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**Economic Analysis of Physician Assistants in Ontario:
Literature Review and Feasibility Study**

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EXECUTIVE SUMMARY

We conducted a literature review of studies on Physician Assistants working in a variety of settings and found few evaluation studies on the costs and/or effectiveness of Physician Assistants in primary care practices, Emergency Departments and in hospital settings other than Emergency Departments. The existing literature is limited because of the non-Canadian settings in which most studies have been performed and because of the non-experimental study designs, which are subject to potential bias. In addition, the research questions that have been addressed have tended to ignore what would appear to be the most important comparison: that between Physician Assistants and other non-physician providers such as Nurse Practitioners.

The evidence we found on the cost-effectiveness of PAs is anecdotal and difficult to translate in the Ontario context. We conclude that it is difficult to make use of the existing literature.

We recommend that MOHLTC consider options for funding a randomized control trial that might involve several trial arms in the particular sectors of relevance to the PA program, for example: physician only; physician and PA; physician and NP; and physician, NP and PA. The purpose of this would be to explore the difference in costs and effects on the different service modalities. This would also provide sufficient information to support modelling the short-run effects that could be expected from allocating the same amount of resources to the different service modalities as well as the implications for physician resources planning.

1. BACKGROUND

This study is a collaborative project of the Health Human Resources Policy Branch of the Ontario Ministry of Health and Long-Term Care (MOHLTC) and the McMaster University Centre for Health Economics and Policy Analysis (CHEPA). In the summer of 2009, MOHLTC approached CHEPA to investigate the cost-effectiveness of introducing Physician Assistants (PAs) in Ontario; this paper explores the feasibility of performing such an evaluation.

2. INTRODUCTION

Although officially first introduced in the military in 1984, PAs have been de facto employed by the Canadian Forces for over 50 years (Canadian Association of Physician Assistants, 2009). PAs working in the Canadian civilian health care system, however, is a recent phenomenon: they were first introduced in Manitoba in 2002 (National Standards Committee, 2007). As of February 2010, there were 307 PAs in Canada; of these, 140 were employed in the Canadian Forces (Canadian Association of Physician Assistants, February 2010). PAs employed in the Canadian civilian health care system are mainly present in four provinces:

- Manitoba introduced PAs and non certified “clinical assistants” (CAs) and in 2002 (Canadian Association of Physician Assistants, June 2010; National Standards Committee, 2007). Although similar, PAs and CAs are distinct professions. CAs are licensed health care practitioners (e.g., nurses, paramedics) or have completed a World Health Organization recognized medical program and have successfully passed the Canadian Medical Licensing Examination (e.g., IMGs). PAs, on the other hand, are formally educated to a national standard recognized by the Council of the College of Physicians and Surgeons of Manitoba. While CAs have restricted practice and require on-site supervision, PAs can practice off-site with remote supervision (Canadian Association of Physician Assistants, May 2010). CAs in Manitoba work in surgical specialties, hospitals and rehabilitation facilities while certified PAs work prevalently in Emergency Departments (EDs). In addition, the University of Manitoba’s Physician Assistant Education Program had 10 PA students in the 2009-2010 academic year (Canadian Association of Physician Assistants, May 2010). As of May 2010, there were 47 non certified CAs, 15 PAs and 24 PA students in Manitoba (Canadian Association of Physician Assistants, June 2010);
- Ontario introduced PAs in 2007 (Ontario Ministry of Health and Long-Term Care, 2008) in hospitals, community health centres, diabetes clinics and long-term care facilities;

- In 2006, Alberta Health informally introduced PAs working mostly in hospitals through Clinical Assistants, Surgical-Clinical Assistants and Surgical Assistants Programs (Calgary Health Region, 2009; Alberta Health Services, 2009);
- New Brunswick is looking to hire 6 PAs in EDs (Canadian Association of Physician Assistants, February 2010; Government of New Brunswick, 2009).

The Canadian Association of Physicians Assistants estimates a yearly growth in civilian PAs of 10 in Manitoba and 50 to 75 in Ontario (Canadian Association of Physician Assistants, February 2010).

In 2005, a survey of Canada's provincial/territorial health ministries asked each of them whether they officially recognized PAs and whether they planned to introduce PAs in their jurisdiction (Hague, 2005). Of the eight provinces/territories that responded to the survey, all indicated that the introduction or expansion of PAs was not a priority: Nova Scotia and Saskatchewan stated they were prioritizing Nurse Practitioners (NPs); Newfoundland had debated introducing PAs but rejected the idea; New Brunswick, Ontario and British Columbia had no official position nor plans to introduce PAs; Yukon was open to the concept and Manitoba, despite having introduced PAs, had no plans to expand their program (Hague, 2005).

Other jurisdictions such as Australia, England, India, Scotland, The Netherlands, South Africa, Taiwan and Thailand have also recently introduced PAs (Buchan, O'May, & Ball, 2007; Caldow & Bond, 2008; Farmer, Currie, West, Hyman, & Anrnett, 2009; Queensland Government, 2010; Hooker, Hogan, & Leeker, 2007; UK Association of Physician Assistants Ltd., 2010). This recent trend has been justified by the seemingly overall positive results experienced by the United States where PAs are well established having been introduced in the 1960s and where an estimated 73,893 PAs were practicing at the end of 2008 (American Association of Physician Assistants, 2008).

3. CONSIDERATIONS TO BE MADE WHEN EVALUATING PAs

In all of the above jurisdictions, the introduction of PAs is part of a larger movement consisting of the creation and expansion of other non-physician health care providers (NPPs) such as NPs and midwives. NPPs can perform some of the routine tasks traditionally performed by physicians, and have therefore been introduced to substitute for physicians in the provision of some services thus increasing access to health care services where chronic physician supply constraints exist.

3.1. Economic Evaluation

Economic evaluation has been defined by Williams as being concerned with ensuring that the value of what is produced by an activity outweighs the value of what has to be sacrificed (Williams, 1983). Two key elements emerge from this definition. First, the evaluation is based on a *comparison* of one activity (what is being evaluated) with something else. Second, the 'something else' is the *activity or range of activities that have to be given up* in order to provide the resources to support the activity being evaluated. The evaluation then compares the values produced from these two different uses of the same resources. If the value to society of what is produced by the activity under evaluation exceeds the value to society of what was produced by the activities that had to be given up, adopting the new activity would produce an increase in efficiency.

3.2. Specifying the Role of PAs and the Policy Question to be Addressed

In terms of evaluating the introduction or use of PAs, we therefore need to have a clear specification of the PA program and the alternative uses of the resources required to fund the introduction and use of PAs in this way. The particular issues that need to be resolved include:

1. How are PAs to be deployed? Under current regulations, PAs are not independent practitioners and can only provide services under delegation from physicians. However, the effect of PAs on the stated program objectives may vary according to the models of service delivery in which they are deployed (e.g., working with individual physicians, working as part of a physician/nurse practitioner team, working as part of a multi-disciplinary practice);
2. What are they to be compared with? Is the comparison to be with a single-handed physician, with a physician/NP team or with a multi-disciplinary team?

Although PAs may already be practicing in a variety of different delivery models, the implications for the efficiency of resource use may differ between delivery modalities and a comparator. Hence studying the use of PAs based on a variety of different modalities would not inform decisions about which, if any, modality is an efficient use of resources and which is not. The example of Nurse Practitioners is helpful here. NPs are independent practitioners with their own legislated scope of practice based on research evidence about the effectiveness and efficiency of their use to deliver primary care services traditionally delivered by General Practitioners or Family Physicians (GPs/FPs). However, in many cases NPs have been used not as an alternative way of providing the same primary care services, but instead as a means of supporting an extended range of services in primary care settings (i.e., an add-on as opposed to a substitute for physician care), roles which have not been evaluated (Birch & Gafni, 2003).

Given the introduction and expansion of NP training programs in Ontario, it would seem important that any evaluation of PAs be performed in comparison to using the same resources to support alternative models of service delivery (e.g., NPs and GPs/FPs working together) to achieve the same objectives.

3.3. Specifying the Setting

PAs in Ontario have been introduced in a variety of settings (Ontario Ministry of Health and Long-Term Care, 2008):

- Hospitals (EDs, general internal medicine, orthopaedic surgery, general surgery, complex continuing care and rehabilitation);
- Community Health Centres (working in primary health care teams);
- Physician Employed Models (physician practices in diabetes care or in long-term care homes).

As examples extracted from the literature and provided later in this paper will prove, the research question, study design, parameters and outcome measures must be customized to reflect the particular characteristics of the setting in which the PAs are being evaluated.

In summary, in order to evaluate PAs, the program goals, evaluation framework and setting must be selected. As these issues are pondered, it is useful to see what information is available in the published literature.

4. REVIEW OF THE LITERATURE ON EFFECTIVENESS AND/OR COSTS OF PHYSICIAN ASSISTANTS

It is important to note that, because questions about the efficiency of resource use depend on the particular setting and circumstances, the same program may be effective in one setting but not in another, even though the performance of the program is the same (Birch & Gafni, 2003). This is because the value of what has to be sacrificed to support the program may differ between settings. Therefore, while we can review existing literature on PAs, the findings of that literature need not apply to the question about the efficiency of using health care resources in Ontario to support the introduction of PAs.

Secondly, one must also keep in mind that many published evaluations of PAs analyze the productivity of PAs as they are being introduced to a setting and to a health care provider team employing PAs for the first time. Over time, we might observe that the productivity of PAs (measured, for example, in terms of patient visits or services provided during a pre-specified

amount of time) and of the team as a whole may increase as both the PA and other members of the care team learn to work together more efficiently than at the point of introduction. Therefore, many studies will measure a short-term productivity change that may be lower than the productivity change witnessed over the longer term.

Lastly, since a cost component almost consistently included in all PA evaluations is the PA's salary and benefits, the salaries are likely entry level and benefits are likely lower during a trial or pilot involving the introduction of junior PAs in a care team. In the long run, one might expect that salaries and benefits paid for PAs will be higher as they increase with experience; real salaries would also have a secular increase if the average seniority of PAs increased over time. As a side note, an additional consideration to be made is the payment method adopted to remunerate PAs. Salary is the only method we found in the literature and it is the method currently used to remunerate PAs in the Canadian provinces that have introduced PAs in their health care system. Other potential methods could be sessional payments, fees-for-service or capitation payments. This issue is potentially non-trivial for a cost-effectiveness analysis since the compensation structure has important implications with regards to both effects and costs.

For the purposes of this report, we conducted a literature review and provided a set of tables in the appendices below. Although these appendices cover studies of PAs (Appendix A) and NPs (Appendix B), we only discuss studies on PAs in the body of this report. The appendices are meant to provide examples of evaluations and by no means represent the result of a systematic review of the literature. The tables list summary information such as research question, evaluation model, setting, duration in time, sample size and results of each study.

The most important point to emerge from our review of the literature is that, as far as we have been able to establish, there have not been any randomized controlled trial (RCT) studies of PAs. As a result, the findings of studies of PA use are all subject to the well-established biases of non-experimental study designs and should be treated with appropriate caution. This contrasts with the research on NPs which has used RCT methods to compare the effectiveness of NP care with that of physicians in both primary and secondary care settings.

4.1. PAs in Ambulatory Primary Health Care Settings

Section A.1 of Appendix A summarizes five studies that we found on PAs working in primary health care practices, none of which were related to PAs in Canada. All but one study evaluated the effectiveness of a physician alone compared to a physician and PA team; the fifth study (Farmer, et al., 2009) was not an evaluation per se as PAs were added to a team to provide additional care (i.e., could be care that was not previously provided) and not a

“substitute for a nurse or a doctor”. Three of these studies were on PAs in the United States (US) (Grzybicki, Sullivan, Oppy, Bethke, & Raab, 2002; Hooker, 2002; Morgan, Shah, Kaufman, & Albanese, 2008) and two on PAs in the United Kingdom (UK) (Farmer, et al., 2009; Woodin, McLeod, McManus, & Jelphs, 2005).

Two studies (Grzybicki, et al., 2002; Hooker, 2002) analyzed the costs of care provided by PAs compared to the costs of care provided by GPs/FPs. The Grzybicki study analyzed data from one primary care practice in September and October 1998; the care team consisted of GPs/FPs, NPs and PAs. Authors combined information from direct observation and semi-structured interviews with data on the practice’s revenue, overhead costs (e.g., salaries, rent) and service delivery (e.g., number of visits) during the study period. PAs and GPs/FPs had an average of, respectively, 80.3 and 93 office visits (FTE equivalent) per week; hence the “task substitution ratio” = $80.3/93 = 0.86$ indicating that PAs could perform 86% of the tasks that GPs/FPs could perform in the same amount of time. Based on the PA’s and GP/FP’s salary and the revenue they each generated from the mean dollars charged per patient visit, the authors estimated the economic benefit of having the PA perform the services to be equivalent to an annual USD 52,592.

The study by Hooker involved 75 PAs and also analyzed data from 1998; the care team consisted of GPs/FPs, NPs, midwives and PAs. The study calculated the total cost of an episode for 4 selected diagnoses: urinary tract infection, shoulder tendinitis, acute bronchitis and otitis media. The cost per episode of care included salary, overhead, imaging, medication, laboratory costs; authors also controlled for patient characteristics such as age, sex, department where treated and health status. The PA cost per episode was lower than the physician cost per episode for all 4 diagnoses and there was a statistically significant difference between the costs for three of the four diagnoses. The authors concluded that PAs are cost effective.

The study by Morgan and colleagues (Morgan, et al., 2008) analyzed data from surveys conducted between 1996 and 2004 that asked respondents questions about their age, sex, race, rural/urban residence, health insurance, socioeconomic status, health status, medical conditions and the number of office visits they received from a PA or from a physician. The authors looked at outcomes in terms of number of office visits per patient and adjusted these results based on each patient’s health status using a measure based on the constellation of diagnoses assigned to them. Results showed that patients who reported having received 30% or more of their visits from a PA had 16% fewer visits than those who reported receiving all of their care by physicians only. Due to the methods adopted and the data used, the authors were unable to calculate costs.

All three above studies found positive results by concluding that PAs are cost-effective in that they provide the same amount of services as do GPs/FPs at equal or lower cost. Not surprisingly, these three studies examined PAs in the US. In addition, the studies did not consider whether the quality of care provided by GPs/FPs and PAs differed.

The last two more recent studies (Farmer, et al., 2009; Woodin, et al., 2005) analyzed activity data by PAs and other care providers and, based on results obtained from their analyses, speculated on its impact on costs based on a comparison of GPs'/FPs' and PAs' salaries (and therefore did not conduct a rigorous cost analysis). Although both studies reported positive outcomes (e.g., reduced wait times for patients, increases access, delivered high quality care to patients) associated with the introduction of PAs, both studies were inconclusive with regard to the effectiveness of PAs. The Woodin study used 2004 data and found large variations in PAs' consultation times and activity volumes across diagnostic groups and across complexity of cases (number of conditions) leading authors to speculate that the cost-effectiveness may be low in some practices where the lower cost of PAs were offset by longer consultation times and lower activity volumes. The Farmer study used data from 2006 to 2008 and was, as mentioned earlier, not an evaluation study per se because PAs provided complementary and not substitute care. Although the study concluded that PAs relieved pressure on GPs/FPs, authors reported that they were unsure how much of this was related specifically to the role of the PA and how much was due to the fact that an extra care team member was added to help with the workload.

These last two studies with inconclusive results are UK studies analyzing the effects of introducing USA-trained PAs who migrated to England and Scotland to work as PAs. Both papers mentioned that there was considerable variation in the amount and type of work undertaken by these PAs, which was due to factors including the PAs' individual personalities, experience, and competence as well as the needs of the practice. Both studies also mentioned difficulties experienced by the practices resulting from some confusion regarding the PA role (due to both the lack of familiarity with the role in the UK health care system and cultural differences between the US and UK health care systems). Farmer stated that: "PAs were less distinctly beneficial in: primary care, where they were replicating the duties of other staff or were endeavouring to start new services in an environment where the social culture was alien to them" (Farmer, et al., 2009).

It is worth mentioning that, although NPs were part of the care team in some studies, none of these studies compared PAs working in conjunction with NPs, either working alone or alongside GPs/FPs.

4.2. PAs in Emergency Departments

Section A.2 of Appendix A provides summary information on selected studies analyzing the contribution of PAs in ED settings. We found four studies of PAs working in EDs of which one related to PAs in Ontario (Ducharme, Alder, Pelletier, Murray, & Tepper, 2009). Two of these studies were reviewed in section 4.1 (Farmer, et al., 2009; Woodin, et al., 2005) as they analyze PAs in a variety of settings and report results separately for each setting. Two studies (Counselman, Graffeo, & Hill, 2000; Woodin, et al., 2005) compared the contribution of a PA working alongside a physician to a physician alone while the other two studies (Ducharme, et al., 2009; Farmer, et al., 2009) assessed the addition of a PA to an ED team.

The Counselman study, which used data from 1999 from the US State of Virginia, surveyed patients after they had received care from a PA and found high satisfaction levels; in fact, 88% were not willing to wait longer to see a physician rather than a PA.

The study by Woodin and colleagues used 2004 data from England and also found positive patient feedback, but found it “difficult to attribute improvements in achievements of targets directly to the PAs, though, because the PAs represent a relatively small addition to the overall staff resource” (Woodin, et al., 2005).

The Farmer study (Farmer, et al., 2009) was included in Appendix A.1 and described in section 4.1 above as it analyzed USA-trained PAs in a variety of settings in Scotland, i.e. primary care practices, EDs, intermediate care, orthopaedics and out-of-hours. With regards to the PAs who worked in EDs, the study found that PAs were considered by some interviewees to be equivalent, productivity-wise, to a medical graduate with two years of training thus possibly representing a saving due to the difference in salary (Farmer, et al., 2009).

Both UK studies (Farmer, et al., 2009; Woodin, et al., 2005) reported difficulties experienced by physicians in supervising PAs in a busy ED.

The last study (Ducharme, et al., 2009), an Ontario study, is a before-after study assessing the contribution of PAs to an ED team by comparing wait times, patient flow and length of stay in cases where PAs were involved in patient care to cases where PAs were not involved in patient care. Administrative hospital data from 6 participating hospitals were analyzed. PAs and NPs were introduced in these EDs as an addition to, and not a replacement of, existing clinical staff. Data included information on all visits to the ED during a 14-day “before” period (November 13 to December 3, 2006) and on visits during a 14-day “after” period (June 11 to 29, 2007). The authors also assessed the contribution of NPs by comparing cases with and without NPs. The study found that patients were 1.6 and 2.2 times more likely in the post period to be seen within wait time benchmarks when, respectively, PAs and NPs were

involved in patient care than in the pre period when PAs and NPs were not working in the ED. The study found favourably for NPs also with regard to lengths of stay as patient stays in the ED in the post period with NPs and PAs were, respectively, 48.8% and 30.3% shorter than in the pre period without NPs and PAs. Although this is not a direct comparison of PAs and NPs, the Ducharme article is one of few studies we found that evaluated both PAs and NPs working alongside physicians.

4.3. PAs in Hospitals: Settings Other than Emergency Departments

We found and have summarized three studies on PAs working in hospital settings other than EDs; all three studies seek to evaluate PAs as they perform duties previously performed most often by residents. One (National Standards Committee, 2007) is a Canadian study while the other two (Miller, Riehl, Napier, Barber, & Dabideen, 1998; Riportella-Muller, Libby, & Kindig, 1995) are American.

The Miller article describes the role of a trauma PA that was developed in a large community hospital in Michigan around 1994, and conducts a before-after study examining the impact of involving two trauma PAs in providing trauma services between 1994 and 1996. Despite the fact that Injury Severity Scores of critical care patients admitted increased between 2004 and 2006 from 13.4 to 16, decreases were observed during this same time period in transfer time to the operating room, to the Intensive Care Unit and to the floor as well as decreases in length of stay. Eight trauma surgeons were surveyed on their perception of resource savings and satisfaction levels: they reported an average time savings of 4 to 5 hours per physician per day thanks to the introduction of trauma PAs who were performing tasks previously performed by surgical residents in trauma centre wards.

The Canadian study is a report prepared by the Canadian Orthopaedic Association's National Standards Committee on the costs and effects of hiring three orthopaedic CAs (please see page 5 above for the difference between CAs and PAs in Manitoba) as replacements for general physicians as surgical assistants in orthopaedic operating rooms in Manitoba in 2006 (National Standards Committee, 2007). General physicians acting as surgical assistants were remunerated on a fee-for-service basis by submitting claims to Manitoba Health whereas the three orthopaedic CAs are paid by salary and hence would not submit any claims when assisting in surgeries. The cost savings for surgical assistant fees not billed by general physicians to Manitoba Health amounted to just over \$270,000 and were almost equal to the cost of the three CAs' salaries during the study period. Cost savings additional to those associated with surgical assistance are given by other tasks performed by PAs such as writing

post-op orders, discharge summaries and making rounds to patients; these generated additional time savings as they gave surgeons “relief of scut work”. Also, an additional positive outcome associated with the hiring of the three CAs was the decrease in wait times by 32% going from 44 to 30 weeks. In summary, this study concluded favourably for PAs as they reduced health system costs by performing tasks previously performed by surgical assistants in operating rooms.

The scope of the third study (Riportella-Muller, et al., 1995) was solely qualitative in that it did not measure and evaluate tasks actually performed by PAs; it simply consisted of a survey of teaching hospitals asking about their experiences in hiring PAs and NPs to perform tasks previously performed by their residents. The study found an overall positive experience for both PAs and NPs. PAs were more likely than NPs to substitute in EDs and surgery while NPs were more likely to substitute in pediatrics and neonatal care. Results also found an overall increase in the number of PAs and NPs, but authors were unsure whether this was a cause or an effect of the decline in the size of the residency program. .

4.4. PAs in Long-Term Care

We found no such studies.

4.5. PAs in Anaesthesia Care Teams

We found no studies on the role of PAs in Anaesthesia Care Teams (ACTs). The ACT is a setting in which PAs have rarely been introduced; the role is most often covered by nurse anaesthetists. In the US in 2002, there were 500 Anaesthesiologist’s Assistants (AAs) but 30,000 Certified Registered Nurse Anaesthetists (CRNAs) (Kane & Smith, 2004). The US has experienced conflict and lack of collaboration between CRNAs and anaesthesiologists. Although PAs in ACTs (AAs) show promise, too little is known at this point (Kane & Smith, 2004).

4.6. Summary of Findings on Effectiveness and/or Costs of Physician Assistants

The existing literature is limited because of non-experimental study designs and the non-Canadian settings in which studies have been performed. In addition, the research questions that have been addressed have tended to ignore what would appear to be the most important comparison: that between PAs and other NPPs (e.g., NPs). The one exception to this (Ducharme, et al., 2009) found that NPs were more effective than PAs in terms of reducing

average wait times and average lengths of stay in EDs, although this study was not based on a randomized controlled trial.

5. DISCUSSION

James Buchan and colleagues point out that the need for an additional NPP is being questioned “given the development of the nurse practitioner who can meet the service needs within a team that is consultant-led, has prescription privileges and can also practice independently” (Buchan, et al., 2007). In exploring the feasibility of conducting an economic evaluation of PAs in Ontario, there are several factors that need to be considered/addressed:

- We found no experimental studies on PAs so findings of current studies are all subject to potential bias;
- Only one study (Ducharme, et al., 2009) compared use of PAs to use of an alternative NPP (NP). The findings from that study were that NPs were more effective than PAs in achieving the system goals. However, this was not based on an experimental study design;
- Direct comparison with NPs is particularly important to understand the economics of using PAs because of the different regulatory position of the two types of providers. Unlike NPs, PAs require close supervision by physicians, which has significant resource implications;
- An economic evaluation of PAs versus NPs must include a comparison of the full costs of PA and NP activities; for example: PA’s and NP’s salary and benefits, the stipend received by the physician for his/her time spent supervising the PA, additional secretarial support and space required/used by the PA or NP, recruitment costs, hiring and relocation costs, orientation of the PAs/NPs and other health care team members working with the PA/NP.

It is difficult to make use of the existing literature from other jurisdictions, and possibly settings, and translate their results for the Ontario context. In terms of the setting, many studies involving PAs working in EDs, for example, commented on the benefit of having PAs in that they brought stability to EDs which are increasingly populated by residents who rotate frequently; this would not be the case in a primary care practice where the care team is much more stable. In terms of location: the US health care system is different from the Canadian health care system as PA-related costs such as salaries vary considerably due to the private market, results are therefore not easily applicable to the Canadian/Ontarian context. The introduction of this new profession in Ontario has been a bumpy one given the lack of support toward PAs from some of the other NPP organizations (see for example, the Registered Nurses Association of Ontario’s position statement on Physician Assistants) (Registered Nurses Association of Ontario, 2010) and the current lack of job opportunities for new PAs. This has been emphasized by the media

coverage (Prokaska, 2010; Talaga, 2010) of the inaugural class graduating from McMaster University's Physician Assistant program, which cannot find a PA job despite having been guaranteed one when they began the two-year program in September 2008. These additional considerations further support the need for a carefully designed trial of PAs and NPs in Ontario.

As can be seen from the studies we found and that are listed in the appendices (please see sample sizes in bold font), the majority of studies involved under 10 PAs. While the sample size of the existing studies has been small for a trial, it will need to be considerably larger in order to allow for the different contexts and characteristics of use and deployment of PAs. Without a sufficiently large sample size, the questions that studies can reliably address are highly specific and likely to be acontextual. These studies are also short in terms of duration with most lasting a few months, some even weeks. The 1974 Burlington randomized controlled trial of NPs published in the *New England Journal of Medicine* (Spitzer, et al., 1974) provides an excellent example of a local, short (14 months), small (hence administratively feasible) yet successful trial aimed at informing Ontario health human resource planning.

6. CONCLUSIONS AND RECOMMENDATIONS

The evidence we found on the cost-effectiveness of PAs is anecdotal and difficult to translate in the Ontario context. We recommend that MOHLTC consider options for funding a randomized control trial that might involve several trial arms in the particular sectors of relevance to the PA program, for example: physician only; physician and PA; physician and NP; and physician, NP and PA. The purpose of this would be to explore the difference in costs and effects on the different service modalities. A trial could also be used to compare the level of quality of health care services received by patients as a function of the composition of the health care provider team. This would also provide sufficient information to support modelling the effects that could be expected from allocating the same amount of resources to the different service modalities as well as the implications for physician resources planning.

In the absence of a trial, current (i.e., without the involvement of PAs) cost and outcome benchmarks could be identified in the relevant settings in order to set the minimums (e.g., minimum additional number of patients seen in a pre-defined period of time) that would be required to see PAs be cost effective to the health care system.

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Appendix A. Summary Tables of Selected Publications on Physician Assistants

A.1. PAs in Ambulatory Primary Health Care Settings

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Farmer, Currie, West, Hyman, & Anrnett, 2009)	Descriptive study (not an evaluation): evaluate the impact and contribution made by PAs in delivering effective healthcare (PAs providing additional care)	Qualitative	Primary care	<ul style="list-style-type: none"> Scotland, 2 years: November 2006 to October 2008 	5 USA-trained PAs working in primary care settings (1 PA left before end of study period).	<ul style="list-style-type: none"> Impact on wait times, usefulness of PAs, contribution of PAs to the care team Data collected: individual and group interviews with PAs, medical supervisors and other team members; monthly feedback forms (e.g., PAs' scope of practice, time spent in clinical supervision); patient satisfaction interviews; Work activity/shadowing data were collected (April/May 2007 and Oct/Nov 2007) to measure the productivity of PAs against other team members (e.g., nurses). Note: data conceal decisions made about the amount of time spent with patients or which type of patients PAs would see so the data are not useful to draw conclusions on productivity. 	<ul style="list-style-type: none"> Individual personalities affected the extent to which PAs were seen as valued team members: if a PA was employed when a nurse could do the job, GBP 15,000 would be overspent, while if a PA were to work 'like a GP/FP', then GBP 43,000 could be 'saved' PAs were less distinctly beneficial as they were replicating the duties of other staff or were endeavouring to start new services in an environment where the social culture was alien to them. 	Team reported improved capacity to see patients, shortened waiting times and relieved pressure on GPs/FPs with the addition of this extra team member

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Grzybicki, Sullivan, Oppy, Bethke, & Raab, 2002)	Estimate the financial productivity of a PA practice compared to a physician-only practice	<ul style="list-style-type: none"> Qualitative (direct observation and semi-structured interviews) to describe tasks performed by PA Quantitative to calculate economic benefit of PA practice 	Ambulatory family/general practice consisting of: <ul style="list-style-type: none"> 1 supervising physician (0.92 FTE) 2 part-time employee physicians (1.25 FTE together) 1 part-time (0.56 FTE) PA 1 part-time (0.92 FTE) NP 	Southwestern Pennsylvania, Sept and Oct 1998	1 practice with 1 part-time PA serving a patient population of 9,200 (representativeness of this practice was compared to national statistics on socioeconomic characteristics and production data)	<ul style="list-style-type: none"> The following three are calculated for a PA and physician: <ol style="list-style-type: none"> Revenue = mean cost per patient visit x mean number of patients seen Overhead (salary, rent, insurance) assumed to be the same, except for PAs' (USD 64,951) and physicians' (USD 140,900) salary Extra practice revenue (generated by others because of the addition of the PA/physician): assumed to be USD 0 Additional data obtained from national averages and/or from the literature USD 46: mean charge per visit for PA USD 45: mean charge per visit for physician. 	<ul style="list-style-type: none"> Authors conclude that the task-substitution ratio is $0.86 = 80.3/93 = \# \text{ FTE office visits by PA} / \# \text{ FTE office visits by supervising physician}$ Economic benefit = compensation-to-production ratio = PA compensation / gross patient charges = $(0.56 \times \text{USD } 64,951) / (\text{USD } 46 \times 45 \text{ pts per week} \times 48 \text{ wks}) = \text{USD } 36,373 / \text{USD } 99,360 = 0.36$. 	GP/FP PAs are of significant economic benefit to practices who employ them
(Hooker, 2002)	Calculate the cost-effectiveness of PAs versus primary care physicians for treating four selected acute medical conditions	Quantitative: episode of care costs are analyzed for the following 4 diagnoses: UTI, shoulder tendinitis, acute bronchitis and otitis media	Primary care, prescribing and diagnostic services (e.g., imaging, laboratory) provided to 420,000 members in a health plan consisting of 75 PAs working with 500 physicians, 80 NPs, 12 nurse midwives and 5,000 other employees	Northwest United States: <ul style="list-style-type: none"> Portland, OR Salem, OR Washington State 1998	<ul style="list-style-type: none"> 51, 38, 43 and 49 PAs by the 4 diagnoses Only records of patients aged less than 65, were not assigned any other diagnosis in the 180 days surrounding the episode date and did not see another provider for that episode: 12,782 (5%) medical office visits 	<ul style="list-style-type: none"> Outcome variable is total cost of episode of care to the employer (Kaiser Permanente) Total cost included: medical office visit costs (salary + overhead), imaging, medication, laboratory Mean PA salary was USD 54,400 and mean physician salary was USD 124,600. Authors ran linear regressions and controlled for patient age, sex, department where treated and health status (calculated by looking at co-morbidities and prescriptions) 	<ul style="list-style-type: none"> Significantly lower cost for all diagnoses except bronchitis where PA cost was USD 224.14 and physician cost was USD 234.74 With diagnoses held constant, the attributes of patients made little difference in the analysis of variance between pts seen by PA and by PC physicians 	PAs are cost effective: they do not require additional resources nor more return visits to manage the episode of care

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Morgan, Shah, Kaufman, & Albanese, 2008)	Is the inclusion of PAs in patient care associated w/increased numbers of office visits per patient?	Quantitative retrospective cohort study using survey data	Primary health care visits	<ul style="list-style-type: none"> Survey sample representative of United States population Visits from 1996 to 2004 	<ul style="list-style-type: none"> Treatment group: 1,762 adults reporting they received 30% or more visits from a PA Control group of 111,183 adults reporting a physician attended all their visits Survey respondents reporting that providers other than PAs or physicians attended their office visits were excluded 	<ul style="list-style-type: none"> Medical Expenditure Panel Survey (MEPS) answers to question on number of office visits had in the past year Case-mix adjustment based on: age, sex, race, rural/urban, health insurance, socioeconomic status, SAHS and medical conditions 	Number of office-based visits per year is reduced by 16% in the PA group (risk ratio=0.84)	PAs do not increase per capita office visits per year
(Woodin, McLeod, McManus, & Jelphs, 2005)	<ul style="list-style-type: none"> Assess the benefits, drawbacks and impact on service quality of introducing PAs Compare their effectiveness to that of GPs/FPs 	Qualitative and quantitative	Primary health care practices	<ul style="list-style-type: none"> Sandwell, West Birmingham and Tipton, West Midlands, England 28 weeks (May 24 to December 3 2004) 	11 USA-trained PAs	<ul style="list-style-type: none"> Qualitative data collected from face-to-face individual interviews and patient focus groups Activity data on encounters with patients: average number of consultations per week, average number of days worked per week, number of consultations by number of conditions (ICPC codes) presenting (e.g., 1, 2 3 ICPC codes); activity by ICPC chapter (diagnostic group) 	<ul style="list-style-type: none"> Similar caseload between the PAs, the supervising GPs/FPs and the non-supervising GPs/FPs at each practice; some practices triaged their patients based on PAs' experience Cost-effectiveness results varied: the lower cost of the PA was offset by longer consultation times and lower activity volumes; in other cases the cost-effectiveness of the PA was high 	<ul style="list-style-type: none"> PAs increased service quality, helped practices to improve access, provided high quality care The cost-effectiveness of PAs compared to GPs/FPs is inconclusive

A.2. PAs in Emergency Departments

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Counselman, Graffeo, & Hill, 2000)	Analyze patients' level of satisfaction of care provided by PAs and ask if patients were willing to wait longer to see a physician	Qualitative	Emergency Department Fast Track staffed by PAs (as opposed to ED Main Treatment Area) located in a community hospital	<ul style="list-style-type: none"> • 2 months: March and April 1999 • Virginia, USA 	A total of 8 PAs staffed the ED full-time at various times	<ul style="list-style-type: none"> • Patient satisfaction score (from 1 to 100) • Patients were asked if they would have been willing to wait longer to see a physician rather than a PA 	<ul style="list-style-type: none"> • Mean patient satisfaction score was 93 • 88% of patients indicated they would not be willing to wait longer to see a physician rather than a PA • The majority of patients wanting to wait longer, were willing to wait no more than 30 more minutes to see a physician 	Patients seen in an ED are very satisfied with the care provided by a PA
(Ducharme, Alder, Pelletier, Murray, & Tepper, 2009)	Assess the impact of PAs and NPs on patient flow, wait times and length of stay	Quantitative	Six selected EDs in medium-sized community hospitals	<ul style="list-style-type: none"> • 14 days for baseline and 14 days for follow-up: Nov 13 to Dec 3 2006 and June 11 to June 29 2007 • Ontario, Canada 	Not specified, minimum of 6 PAs and 6 NPs (one per site although some sites had more than 1)	<ul style="list-style-type: none"> • Type of health care provider involved in patient care • CTAS score to measure acuity • Wait time (minutes between triage time and time of initial assessment by physician) • Length of stay in ED (triage to disposition) • Discharge disposition • Multivariate analysis adjusting for hospital, acuity level and time of patient visit 	<p>When a PA or NP were involved in patient care, respectively:</p> <ul style="list-style-type: none"> • Patients were 1.6 and 2.1 times more likely to be seen within the wait time benchmarks • Lengths of stay were 30.3% and 48.8% shorter 	The addition of PAs and NPs to an ED team increases patient flow and reduces wait times, there is a lower proportion of patients leaving the ED without being seen

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Farmer, et al., 2009)	(not an evaluation) Descriptive study: evaluate the impact and contribution made by PAs in delivering effective healthcare (PAs providing additional care, not substitute care)	Qualitative	Emergency Department	Scotland, November 2006 to October 2008	4 USA-trained PAs working in emergency departments (1 PA left before end of study period)	<ul style="list-style-type: none"> Data collected: individual and group interviews with PAs, medical supervisors and other team members; monthly feedback forms (e.g., PAs' scope of practice, time spent in clinical supervision); patient satisfaction interviews. Work activity/shadowing data were collected (April/May 2007 and Oct/Nov 2007) to measure the productivity of PAs against other team members (e.g., nurses). However, the data conceal decisions that were made about the amount of time spent with patients or which type of patients PAs would see so the data are not useful to draw conclusions on productivity 	<ul style="list-style-type: none"> PAs valuable by providing continuity in a highly dynamic environment: with doctors in training, rotating through wards, PAs were appreciated as providing continuity and a knowledgeable, approachable education resource Some stated that the department's compliance with the Government's four-hour waiting time target was directly attributable to the deployment of PAs 	<ul style="list-style-type: none"> Productivity-wise, PAs were considered equivalent to a medical graduate with two years of training and therefore represented a saving between GBP 11,000 and 21,000 Medical supervision was difficult in large, busy EDs
(Woodin, et al., 2005)	<ul style="list-style-type: none"> Assess the benefits, drawbacks and impact on service quality of introducing PAs Compare the effectiveness 	Qualitative and quantitative	Emergency Department	<ul style="list-style-type: none"> Sandwell, West Birmingham and Tipton, West Midlands, England 28 weeks (May 24 to December 3 2004) 	6 USA-trained PAs working in Accident and Emergency hospital departments	<ul style="list-style-type: none"> Qualitative data collected from face-to-face individual interviews and patient focus groups Activity data on encounters with patients: average number of consultations per week, average number of days worked per week, number of consultations by number of conditions (ICPC codes) presenting (e.g., 1, 2 3 ICPC codes); activity by ICPC chapter (diagnostic group) 	<ul style="list-style-type: none"> Positive feedback from patients in terms of quality of care received High degree of variation in the pattern of activity across the PAs Challenging supervisory relationship 	Difficult to attribute improvements in achievements of targets directly to PAs because they represent a relatively small addition to the overall staff resource

A.3. PAs in Hospitals – Settings Other than Emergency Departments

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(National Standards Committee, 2007)	Conduct an analysis of the costs and effects of hiring orthopaedic PAs as replacements for general physicians as surgical assistants	Qualitative and quantitative	Orthopaedic Operating Room (OR)	<ul style="list-style-type: none"> About one year (2006) Manitoba, Canada 	3 PAs	<ul style="list-style-type: none"> Time savings for orthopaedic surgeons (“relief of scut work”) Opinion survey of stakeholders including surgeons, nurses, residents and patients on the role of physician assistants in care delivery Costing analysis aimed at PAs’ role as surgical assistants: the cost saving of \$270,227 for surgical assistant fees not billed to Manitoba Health is close to the cost of hiring three PAs (between \$270,000 and \$327,000). The cost analysis excludes other tasks performed by PAs (e.g., writing post-op orders, discharge summaries, making rounds to patients) Wait times for orthopaedic surgery 	<ul style="list-style-type: none"> PAs were found to free up for their supervising orthopaedic surgeon the equivalent of four 50 hour work weeks per year Wait time decreased by 32% and went from 44 to 30 weeks 	PAs can greatly improve surgical throughput, greatly improve surgeon capacity and reduce health system expenditures
(Miller, Riehl, Napier, Barber, & Dabideen, 1998)	Examine the use of PAs for tasks traditionally performed by surgical residents	Quantitative and qualitative	Large community hospital trauma centre	<ul style="list-style-type: none"> Four years: various data collected from 1994 to 1997 Flint, MI, USA 	7 trauma and surgical PAs	<ul style="list-style-type: none"> Patient demographics Injury Severity Score Transfer times, length of stay and procedure time lengths Complication rates Resource savings were determined from calculations of patient load Physician survey distributed to the 8 trauma surgeons asking about perception of resource savings and satisfaction levels (e.g., queries on operating room time reductions, patient length of stay, and patient outcomes related to PA use) 	<ul style="list-style-type: none"> Injury Severity Scores increased 19% Transfer times to the OR decreased 43% Transfer time to the ICU decreased 51% Transfer time to the floor decreased 20% Length of stay: for admissions decreased 13%; for neurotrauma ICU patients decreased 33% 	The surgeon/ PA model is a viable alternative for verified trauma centers unable to maintain a surgical residency program. Consistency and quality of care are achieved while saving costs

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Riportella-Muller, Libby, & Kindig, 1995)	Document the general experience of using non-physician providers (NPPs: NPs and PAs) to perform tasks previously performed by physician residents	Qualitative only: <ul style="list-style-type: none"> • Mail survey I to medical directors of hospital • Mail survey II (directors, chairs, chiefs, admin, etc) of department for info on organizational staffing practices • Further follow-up interviews 	Teaching hospitals	US nationwide (“fairly representative of the 391 hospitals belonging to the Council of teaching Hospitals”, p.182)	<ul style="list-style-type: none"> • 286 hospitals responded to survey I: 178 of these reported substitution occurring in 463 clinical departments within their hospitals • Survey II: of the 463 departments, 325 responded to survey II but only 255 departments were eligible • 20 follow-up interviews (e.g., NPP productivity, reasons for hiring NPPs): unpublished 	<ul style="list-style-type: none"> • Survey asked questions such as: have you decreased the # of medical residents in your program due to the employment of NPPs? • Number of NPPs by department and specialty • Aggregate data on number of residents, physicians, PAs and NPs, 1991 and 1992 • Legislative restraint in some states due to Medicare reimbursement limited in scope-of-practice affecting NPPs 	<ul style="list-style-type: none"> • Of the 255 responding departments, 178 reported using PAs and 139 reported using NPs for some tasks previously done by physician residents • PAs more likely than NPs to substitute in EDs and surgery, NPs more likely to substitute in pediatrics and neonatal care • Increase in the number of NPPs but unsure whether NPPs is a cause of effect of decline in size of residency program 	Experience appears to be overall positive

Appendix B. Review of the Literature on Effectiveness and/or Costs of Nurse Practitioners

The literature on the costs and effectiveness of introducing NPs is much more advanced. In contrast to PAs, the NP role is not based on delegation so NPs can make medical decisions independently (i.e., without seeking the opinion of a physician). Nevertheless, physicians may still be involved, to a small extent, in cases handled by NPs (e.g., for advice).

We conducted a literature review on the effectiveness of NPs and, similarly to Appendix A above for PAs, we provide a summary of relevant studies by clinical setting in the tables below.

B.1. NPs in Ambulatory Primary Health Care Settings

We identified and summarized 10 studies on the effectiveness of NPs in primary health settings (please see Summary Table B.1 below), 7 of these are Canadian studies. Among these, three are studies based on a “landmark Canadian study of nurse practitioners” (Canadian Health Services Research Foundation, 2002) that was conducted in Burlington, Ontario in 1974 (Spitzer, Kergin, et al., 1973; Spitzer, Russell, & Hackett, 1973; Spitzer, et al., 1974).

Many studies on NPs in primary care reported a high degree of patient satisfaction in the care received by NPs and/or no difference in patient health status compared to care received by GPs/FPs (Graveley & Littlefield, 1992; Spitzer, et al., 1974; Venning, Durie, Roland, Roberts, & Leese, 2000). When evaluating the impact of introducing NPs on GP/FP workload, one study reported reduced GP/FP workload (Spitzer, et al., 1974) while another reported no change in GP/FP workload (Laurant, Hermens, Braspenning, Sibbald, & Grol, 2004). A randomized controlled trial of patients requesting a same-day appointment (Venning, et al., 2000) concluded that costs for services provided by GPs/FPs were equal to those of services provided by NPs due to NPs’ longer consultation times hence NPs were as cost-effective as GPs/FPs. A cost-

effectiveness analysis (Graveley & Littlefield, 1992) of three alternative staffing models in three prenatal care clinics found that a clinic staffed by a mix of 1 NP, 1 physician, 5 registered nurses, 3 nurse aides and 1 social worker presented the lowest personnel costs; however, a clinic staffed by three clinical nurse specialists and one obstetrics resident (for consultations) was most cost-effective as it presented the lowest cost per number of appointments.

B.2. NPs in Emergency Departments

We identified and summarized four studies (please see Table B.2 below); two of these studies are Ontario studies.

Two studies directly compared the quality of care received by NPs to physicians: one concluded that NPs deliver care with same or higher levels of patient satisfaction and health outcomes (Sakr, et al., 1999) while the other concluded that care provided by NPs yielded higher levels of patient satisfaction (Cooper, Lindsay, Kinn, & Swann, 2002). The first study found no differences in recovery times and level of symptoms between NPs and physicians while the second found no difference in clinical errors, accuracy of examination, adequacy of treatment, planned follow-up or requests for radiography.

Of note is also the recently published Ontario study (Ducharme, et al., 2009) mentioned in Section 4.2 above. This before-after study assessed the impact of introducing NPs and PAs in Ontario Emergency Departments and concluded that PAs and NPs reduced wait times and length of stay. As mentioned in the main body of this report, although this was not a head-to-head comparison of PAs and NPs, the study did find that patients were 2.2 and 1.6 times more likely in the post period to be seen within wait time benchmarks when, respectively, NPs and PAs were involved in patient care; the study also found favourably for NPs with regards to lengths of stay

as patient stays in the ED were respectively, 48.8% and 30.3% shorter with NPs and PAs than without NPs and PAs.

B.3. NPs in Hospitals: Settings Other than Emergency Departments

We identified and summarized three studies of NPs working in hospital settings other than Emergency Departments (please see Table B.3). One of these three studies is Canadian (Mitchell-DiCenso, et al., 1996).

Two of the three studies, including the Canadian one, were randomized controlled trials. Randomized controlled trials are considered by most to provide the most reliable research evidence due to the fact that subjects are randomly allocated to alternative treatments/interventions thus eliminating the “volunteer bias” that many case studies suffer from. In this case, although both trials were held in a teaching hospital, one was set in a neonatal intensive care unit (Mitchell-DiCenso, et al., 1996) while the second in a general medicine ward (Pioro, et al., 2001). In both these studies, patients were randomly assigned to care led by either NPs or residents/specialists; both studies found no difference in length of stay, long-term outcomes, death rates, quality of care and total costs of care provided to patients.

In the third study, Kleinpell and colleagues (Kleinpell, Ely, & Grabenkort, 2008) conducted a thorough review of the literature on NPs providing care to critically ill patients. Some of the studies they identified are listed in Table B.2 on NPs in EDs (Cooper, et al., 2002; Sakr, et al., 1999) and B.3 (Mitchell-DiCenso, et al., 1996). In this recently published article in *Critical Care Medicine*, the authors conclude that: “a low level of evidence was found with only two randomized controlled trials assessing the impact of nurse practitioner care” (Kleinpell, et al., 2008).

B.4. Nurse Practitioners in Long-Term Care

The effectiveness of NPs has also been evaluated in the context of nursing homes (Table B.4 below). We found one study by Burl and colleagues published in 1998; they concluded that introducing NPs working alongside physicians yields significant financial gain: in a long-term care facility receiving an average of USD 929 per resident per month, the facility experienced a financial gain of USD 72 per resident per month when NPs were added as opposed to a loss of USD 197 when only physicians were employed in the facility. This study also concluded that there was no difference in terms of use of ancillary services such as X-ray, laboratory services and prescription drug use between the two groups (Burl, Bonner, Rao, & Khan, 1998).

B.5. Summary of Findings on Effectiveness and/or Costs of Nurse Practitioners

Many of the studies we reviewed, including few randomized controlled trials, conclude that NPs represent an effective, in some cases cost-effective, role in the health care system. However, given the low number of methodologically sound studies available, most of these studies are not generalizable as the results are context-dependent. We conclude that there is weak evidence supporting the effectiveness of NPs.

Appendix C: Summary Tables of Selected Publications on Nurse Practitioners

Table C.1. NPs in Ambulatory Primary Health Care Settings

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Denton, Gafni, Spencer, & Stoddart, 1983)	Estimate the potential savings for Canada as a whole if primary care were provided (to a certain extent) by NPs rather than physicians (net of required GP/FP supervision time)	Quantitative	Ambulatory medical care provided outside of hospitals	<ul style="list-style-type: none"> • Canada • 1980 plus a series of projections to 2050 based on alternative assumptions with regards to mortality or fertility rates 	Not applicable: utilization of NPs is based on average amounts extracted from the literature	<ul style="list-style-type: none"> • Cost model based on the presence and absence of NPs, the age-sex breakdown of the population and on population projections • Amount of time for NPs to perform tasks instead of physicians based on literature and between 1.25 and 2.00 (consistent with evidence and opinions in the literature) • Costs are averages from provincial plans, surveys administered by professional associations • Sensitivity of the baseline results was explored by varying some of parameters in the model 	Based on the “standard” set of assumptions and parameter values, authors estimate that 10.0% of all medical costs and 15.9% of ambulatory costs could have been saved in 1980 had NPs’ time been substituted for physician time in the provision of all services for which such substitution has been demonstrated to be safe and feasible. Savings on ambulatory services could have been in the 16-24% range. These results are insensitive to alternative assumptions on population projections.	A full-scale introduction of NPs throughout the country has the potential of saving large amounts of money to the Canadian health care system

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Gould, Johnstone, & Wasyliw, 2007)	(not an evaluation per se) Explore NPs' perceptions of being accepted as primary healthcare providers by their patients and the NPs' levels of professional satisfaction (not an evaluation study)	<ul style="list-style-type: none"> • Case study (semi-structured interviews) • Qualitative 	Primary health care practice: <ul style="list-style-type: none"> ○ 6 NPs working in a Community Health Centre ○ One NP in private practice 	Rural New Brunswick, interviews with NPs conducted approx. in 2003 (not specified)	7 NPs	<ul style="list-style-type: none"> • Approach to care • Client issues • NP as profession • Acceptance • Relationship with other professions • System issues 	<ul style="list-style-type: none"> • Nursing philosophy with holistic approach was described as being clearly different from medical care • Difficulties and barriers encountered in the establishment of the profession in the province • A pioneering outlook characterized by a sense of excitement and pride in the work 	To work effectively to reduce healthcare costs and increase access to health care, NPs need to be accepted by both the public and the other healthcare professionals
(Graveley & Littlefield, 1992)	Evaluate the costs and effectiveness of three alternative prenatal clinic staffing models (as listed in "Setting" column)	Qualitative and quantitative	<ul style="list-style-type: none"> • Primary health care (prenatal care only) • Three staffing models: <ol style="list-style-type: none"> 1. Physicians + licensed vocational nurse 2. Mixed staff: physician + NP + RN + nurse aides + social worker 3. Physicians + clinical nurse specialists 	Location not mentioned (possibly San Antonio, TX, USA)	<ul style="list-style-type: none"> • 1 NP, 6 physicians, 3 clinical nurse specialists, 5 registered nurses, 3 licensed vocational nurses, 3 nurse aides, 1 social worker • 156 female patients 	<ul style="list-style-type: none"> • Outcomes: maternal satisfaction (interviews with patients) and physiological outcomes • Cost data: clinic staffing costs and hours of service • Controlled for: ethnicity, age and sex • Effectiveness calculated as appointments (kept)/hours • Cost-effectiveness ratios: cost per appointment and cost per kept appointment 	<ul style="list-style-type: none"> • No difference in outcomes across 3 clinics • Mixed clinic had lowest personnel costs but clinical nurse specialist-based clinic had lowest cost per clinic visit and highest effectiveness 	Use of nurse specialists might substantially reduce costs while maintaining quality

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Laurant, et al., 2004)	Examine the impact on GP/FP workload of adding NPs to the general practice team	<ul style="list-style-type: none"> • Randomized controlled trial (RCT) • Quantitative study 	Primary health care practices	<ul style="list-style-type: none"> • Southern region of the Netherlands • 24 months (6 months before and 18 months after) for interviews 	<ul style="list-style-type: none"> • 4 NPs, one per physician group, each NP working in a physician group • 4 physician groups in treatment group, 3 in control group • 30 GPs/FPs in treatment group, 18 in control 	<ul style="list-style-type: none"> • Objective workload analysis: 28 consecutive days of encounter data (only pts with COPD or asthma, dementia, cancer): number of ambulatory consultations, telephone consultations and home visits • Subjective (perceived) workload: interviews on satisfaction levels, perceived discrepancy between investment and reward 	<ul style="list-style-type: none"> • Objective workload: Number of contacts in surgery hours in treatment group increased (stat. significant), this was due mostly to patients with COPD or asthma • Subjective workload: no significant difference between intervention and control in both baseline (6 months before introducing NPs) and 18 months after (i.e., no subjective benefits in terms of workload) 	GP/FP workload was NOT reduced: NPs are used as supplements rather than substitutes
(Reay, Patterson, Halma, & Steed, 2006)	(not an evaluation per se) To report on the experiences of introducing a nurse practitioner (NP) into a rural physicians' clinic (not an evaluation study)	<ul style="list-style-type: none"> • Case study (open-ended interviews) • Qualitative study 	A Rural family practice of 8 FPs	<ul style="list-style-type: none"> • Taber, Alberta • 6 months sometime between 2000 and 2003 	<ul style="list-style-type: none"> • 1 NP (twenty stakeholders were interviewed: physicians, patients, Regional health Authority officials, office staff, community members) 	<ul style="list-style-type: none"> • Patient satisfaction • Billing and work-time records 	<ul style="list-style-type: none"> • High patient satisfaction with the NP • Billing potential that surpassed salary costs • Successful introduction of the NP relied on: 1) flexibility in the first stages of developing the role; 2) strong connections to key individuals outside the clinic to maintain integration with the community; 3) support and guidance provided by mentor group; 4) cost sharing (matched with benefits) by the clinic and provincial health system for sustainability of the position. 	NP role viewed positively by all stakeholders

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Spitzer, et al., 1974)	Investigate the effects on patients and on the practice of introducing NPs in a family practice and having NPs handle most patient encounters	<ul style="list-style-type: none"> • RCT • Qualitative and quantitative 	Primary health care: Two family practices consisting of a physician and a NP each (these two nurses were formerly in the office as conventional nurses)	<ul style="list-style-type: none"> • Burlington, Ontario • 14 months • Experimental period: July 1971 to July 1972 • Plus two months patient survey in May and June 1971 	<ul style="list-style-type: none"> • 2 NPs • 1,598 families (4,325 patients) were randomized in a ratio of 2:1 between NPs and physicians + conventional nurse. • 817 patients answered a status survey (296 in NP group and 521 in physician group) • 21,085 encounters plus 2,991 encounters in the baseline period 	<ul style="list-style-type: none"> • Patient survey: satisfaction with health care, prior use of services, demographic, social function (only in comparison survey) and emotional status (only in comparison survey) • Practice income measured in physician billings 	<ul style="list-style-type: none"> • In the NP group: physicians were involved in an average of 33% of patient encounters • In the physician group: doctors continued to be involved in 86% of visits (as was before the trial) • Clinical outcomes and satisfaction outcome measures were similar between groups • Due to decreased doctor workload, the practice was able to accept more families so grew from 1,598 to 1,952 (22% increase) • Practice income fell by 5% due to absence of billings by NPs • NPs provided services equivalent to CAD16,000, 50% of which were unsupervised services 	NPs can provide first-contact primary clinical care as safely and effectively, with as much satisfaction to patients, as a family physician
(Spitzer, Russell, et al., 1973) and (Spitzer, Kergin, et al., 1973)	<ul style="list-style-type: none"> • Is the modified deployment of physicians and nurses profitable to a family medicine practice? • How do practitioners view and interpret their financial experiences during the year of the trial? 	Qualitative	Primary care practices providing family medicine	<ul style="list-style-type: none"> • Burlington, Ontario • 12 months 	<ul style="list-style-type: none"> • 7 NPs: 14 family practices with a nurse each: 7 nurses were randomly selected to be trained as NPs and re-enter the practice as the “experimental group”; the other 7 remained in their traditional roles as controls • 2 practices dropped out of study 	<ul style="list-style-type: none"> • Interviews with physicians: Has there been a marked change in the net income of their practice between the current year and the last full fiscal year prior to the trial? • Interviews with physicians and NPs on satisfaction with work 	<ul style="list-style-type: none"> • No statistically significant differences in change in net income: <ul style="list-style-type: none"> ○ Experimental group: increased in 3, unchanged in 2 decreased in 1 ○ Control group: increased in 1, unchanged in four, decreased in 1 • Little difference in job satisfaction between physicians and NPs 	Family practices with NPs are not adversely affected in financial performance

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Venning, et al., 2000)	<ul style="list-style-type: none"> Compare the cost-effectiveness of GPs/FPs and NPs as first point of contact in primary care RCT of patients requesting an appointment the same day 	Qualitative and quantitative	General practice teams of GPs/FPs and NPs working alongside each other, varying number of partners (1 to more than 5, practice list size: 3000 to more than 12,000)	Geographically dispersed in urban and rural areas of England and Wales	<ul style="list-style-type: none"> 20 NPs, one each in a general practice 1716 patients eligible for randomization; 1316 agreed to randomization 	<ul style="list-style-type: none"> Consultation process: length in minutes (electronic time stamp), examinations, prescriptions, referrals (from medical records) Patient satisfaction (medical interview satisfaction scale and patient enablement instrument) Health status (SF-36) Return clinic visits over two weeks Costs of: GP/FP and NP time (from another study), prescription costs from British National Formulary 	<ul style="list-style-type: none"> Analysis of NP and GP/FP consultation times adjusting for age and sex of patients NP consultations were significantly longer than GPs'/FPs' and carried out more tests No difference in prescribing and health status outcome Patient satisfaction higher even when controlling for length of time No difference in costs per consultation between NP and GP/FP 	<ul style="list-style-type: none"> Clinical care and health service costs of GPs/FPs and NPs were similar If NPs shortened their consultation time, they could be more cost effective
(Way, Jones, Baskerville, & Busing, 2001)	Determine what primary health care services are provided to patients by NPs and FPs working in the same rural practice setting (not a formal evaluation study).	Qualitative	2 rural primary care practices	<ul style="list-style-type: none"> Eastern rural Ontario 2 months: Sept-Oct 1999 	5 NPs and 13 FPs	<ul style="list-style-type: none"> Delivery of: health promotion services, disease prevention services, rehabilitative services, supportive services Encounter data were analyzed 	<ul style="list-style-type: none"> NPs were underutilized with regard to curative and rehabilitative care. Referral patterns indicate little evidence of bidirectional referral (a measure of shared care). The most frequent reason to see an NP was period health examination, most frequent reason for visiting FP was cardiovascular disease other than hypertension Delivery of health promotion services similar for NPs and FPs Delivery of curative services and rehabilitative services, was higher for FPs than for NPs NPs provided more services related to disease prevention and more supportive services 	Medicolegal issues related to shared responsibility, lack of interdisciplinary education and lack of familiarity with the scope of NP practice explain results

Table C.2. NPs in Emergency Departments

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Cooper, et al., 2002)	Measure the quality of emergency NP-led care compared to physician-led care	<ul style="list-style-type: none"> • RCT • Qualitative 	Emergency Department, services associated with accidents and injuries	<ul style="list-style-type: none"> • Glasgow, Scotland, UK • 2 months: Dec 1998 and Jan 1999 	8 NPs	<ul style="list-style-type: none"> • Patient satisfaction survey • “Clinical audit tool” to assess clinical documentation 	<ul style="list-style-type: none"> • Patients more satisfied with the level of care from NPs because NPs were easier to talk to, gave them information on accident and illness prevention and gave them enough information on their injury.(statistically significant) • NPs' clinical documentation was of higher quality than physicians' • No differences were found in recovery times, level of symptoms, time off work or unplanned follow-up between groups 	Higher levels of satisfaction with NPs-led care than physicians-led care
(Ducharme, et al., 2009)	Assess the impact of PAs and NPs on patient flow, wait times and length of stay	Quantitative	Six selected EDs in medium-sized community hospitals	<ul style="list-style-type: none"> • 14 days for baseline and 14 days for follow-up: Nov 13 to Dec 3 2006 and June 11 to June 29 2007 • Ontario, Canada 	Not specified, minimum of 6 PAs and 6 NPs (one per site although some sites had more than 1)	<ul style="list-style-type: none"> • Type of health care provider involved in patient care • CTAS score to measure acuity • Wait time (minutes between triage time and time of initial assessment by physician) • Length of stay in ED (triage to disposition) • Discharge disposition • Multivariate analysis adjusting for hospital, acuity level and time of patient visit 	<p>When a PA or NP were involved in patient care, respectively:</p> <ul style="list-style-type: none"> • Patients were 1.6 and 2.1 times more likely to be seen within the wait time benchmarks • Lengths of stay were 30.3% and 48.8% shorter 	The addition of PAs and NPs to an ED team increases patient flow and reduces wait times, there is a lower proportion of patients leaving the ED without being seen

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Sakr, et al., 1999)	Assess the care and outcome of patients with minor injuries who were managed by an NP or a junior doctor	<ul style="list-style-type: none"> • RCT • Qualitative and quantitative 	Accident and emergency department	<ul style="list-style-type: none"> • Sheffield, UK • Feb – August 1997 	<ul style="list-style-type: none"> • Number of participating NPs and junior doctors not specified • 1453 patients randomized 	<ul style="list-style-type: none"> • Adequacy of care: history taking, examination of patient, interpretation of radiographs, treatment decision, advice, follow-up 	<ul style="list-style-type: none"> • No difference between NP and junior doctor in clinical errors, accuracy of examination, adequacy of treatment, planned follow-up, or requests for radiography. Interpretation of radiographs was similar in the two groups • NPs were better than junior doctors at recording medical history • Fewer patients seen by a NP had to seek unplanned follow-up advice about their injury 	Properly trained accident and emergency NPs can provide care for patients with minor injuries that is equal or in some ways better than that provided by junior doctors.
(Thrasher & Purc-Stephenson, 2007)	(not an evaluation per se) Identify facilitators and barriers in integrating NPs in EDs	Qualitative	Six Emergency Departments	Ontario, Canada	<ul style="list-style-type: none"> • 6 NPs (one per ED) • 24 stakeholders interviewed across 6 hospital EDs who had been employing NPs • For each ED, the following were interviewed: Np, physicians, Registered Nurse and ED manager 	Semi-structured interviews asking about perceived reasons of introducing the NP into the ED, about the role of the NP, what would make the role more effective, whether integrating the NP was a good idea and the participant's involvement in the implementation progress	Three themes emerged: <ol style="list-style-type: none"> 1. Organizational context (gaps in the current health care system, high patient volume, need to restructure the ED) 2. Role clarity (understanding the NP's function in the ED, strategies to increase awareness of or build support for the NP's role) 3. NP recruitment (attracting and retaining NPs to work in EDs, background in emergency medicine, autonomy to work the in the ED, regulatory and legal issues) 	These findings can be useful for policy with regards to the future development of the factors identified for successful implementation of the NP role in Canadian EDs

Table C.3. NPs in Hospitals – Settings Other than Emergency Departments

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Mitchell-DiCenso, et al., 1996)	Compare a clinical nurse specialist/neonatal practitioner (CNS/NP) team with a pediatric resident team in the delivery of neonatal intensive care	<ul style="list-style-type: none"> • RCT • Qualitative and quantitative 	Neonatal Intensive Care Unit: Patients cared by CNS/NP team during the day and pediatric residents at night vs. pediatric residents 24h a day (2 at a time worked in NICU)	<ul style="list-style-type: none"> • Hamilton, Ontario (McMaster hospital) • 1 year: Sept 1991 to Sept 1992 	<ul style="list-style-type: none"> • 4.5 CNS/NPs vs. 15 residents • NICU team also included 7 neonatologists and 3 neonatal trainees • 821 infants randomized to one of the two teams 	<ul style="list-style-type: none"> • Mortality • Number of neonatal complications • Length of stay • Quality of care (quantitative indicator condition approach) • Parent satisfaction with care • Long-term outcomes • Cost per infant 	<ul style="list-style-type: none"> • CNS/NP and resident teams are similar with respect to all tested measures of performance • The cost per infant in the CNS/NP group was \$14,245 and in the resident group \$13,267 (statistically no difference) 	Results support the use of CNS/NPs as an alternative to pediatric residents in delivering care to critically ill neonates
(Pioro, et al., 2001)	Review the resource use and outcomes of care provided to general medical patients by NPs or physicians	<ul style="list-style-type: none"> • RCT • Quantitative • Qualitative (patient interviews) 	General medical care provided in teaching hospital wards	<ul style="list-style-type: none"> • Cleveland, Ohio, USA • March 1994 to Sept 1995 	<ul style="list-style-type: none"> • 2.5 NPs • 381 patients randomized 	<ul style="list-style-type: none"> • Data extracted from medical records, interviews and hospital accounting databases • Length of stay; charges; costs; consultations; complications; transfers to intensive care; 30-day mortality; patient assessments of care; changes in activities of daily living, SF-36 scores and symptom severity. • Outcomes at discharge and at 6 weeks follow-up 	<ul style="list-style-type: none"> • Length of stay and total costs of patients admitted were similar between the two randomized patient groups • The two groups did not differ in rates of in hospital adverse events including complications, transfer to intensive care and death; the two groups did not differ in discharge destination • However, of patients returning home after discharge, more NP patients received home care services • Changes in functional status scores, health status scores and symptom severity generally improved and were similar between groups 	NP-based care can be implemented successfully in teaching hospitals and, compared to house staff care, may be associated with similar costs and clinical and functional outcomes

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main Outcome Measures	Results	Bottom Line Verdict
(Riportella-Muller, et al., 1995)	Document the general experience of using non-physician providers (NPPs: NPs and PAs) to perform tasks previously performed by physician residents	Qualitative only: <ul style="list-style-type: none"> • Mail survey I to medical directors of hospital • Mail survey II (directors, chairs, chiefs, admin, etc) of department for info on organiz'l staffing practices • Follow-up interviews 	Teaching hospitals	US nationwide (“fairly representative of the 391 hospitals belonging to the Council of teaching Hospitals”, p.182)	<ul style="list-style-type: none"> • 286 hospitals responded to survey I: 178 of these reported substitution occurring in 463 clinical departments within their hospitals • Survey II: of the 463 departments, 325 responded to survey II but only 255 departments were eligible • 20 follow-up interviews (e.g., NPP productivity, reasons for hiring NPPs): unpublished 	<ul style="list-style-type: none"> • Survey asked questions such as: have you decreased the # of medical residents in your program due to the employment of NPPs? • Number of NPPs by department and specialty • Aggregate data on number of residents, physicians, PAs and NPs, 1991 and 1992 • Legislative restraint in some states due to Medicare reimbursement limited in scope-of-practice affecting NPPs 	<ul style="list-style-type: none"> • Of the 255 responding departments, 178 reported using PAs and 139 reported using NPs for some tasks previously done by physician residents • PAs more likely than NPs to substitute in EDs and surgery, NPs more likely to substitute in pediatrics and neonatal care • Increase in the number of NPPs but unsure whether NPPs is a cause of effect of decline in size of residency program 	<ul style="list-style-type: none"> • Experience appears to be overall positive • No info/data on tasks actually performed by NPPs • For our purposes: this paper is not very useful.

Table C.4. NPs in Long-Term Care Facilities

Study (Authors and Year)	Evaluation Model and Research Question	Type of Study/Model	Setting	Location and Study Period	Sample Size	Parameters and Main outcome measures	Results	Bottom Line Verdict
(Burl, et al., 1998)	Analyze the impact of utilizing geriatric nurse practitioner/physician (GNP/MD) teams on cost and utilization compared to a physician-only care team	<ul style="list-style-type: none"> • 1-year retrospective study • Quantitative 	Long-term care facilities	Central Massachusetts, USA	<ul style="list-style-type: none"> • 10 geriatric NPs • 45 LTC facilities 	Utilization and cost data for the entire pool of residents for all services covered by the HMO: inpatient days, emergency department utilization, skilled nursing days, and all ancillary services such as lab, X-ray, drugs.	<ul style="list-style-type: none"> • Acute care and ED costs were significantly lower for the GNP/MD-covered patients. There was a gain of \$72 per resident per month with the GNP/MD-covered patients compared with a loss of \$197 per resident per month for physicians alone. • No significant differences in ancillary services or prescriptions 	This reduction in costs encouraged the HMO to support the concept that GNP/MD teams should cover all long-term care HMO residents.

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