastolic: M=75, SD=11.3) than the physicians (systolic: M=136, SD=13.4; diastolic: M=79, SD=11.24) • The physician/NP team revealed significantly higher scores for discussion of blood pressure medication vs. physicians • There were no group differences for knowledge of hypertension	• The NP/physician team had improved clinical outcomes for patients compared with physician-only • NPs could influence compliance and improve education	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Shepperd et al., 1998) UK	• Surgical • NP	• RCT • Cost minimisation study • To examine the cost of providing hospital at home in place of some forms of inpatient hospital care	• One hospital • Patients n=hip replacement (n=86), knee replacement (n=86), hysterectomy (n=238), elderly medical patients (n=96), chronic obstructive airways disease patients (n=32)	• Hip replacement patients perceived greater improvement in quality of life with 'hospital at home' (difference in change from baseline value 0.50, 95% CI 0.13 to 0.88) • One third of knee replacement patients remained in hospital 14 (30%) • However, a significant proportion of knee replacement patients remained in hospital 14 (30%)	• Hospital at home care did not reduce total health care costs for all groups • Costs were significantly increased for patients recovering from a hysterectomy and those with chronic obstructive airways disease • There was some evidence that costs were shifted to primary care for elderly medical patients and those with chronic obstructive airways disease • The study suggests that patient cohorts need to be well considered for model optimisation	1
(Shum et al., 2000) UK	• MIU • emergency • NP	• Before-and-after study • Specially educated practice nurses. • Rural and metropolitan • Patients requesting and offered same day appointments by receptionists	• Five GP practices • 1815 patients • NP vs. GP care • Questionnaire •	• No difference in rate of prescriptions (nurses 481/736 (65.4%) v doctors 518/816 (63.5%). 577/790 (73%) of patients were managed by NPs. High satisfaction with NPs compared to GPs mean (SD) score of satisfaction 78.6 (16. 0) of 100 points for NPs vs. 76.4 (17.8) for doctors • NP consultations were two minutes longer than GPs'	• NP care was equal to or in some cases better than GP care • Potential for slight increase in cost due to increased consultation time • Equitable service for patients • Timely access to a health clinician • Nurses can safely manage specific patient groups	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Spisso et al., 1990) US	• ICU • Adult • NP • Trauma • The University of California, Davis, Medical Center	• Comparative prospective study • 12 months	• One medical centre • Metropolitan • Trauma NP to accommodate the rising patient volume and acuity	• NPs were associated with a decrease in average length of stay for the seriously injured patients from 8.10 to 7.05 days while hospital the length of stay for other patients remained unchanged • NP discharge summaries complete in 95% of sampled records compared with approximately 75% of the residents' notes • With introduction of the NPs, outpatient clinic waiting times decreased from 41 to 19 minutes • Patient complaints regarding the trauma team decreased from 16 to seven per year. • Time saved for doctors averaged 352 minutes per day when NPs were on duty	• Clinical and hospital outcomes improved with NP care • NPs reduced patient length of stay • The NPs were well received by the hospital nurses, hospital quality assurance personnel, and ancillary services • Documentation in medical notes increased substantially	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Stables et al., 2004) US	• Cardiology • NP • Outpatient Procedural • Clinic	• RCT • NP vs. Resident doctors	• 12 months • One site • 339 patients • Compared NPs prepared patients for cardiac catheterisation vs. residents	• Cardiologist's evaluation identified appropriate care in the NP group (98.3%) and resident doctors (98.8%) (p=1.0) • Adverse clinical events for NP group 0/175 (0%) vs resident doctors group 2/161 (1.2%) • (Risk difference=-1.2%, upper boundary of the 95% CI=+2.0%) • Patient satisfaction was greater for the NP group (p=0.04) • The median time for the preadmission clinic visit was less for the NP group 165 min compared with 185 min for doctors (p=0.01)	• No discernable difference in patient outcomes • NPs achieved higher satisfaction ratings	1

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Sturgess et al., 1996) US	• Surgical • NP	• A prospective study • Evaluation of one nurse's minor surgery performance • One year study • To evaluate the success rate and complications of percutaneous endoscopic gastrostomy (PEG) insertion performed with an endoscopy NP, rather than a second doctor, carrying out percutaneous gastric puncture	• One NP • One hospital unit • 50 consecutive PEG insertion procedures by NP/surgeon vs. surgeon/resident doctor	• The NP was successful in 100% of patients • Both groups had the same complication rate • Immediate complications from the procedure occurred in two cases in both the nurse-assisted and doctor-assisted groups • Thirty day mortality was 8% in the NP group vs. MO 12% following doctor-assisted PEG (mainly due to progression of the underlying condition) • Outcome at three months was similar in the two groups, except for a slightly lower incidence of stomal infection in the NP group	• There was no discernable difference in clinical outcomes • The endoscopy NP in the gastric puncture for PEG insertion appeared to be safe and effective and offered advantages in terms of the efficient provision of a PEG placement service, increased continuity of care for the patient	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Szafran and Bell, 2000) Canada	• Walk-in centres (WiCs) • Emergency • NP • Rural and metropolitan	• Comparative study • Six-month study • Questionnaire • Nine community-based family practices	• Patient • Questionnaire • Return rate 89.6% • (403 of 450) • WiCs attractive options to young adults and parents • Extended opening times appealing • Non appointment system convenient • Mixed locations improved public access convenience • Closed after hour General Practitioner services led to redirection by patient to a WiC	• 7.5% of patients (22.2% of rural, 35.5% of urban patients) attended WiCs • Rural (91.1%) than urban (60.7%) • Patients felt they could contact their doctors during evenings and weekends (P.004) • More urban (67.2%) than rural (33.3%) patients did not call their own physicians before going to WiCs (P.002)	• There was no discernable difference in clinical outcomes • Utilisation was greater for urban based settings • Potential emergency department and general practitioners' patients choose WiCs • Patient expectations and perceptions need to be managed • Early engagement with local medical community enhanced acceptance • Rural patients perceive a different relationship with their GP than metropolitan patients	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Tranmer and Parry, 2004)	• Surgery • NP	• Comparative prospective study • NP follow-up vs. routine hospital follow-up • The purpose of this trial was to determine the effectiveness of advanced practice nursing support on cardiac surgery patients' during the first five weeks following hospital discharge	• Patients (n=200) were randomly allocated to two groups: (a) an intervention group who received telephone calls from an NP familiar with their clinical condition and care needs, twice during the first week following discharge then weekly thereafter for 4 weeks, and (b) a usual care group. Measures of health-related quality of life, symptom distress, satisfaction with recovery care, and unexpected health care contacts were obtained at five weeks following discharge	• No significant group differences in of health-related quality of life, unexpected contacts with the health care system, or symptom distress • The provision of NP support via telephone follow-up after cardiac surgery is feasible	• There were no significant group differences • May have increased cost due to NP role	3

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Varughese et al., 2006), US	• Surgical • Paediatric • NP	• Prospective comparative study • 12-month study • NP-assisted preoperative evaluation program • The strategic goal of this program was to shift anaesthesiologists from the pre-anaesthesia clinic to the OR, while maintaining the quality of preoperative care	• 1,509 children (one month–18 years) • 463 parents • 20 preoperative NPs • 25 anaesthetic staff • Indicators of quality were incidence of respiratory complications (apnea/hypopnea, laryngospasm, bronchospasm, and supplemental oxygen use in postanaesthesia care unit), patient preoperative preparation time and parent and staff (anaesthesiologists and preoperative clinic nurse) satisfaction • These indicators were recorded for one week every three months for one year	• The NP maintained patient safety, timeliness, and a high level of parent satisfaction as well as increased staff satisfaction • Two anaesthesiologists were able to return to the operating theatre to assist	• There were no differences in clinical patient outcomes for the NP group • NP-assisted preoperative evaluation program can offer operational advantages without compromising care	2

Author Country	NP Model of care	Design	Method sample size, etc	Results	Outcomes	Quality of evidence*
(Wolke et al., 2002) UK	• ICU • Neonate • NPs	• RCT • 12-month comparing medical officer and midwife NP • To determine whether the routine examination of the newborn by a midwife NP compared with a junior paediatrician • To determine maternal satisfaction with the examination	• 826 mother and baby pairs • One district hospital	• Some 81% of mothers reported that they were satisfied or very satisfied with the newborn examination • Mothers assigned to a midwife NP were more satisfied with the newborn examination (crude odds ratio (OR) 0.54 (95% confidence interval (CI) 0.39 to 0.75), p<0.001) • After provision of health education during the examination, continuity of care provided, and history of miscarriage had been controlled for, status of examiner was no longer related to maternal satisfaction (adjusted OR 0.82 (95% CI 0.57-1.20), NS) • The discussion of health care issues by the examiner (adjusted OR 0.49 (95% CI 0.34 to 0.70), p<0.001) and continuity of care (adjusted OR 0.43 (95% CI 0.23 to 0.81), p<0.01) were both related to enhanced satisfaction, and history of miscarriage (adjusted OR 1.61 (1.08 to 2.40), p<0.05) was associated with lower maternal satisfaction with the newborn examination • Midwives (61%) were more likely than doctors (33%) to discuss health care Issues	• There was no discernable difference in clinical outcomes • Mothers were more likely to be satisfied with the newborn examination by a midwife practitioner than a doctor • Midwife practitioners were more likely to discuss health care issues during the examination and were able to provide continuity of care	1

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