A Cost Study of GP Access After Hours (GPAAH)

May 2015

HUNTER RESEARCH FOUNDATION

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Executive Summary

GP Access After Hours (GPAAH) is an innovative model for the delivery of comprehensive, high quality after-hours primary care to the community of the Lower Hunter region. GPAAH is an integrated medical service incorporating four elements:

1. A telephone patient streaming service (PSS)
2. GP clinics. There are five clinics situated across the Hunter Urban Region (termed the *GPAAH region*), with four co-located in public hospital Emergency Departments (Belmont Hospital, Maitland Hospital, John Hunter Hospital, and the Calvary Mater Newcastle). The fifth is a clinic located within the Hunter New England Health Polyclinic at Toronto.
3. Transport service, provided to patients who could not otherwise attend a GPAAH clinic
4. Home visits, for patients needing home-care or assessment

In a climate of limited healthcare resources, there is a need for an independent economic evaluation of whether services like GPAAH represent a cost saving for the health system. This economic evaluation covered all four elements of the GPAAH service, and assessed the costs of providing the GPAAH service relative to the costs of providing alternative models of care. We focused on the cost to the health system in the GPAAH region, which included the financial cost to the Australian taxpayer and the financial cost (in the form of out-of-pocket costs) to the users of the selected primary-care services.

We conducted the economic analysis using a cost-study approach, which compared the health system costs of delivering GPAAH to the health system costs without GPAAH

The list of alternative services was based on responses by GPAAH users to a survey asking GPAAH users what they would have done if GPAAH did not exist. We dubbed this alternative, non-GPAAH, scenario the *counterfactual scenario*. The survey was carried out at two triage points:

- the PSS, for those GPAAH users whose only point of contact with the GPAAH service was the telephone triage line
- the GPAAH clinics

Using the results of this survey, along with actual patient volumes and costs across both GPAAH and the GPAAH alternatives, we estimated the health system costs in two scenarios, one with GPAAH (the actual scenario), and one without GPAAH (the counterfactual scenario). The difference in health system costs between these two scenarios was the 'net cost' of GPAAH.

The GPAAH service was estimated to have saved the health system $.10.5 million over 2013/14.

The cost of operating the GPAAH service in the 2013/14 financial year was $7,551,932. If GPAAH did not exist, the cost of providing the extra alternative services that patients would have accessed would have been $18,094,330. Therefore the presence of the GPAAH service resulted in a net saving to the health system of $10,542,398 (Table 1).

Table 1: Baseline net costs

Net cost	**-$10,542,398**
Of which:	
- Saving from closing GPAAH	$7,551,932
- Cost of extra ED attendances	-$16,583,825
- Cost of extra in-hours GP attendances	-$386,467
- Cost of extra GP home visits	-$781,316
- Cost of extra extended-hours GP attendances	-$342,722
If 'Net cost' is:	< 0 -- GPAAH is a net SAVING to the health system > 0 -- GPAAH is a net COST to the health system

Notes: See the Appendix for a discussion of variables and data sources

Three main changes in patient flows occurred as we moved from the GPAAH to the non-GPAAH scenario, which contributed to the savings outlined above. These flows were:

1. Emergency Department attendances rising from 14 to 61 per cent;
2. Home visits rising from 0.04 to 7 per cent.

3. Calls managed during the after-hours period by phone advice falling from 30 per cent to 3 per cent.

These outcomes likely reflected the impact of the PSS in terms of triaging patients to the appropriate care that matched their medical need, and the PSS's role in coordinating this care (through phone advice, clinic appointment, home visit or an Aged Care facility visit). Co-location and close collaboration with Emergency Departments assisted the direct transfer of patients from EDs to GPAAH clinics.

Our baseline finding – that avoided ED presentations were the greatest source of cost saving – was not a surprise since:

1. Of all the alternative services to GPAAH, ED had the highest marginal cost. We estimated the ED marginal cost for Emergency Severity Index (ESI) category 4 and 5 attendances to be around $402 compared to: $132 for GP home visits; $60 for extended-hours GPs; and $53 for in-hours GPs
2. Of all the alternative services to GPAAH, EDs absorbed the greatest number of GPAAH users; 61 per cent of GPAAH users said they would have gone to an ED if GPAAH did not exist

Our findings are consistent with prior literature, which found that effective GP after-hours services led to health system cost savings, by shifting low-acuity patients from EDs to relatively less expensive (and more appropriate) primary-care alternatives.

Our net cost estimates were subject to a range of sensitivity analyses, based on changing the values of key parameters in our model. The parameters were: the relative shares of the GPAAH alternatives nominated by GPAAH users in the counterfactual scenario; and ED marginal costs.

The sensitivity analyses are detailed in the body of the report and demonstrate that the findings are broadly unchanged even with significant variation to the key parameters. Consequently:

the baseline findings are qualitatively robust to changes in the value of key parameters in the model.

1. Scope and Methodology

Hunter Primary Care Ltd (the 'Client') commissioned the Hunter Research Foundation (HRF) and the Hunter Medical Research Institute (HMRI) to undertake a cost study of the GP Access After Hours (GPAAH) service. GPAAH is an innovative model for the delivery of comprehensive, high quality after-hours primary care to the Lower Hunter community. The elements of the service are discussed in detail in Section 2.

Stated objectives of the service include:

- To operate a sub-regional network of GP after hours clinics
- To provide a region-wide Patient Streaming Service (PSS)
- To provide a home visit service across the region
- To provide funded transport to patients when necessary
- To maintain a workforce of GPs, nurses and clerks for the GP clinics and PSS
- To implement a system of stakeholder consultation
- To provide a high quality service, and
- To manage the service within budget

A key population-level objective of the GPAAH service is to provide an integrated service that ensures patients receive the appropriate level of care. In doing so the service aims to deliver an integrated, comprehensive medical service when a person's regular GP is usually closed. The GPAAH sevice is a cooperative of over 250 GPs providing after hours care to around 300,000 people across the Lower Hunter. The after hours service triages patients to the most appropraiate level of care for their immediate health needs and then directs the patient back to their regular GP to ensure continuity of care.

1.1 Alternative economic evaluations

In a climate where resources for healthcare are limited, there is a need for an independent evaluation of whether health interventions such as GPAAH represent a cost saving for the health care system. The evaluation of GPAAH's impacts isfounded on an evidence-based approach to determine the demand for, use of, and costs of the service. The evaluation covers all four elements of the GPAAH service, and focuses on assessing the costs of providing the GPAAH service relative to the costs of providing alternative models of care.

To assess the economic value of the GPAAH service in terms of the efficient allocation of financial resources, a cost-study approach is used. This involves the comparison of the resources consumed by GPAAH with the resources used by alternative services (such as Emergency Departments, and other after-hours service options). Cost studies are designed with consideration of:

- the perspective – that is, a cost to whom? In this study, we focus on the cost to the health system in the Hunter Urban Region, also termed the *GPAAH region*. This includes the financial cost to the Australian taxpayer and the financial cost (if any) to the user of the selected primary-care service. The financial cost to the taxpayer is proxied by the funding provided by: the Commonwealth government directly; Medicare Australia; and funding by Hunter New England (HNE) Health. The financial cost to the user is the amount of any out of pocket costs.

- the breadth of programs being considered – in this study, we focus on the GPAAH service and selected alternative services. The list of alternative services is based on responses by GPAAH users to a scenario in which GPAAH did not exist (dubbed the *counterfactual scenario*).

- the costs to include, and the relative magnitude of costs.

A cost study only examines the financial 'cost' side of the program; it does not consider:

- whether the program is 'effective' – that is, does the program do what it intends?
- the monetary and non-monetary benefits experienced by participants (e.g. patients and staff of the service).

Other forms of economic analysis include a *cost-effectiveness analysis (CEA)* which compares the relative costs of an intervention to a meaure of its 'effect', by dividing the cost by the measure of an outcome or set of outcomes. The measure of the outcome (such as 'life years gained') need not be converted into the same monetary units as the denominator (Table 2). A *cost-benefit analysis (CBA)* provides a broader measure of value by expressing the outcome of the intervention in terms of monetary benefits, which facilitates direct comparison with the costs. Results are expressed either as net economic benefit (total benefits minus total costs) or as a benefit-cost ratio (total benefits divided by total costs).

A cost-study methodology is adopted in this analysis for three reasons:

1. Its relatively narrow scope – a cost study focuses only on costs and therefore enables an in-depth analysis of the factors influencing the size of those costs
2. Its use as a decision-making tool – due to its narrow scope, a cost-study provides information that allows health-system administrators to evaluate the costs of alternative modes of after-hours primary care in the Hunter.
3. A cost-study provides information needed to conduct more sophisticated economic evaluations, such as CEAs and CBAs. In future work, we will conduct a CBA of the GPAAH service, which will utilise all the information used in this analysis.

Table 2: Measurement of costs and consequences in economic evaluation

Type of study	Measurement/valuation of costs in both alternatives	Identification of consequences	Measurement/ valuation of consequences
Cost study	Monetary units	None	None
Cost-effectiveness analysis	Monetary units	Single effect of Interest. If more than one intervention is being compared, the outcome must be common to the alternatives. The analysis examines the degree extent to which each alternative achieves 'success' against in the outcome	Natural units (e.g. life years gained, disability-days saved, points of blood pressure reduction, etc.)
Cost-benefit analysis	Monetary units	Single or multiple effects, not necessarily common to both alternatives	Monetary units

Source: Drummond *et al.* (2005)

In order to asssess the cost-savings that GPAAH has delivered to the health system, we need to:

1. Estimate the proportion of patients that would potentially have been treated by the alternative services if GPAAH had not been available
2. Estimate the increased/decreased costs to the service system of patients following these alternate pathways.

1.2 Constructing the counterfactual: two approaches

There are two approaches to construct the counterfactual 'no-GPAAH' scenario:

1. *Using the pre-implementation period.* This approach compares the health system cost over two periods:
    a. a pre-implementation period, prior to GPAAH clinics and PSS being operational. This is the counterfactual scenario in which GPAAH does not exist.
    b. a post-implementation period, which commences from the first day that the GPAAH service commenced.

    As different GPAAH clinics commenced at different times, this comparison would use multiple baselines. Typically, a 12-month window would be used for both the pre-implementation and post-implementation period. Comparison in this case would derive from data which is over 10 years old and may have limited relevance today.

2. *Asking patients to identify their actions in a potential counterfactual scenario:* this approach establishes the counterfactual scenario by surveying GPAAH users at the point of triage, asking these users what they would have done if GPAAH were unavailable. The literature shows that undertaking a brief survey of this nature is feasible[1].

We use the second approach in this study, carrying out the survey at two points:

- the PSS, for those GPAAH users whose only point of contact with the GPAAH service is the telephone triage line.
- the GPAAH clinics, which covers: PSS callers triaged to a clinic; patients referred from ED to GPAAH; and people who "walk-in" to the clinic without prior contact with either the PSS or a hospital ED.

For those patients who enter a GPAAH clinic via the PSS, the survey is carried out only once: at the conclusion of their consultation with the GP at the clinic.

The benefit of this approach is that we can ensure that: (i) the patient mix stays constant; and there are no significant confounding changes to either: (ii) health system funding or to (iii) health system performance. None of these three conditions are guaranteed to be met under the first approach.

[1] An example of this type of survey is the Australian Bureau of Statistics' (ABS') periodic survey of patients' experiences of the health system (ABS, 2014). A component of this survey asks those patients who were treated in an ED whether they felt their treatment could have been provided by a GP.

For example, GPAAH patient volumes – both within its clinics and through its telephone triage service – have grown strongly over the past decade (see Section 2). In undertaking a pre- and post-implementation comparison, it is vital that potential growth in volumes or changes in patient composition between the two periods are appropriately accounted for, to ensure an 'apples-with-apples' comparison of the two periods.

During the scoping of this project, an additional practical issue arose with the first approach: the availability of costing data for the early years of the GPAAH service. The GPAAH service commenced at Maitland Hospital on 1 July 1999; as such, a 12-month pre-implementation window would have required data from 1 July 1998 – 30 June 1999. Liaison with HNE Health staff indicated difficulty in accessing data on Maitland hospital ED costs for this time period.

However, there are also weaknesses with the approach we have chosen, such as:

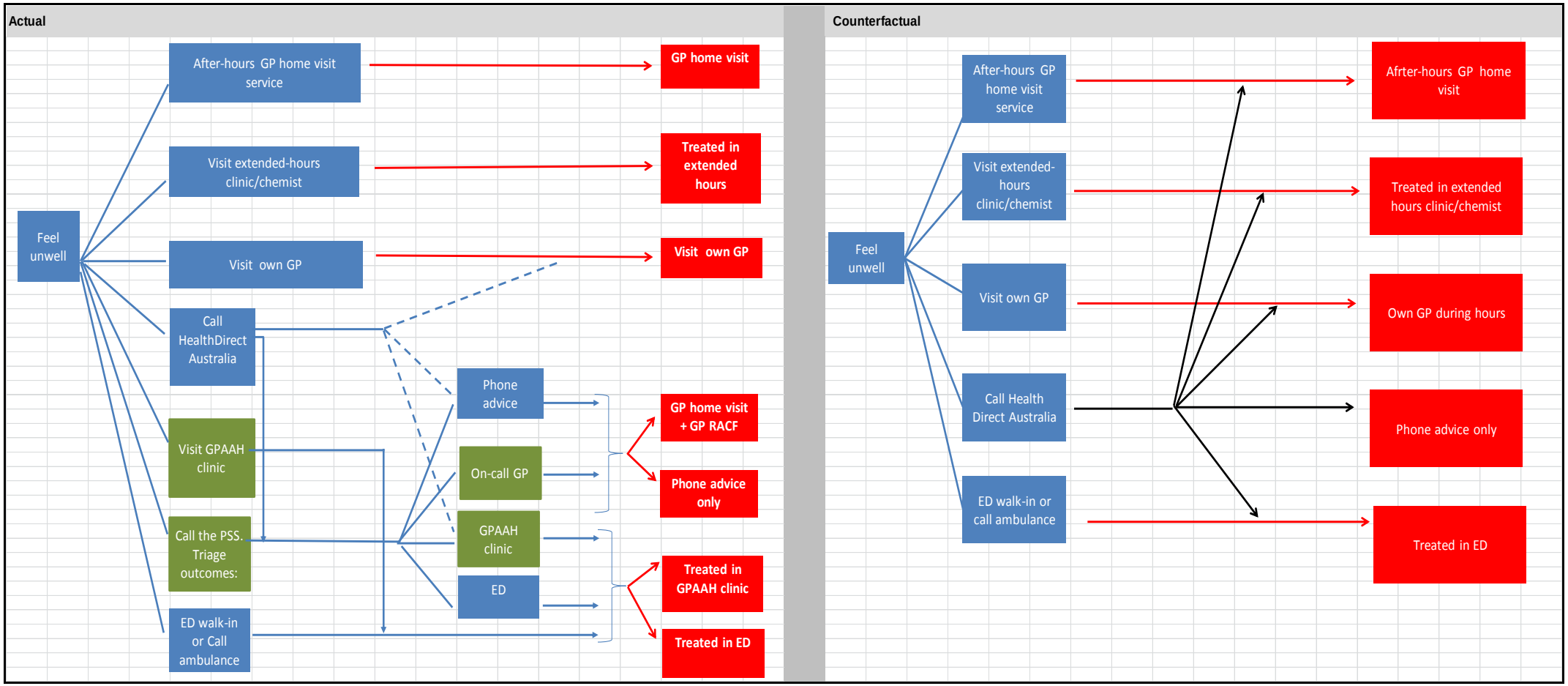
- modelling outcomes for the entire GPAAH region based on a sample of GPAAH patients
- assuming that surveyed patients have knowledge of available options to provide a true indication of their actual choices under the counterfactual scenario

Key considerations for the design of the cost study are:

- *Time period and base year:* as the value of money changes over time, economic evaluations report financial outcomes where dollars have been converted to a value in a common, 'base' year. For this study, the base year is the 2013/14 financial year – 1 July 2013 to 30 June 2014.
- *Data availability:* the techniques employed in generating estimates for the cost study were partly guided by data availability. Wherever possible, data sources chosen are for the 2013/14 year and pertain to the geographical area in which GPAAH currently operates.

Figure 1 presents a flow-diagram of patient pathways for two scenarios with GPAAH present in the service system (*actual scenario*) and likely patient flows without GPAAH (*counterfactual scenario*). We do not attempt to develop a pathway model extending beyond the presenting condition and its immediate treatment (such as would occur in a GPAAH clinic). The counterfactual scenario also does not extend beyond the initial interaction for the purposes of treatment with the prefered alternative service. The green boxes in the left hand side of Figure 1 represent the the largest components of the GPAAH service (the PSS and the clinics).

Figure 1: Annual flows into GPAAH: Actual versus Counterfactual

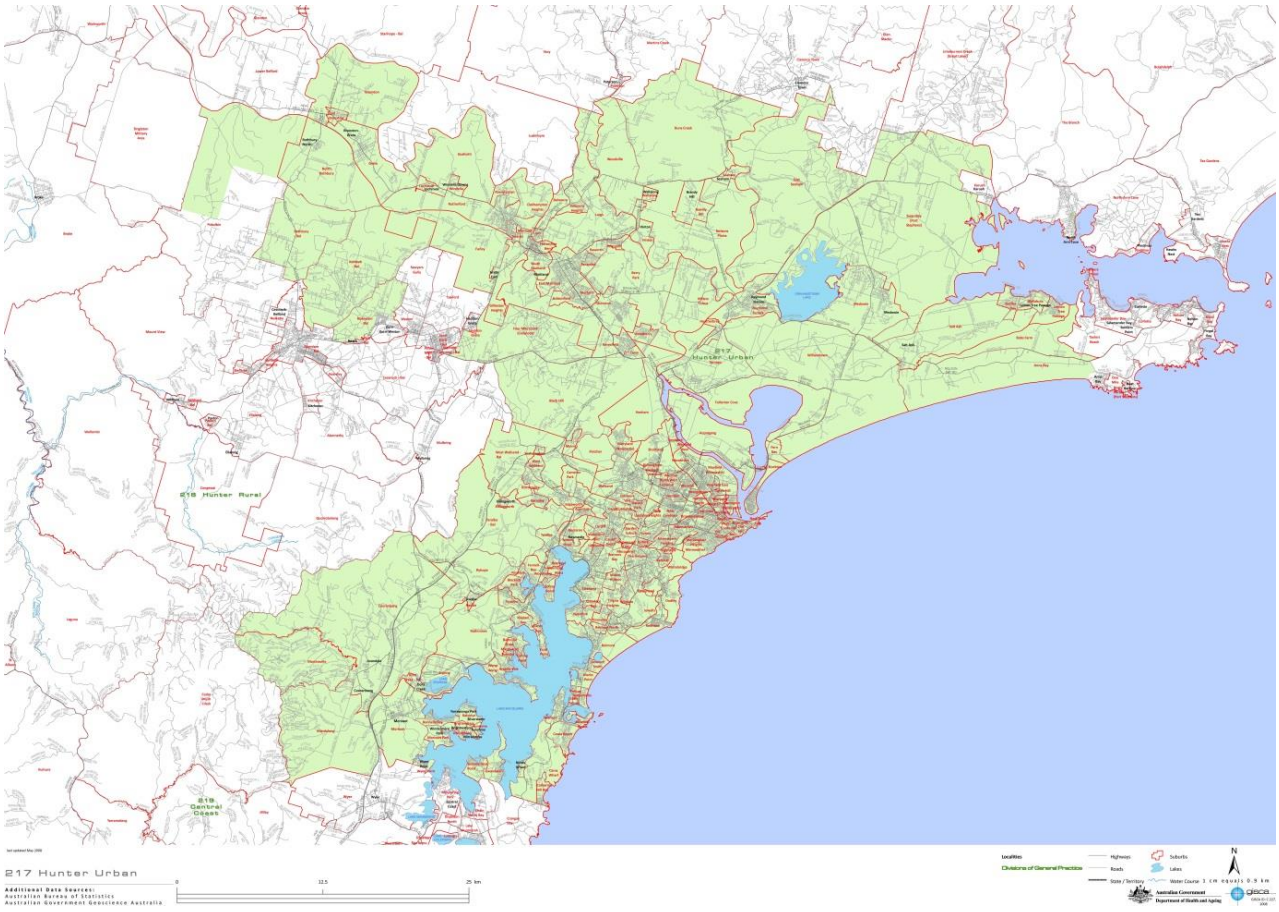


2. GPAAH Service Overview

GP Access After Hours (GPAAH) is an innovative, unique and collaborative service model for the delivery of after hours (as opposed to extended hours) primary medical care to the community of the GPAAH region, through a limited GP workforce (HML, 2012).

The *GPAAH region* is more commonly known as the *Hunter Urban Region* and comprises Newcastle, Lake Macquarie, Maitland and Raymond Terrace areas (Figure 2). The area is located approximately 160 kilometres north of Sydney, NSW and contains urban, industrial and rural areas within the Lower Hunter Valley (HUDGP, 2000).

Figure 2: GPAAH region



The GPAAH service was established in Maitland in 1999, and then expanded to cover the entire Hunter Urban Region in 2003. GPAAH incorporates the following elements:

- The telephone Patient Streaming Service (PSS) – this triages patients and directs them to, or provides, the appropriate care. This may include: advice to call 000; advice to go

straight to ED; providing the next available appointment at the GPAAH clinic; passing the call on to an on-call GP for a home visit, RACF visit or phone advice, or RN phone advice. In 2013/14 the PSS received over 79,000 calls.

- Clinics – there are five clinics situated across the GPAAH region, with four co-located in public hospital Emergency Departments (Belmont Hospital, Maitland Hospital, John Hunter Hospital, and Calvary Mater Newcastle). The fifth is a standalone clinic located in Toronto (Toronto Polyclinic). The five clinics provide up to 1,000 consultations per week for patients who need to be seen in the after-hours period. GPs in the clinic are provided with a registered nurse (who sees each patient before the doctor) clerical staff and facilities. Integration with HNE Health is achieved by co-location of four clinics with Emergency Departments (ED), agreed site procedures for transfer of patients between the GPAAH clinics and EDs in both directions, and triage of patients through the call centre. In 2013/14, the Clinics managed almost 50,000 patients.

- Transport services – transport can be arranged for patients who could otherwise not attend the clinics. Patients may be authorised by the telephone triage nurse or the on-call GP to travel by taxi or hire car to and from the clinic premises at the expense of the service if a lack of transport precludes them from otherwise attending.

- Home visits – for patients who need assessment or care in the home. Home visits are provided to patients who require care before the next working day for whom travelling to a GP service would have a detrimental effect on their health, and for patients at Residential Aged Care Facilities. The home visit service is accessed via thePSS, with the triage nurse following protocols regarding eligibility for a home visit.

In total, the GPAAH service managed over 86,000 patients in 2013/14.

In 2013/14, 18 per cent of GPAAH clinic patients came from referals from emergency departments to GPAAH, compared to the 4 per cent of GPAAH clinic patients referred to EDs within the GPAAH region. 10 per cent of PSS callers were advised by the PSS to attend an ED.

In addition to this, GPAAH manages many patients who would otherwise have presented to an ED. For example, a survey of GPAAH users – both PSS callers and GPAAH-clinic attendees – revealed that three-out-of-five users would have gone to an ED if the GPAAH service was not in existence. Based on the actual number of GPAAH-clinic attendees during the 2013/14 financial

year, this implies that the GPAAH service reduced ED presentations by around 30,000 in 2013/14. A detailed discussion of this survey is provided in Section 4.

2.1 Clinics

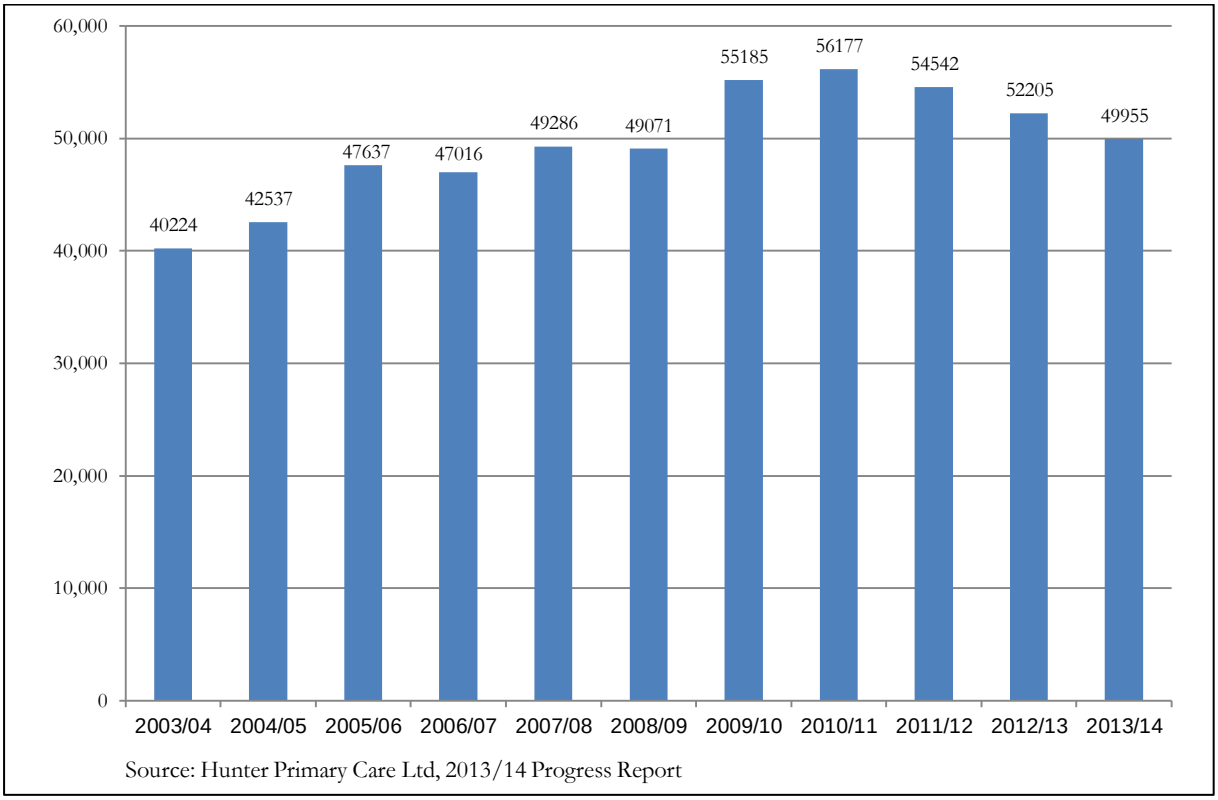
Upon arrival at a GPAAH clinic, patients are registered by an administration officer. The Registered Nurse takes the patient into the consulting room and commences clinical assessment and documentation of the presenting problem. The GP then completes the assessment and determines patient management. The only exception to this has been the limited introduction of a Nurse Practitioner, who works alongside the GP during peak times.

In terms of the number of patient presentations at clinics, the highest numbers are typically at the Maitland clinic, followed by the John Hunter, Belmont, Toronto, and Calvary Mater Newcastle (CMN).

Patient Volumes and Variations in Demand

Across all five GPAAH clinics, patient attendances grew around 20 per cent over the decade to 2013/14 (Figure 3). Patient attendances spiked in the 2009/10-2010/11 period, which was attributed to the H1N1 Flu pandemic which occurred during 2009/10 (HPC, 2012). Following this spike, patient numbers fell, from 56,177 in 2010/11 to 49,955 in 2013/14, a 11 per cent decline.

Figure 3: Patient attendances at all five clinics



Historically, patient throughput has been highest on weekends and public holidays (Table 3). During 2013/14 – this study's period of analysis – patient throughput was highest on public holidays, 1-6pm on Saturdays (3.6 patients) and 9am-4pm Sundays (3.5 patients).

Table 3: Patient appointments per hour by time period

Time Period	Patients Seen per Hour				
	2009/10	2010/11	2011/12	2012/13	2013/14
Weekdays	4.3	4.4	4.3	4.1	3.2
Saturday 1-6pm	4.5	4.6	4.5	4.3	3.6
Saturday 6-11pm	3.9	4.0	3.9	3.5	2.9
Sunday 9am-4pm	4.7	4.9	4.9	4.6	3.5
Sunday 4pm-11pm	4.3	4.2	4.3	4.0	3.4
Public Holiday 9am-11pm	4.4	4.3	4.4	4.5	4.1

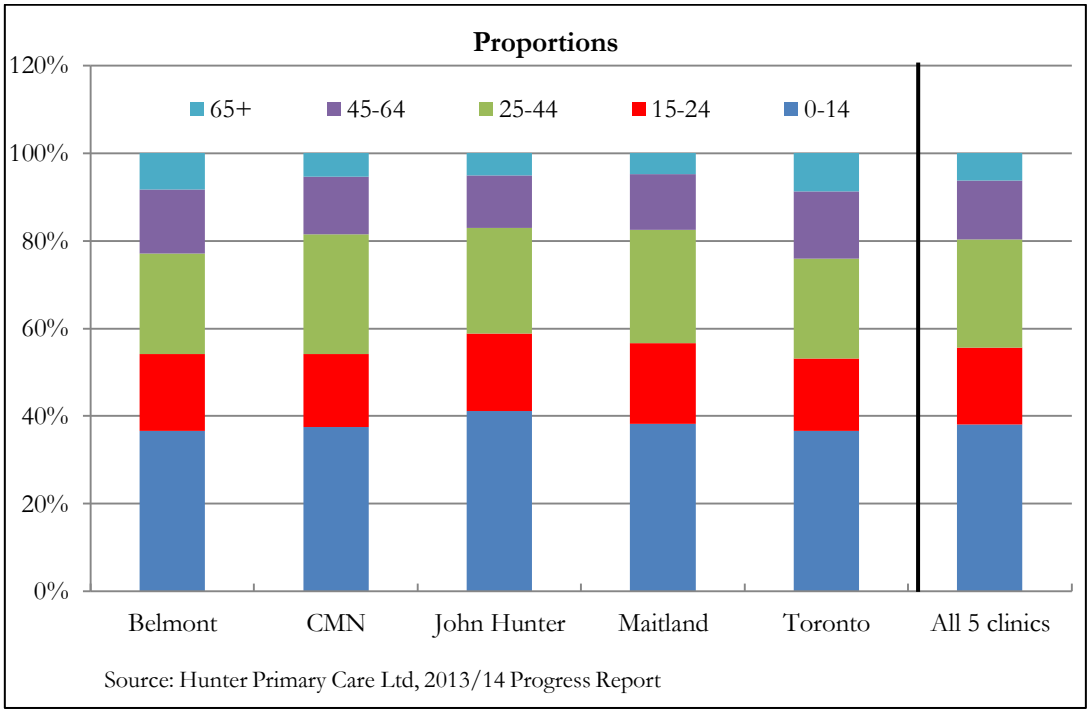
These statistics are useful not only in highlighting when clinics are relativey busy, but also in providing a benchmark on which to evaluate the representativeness of our survey sample of GPAAH users. Our sample of GPAAH users is discussed in detail in Section 4.

Characteristics of Patients

Over the 2013/14 period, 38 per cent of patients who presented to the GPAAH Clinics were under 15 years of age, with almost half of these 5-14 year-olds (Figure 4). These proportions were similar across the individual clinics, and consistent with what occurred in prior years.

The 38 per cent share of patients under the age of 15 was signficantly greater than this cohort's share (16 per cent) of the Newcastle and Lake Macquarie population. By contrast, 65+ year-olds constituted 6 per cent of GPAAH users, yet represented 22 per cent of Newcastle and Lake Macquarie's population. This implies that the GPAAH service is heavily used by younger members of the population and may provide particular benefits for young people.

Figure 4: Age range of GPAAH clinic patients

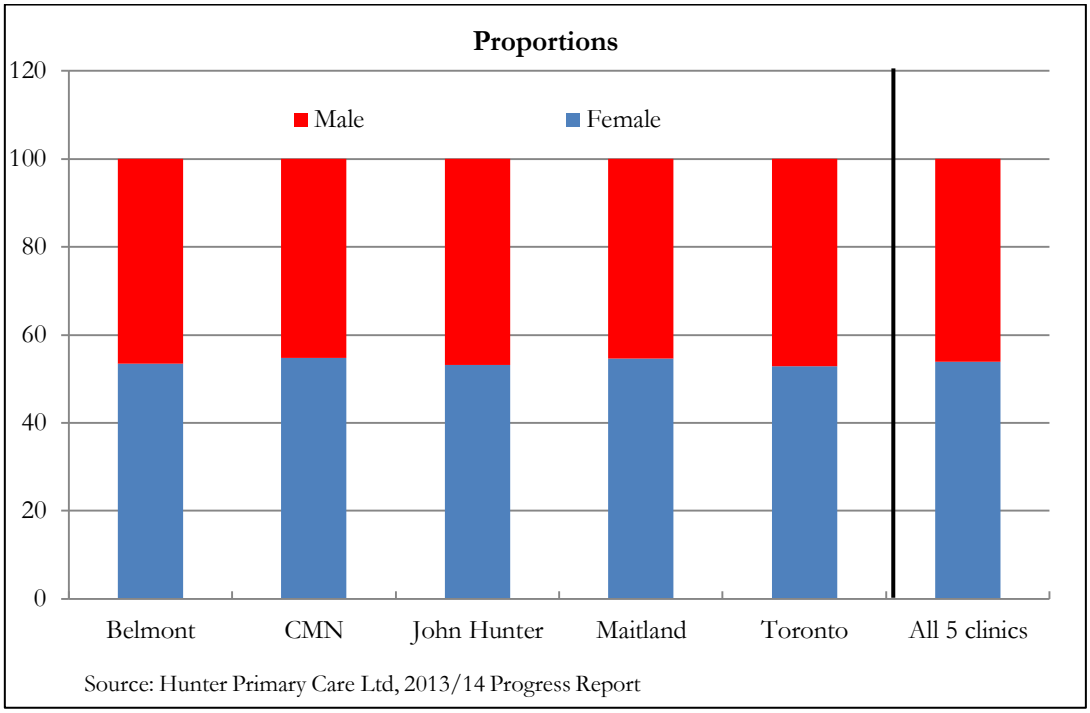


Source: Hunter Primary Care Ltd, 2013/14 Progress Report

Females tended to be higher users of GPAAH clinics than males, comprising 54 per cent of patients compared to 46 per cent for males in the 2013/14 financial year (Figure 5). Females outnumbered males in each of the five clinics, a consistent finding throughout the life of the GPAAH service.

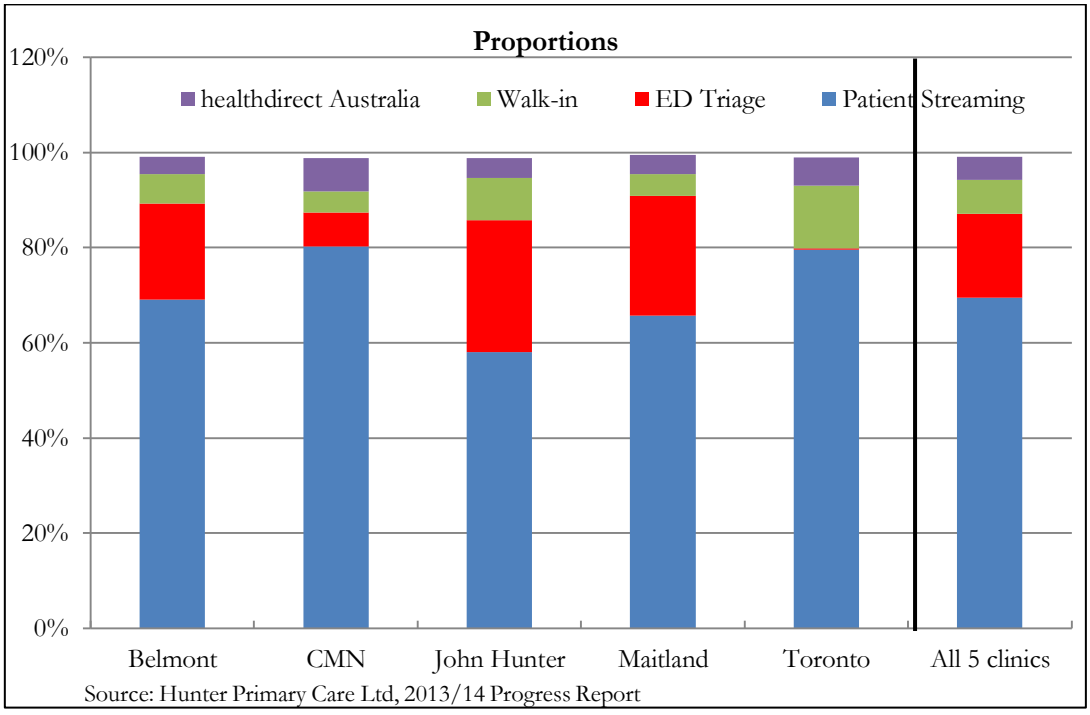
As with the statistics on clinic appointments by time period, the statistics on patient characteristics can be used to evaluate the representativeness of our sample of GPAAH users

Figure 5: Gender of GPAAH clinic patients



The profile of patients by point of origin has also changed little over the years. Over 2013/14, the majority (70 per cent) of patients seen across all five GP clinics were referred via the PSS (Figure 6). The second most common source of patients were those triaged from EDs (18 per cent). Toronto had the lowest share of ED-triaged patients (0.2 per cent), due to its standalone status; the other four clinics are co-located with their respective hospital's ED.

Figure 6: Origin of GPAAH clinic patients

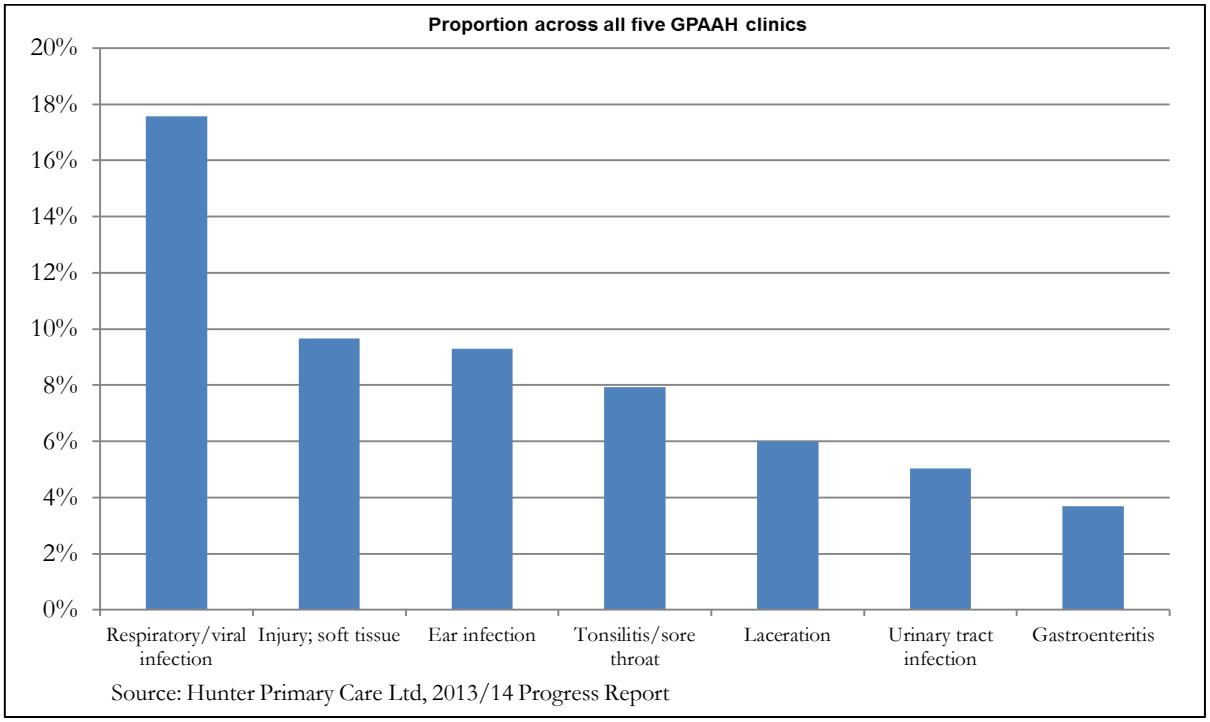


In 2013/14, for the overall service, the proportion of walk-in patients was around 7 per cent, although Toronto continued to have a large proportion of walk-in patients (13 per cent).

Reason for Presentation

Across all five GPAAH clinics, the top 5 presentations were: respiratory or viral infection; soft tissue injury; ear infection; tonsillitis or sore throat; and laceration, in 2013/14 (Figure 7). These five presentations accounted for 31 per cent of all clinic presentations, with these proportions remaining broadly unchanged from the commencement of the GPAAH service in 2003.

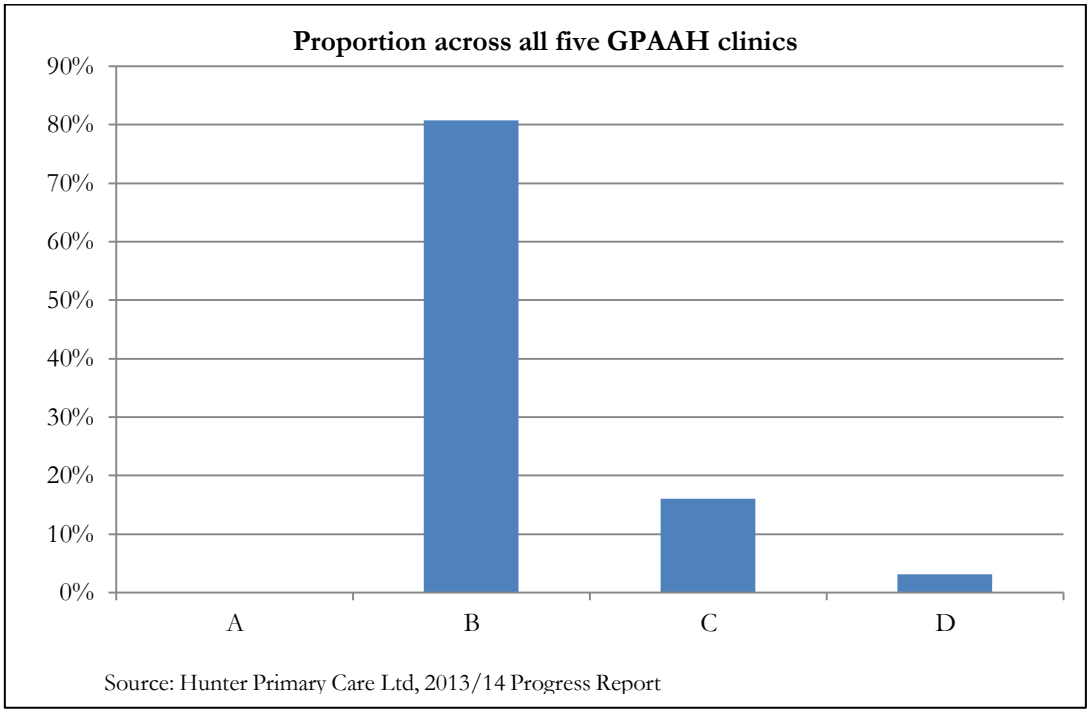
Figure 7: Reasons for presentations to GPAAH clinics



Source: Hunter Primary Care Ltd, 2013/14 Progress Report

Further information can be gained by examining the proportion of MBS consultation levels charged in the GPAAH clinics (Figure 8). In 2013/14, Level B consultations – the 'standard' consultation, lasting up to 20 minutes – comprised the bulk (81 per cent) of all MBS consultations. The most intensive consultation (Level D) comprised only 3 per cent, though certain clinics (such as the John Hunter) had a higher proportion of Level D consultations, likely due to the higher complexity of presenting patients.

Figure 8: MBS consultation levels



Of those GPAAH clinic presentations in 2013/14 whose follow-on destination was recorded, 96 per cent returned home after their clinic appointment, while the remainder were referred to an ED after further assessment of their condition.

2.2 ED Attendances

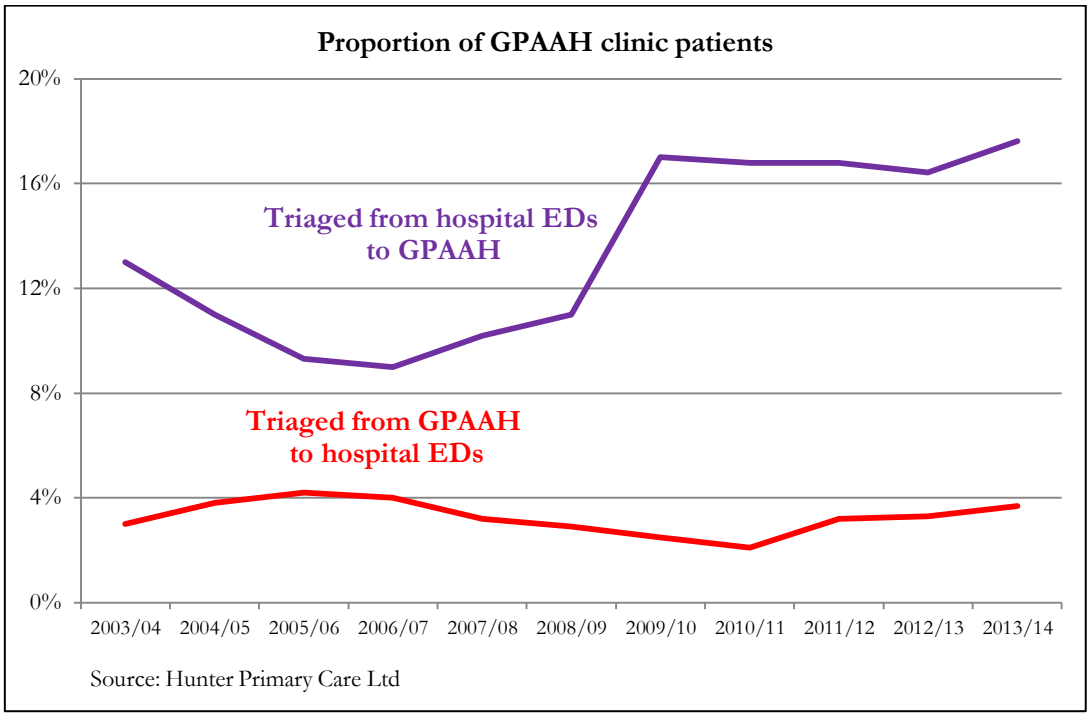
The flow of patients between hospital EDs and the GPAAH service occurs in three ways:

- ED presentations that are triaged to a GPAAH clinic – in 2013/14, there were 8,792 such patients (18 per cent of all GPAAH clinic patients)
- GPAAH clinic patients that are transferred to ED, following an assessment of the patient indicating that care in ED is more appropriate. In 2013/14, 1,839 (4 per cent of total) GPAAH clinic patients were transferred to an ED.
- Patient Streaming Service (PSS) callers who are advised by the PSS to attend an ED. In 2013/14, this totalled 9,083 callers (11 per cent of all callers). This proportion has been largely unchanged over the history of the GPAAH service.

The proportion of clinic patients who originated from an ED referral has increased over the past few years, from 9 per cent in 2007/08 to 18 per cent in 2013/2014 (Figure 9). This is due to a combined collaborative partnership between GPAAH and HNE Health seeking to ensure patients are seen in the most appropriate health care setting. Over the past three years, GPAAH

and HNE Health staff have worked at improving inter-departmental relationships and understanding, resulting in a larger flow of patients between the two services.

Figure 9: Patient flows between hospital EDs and the GPAAH service



2.3 Patient Streaming Service (PSS)

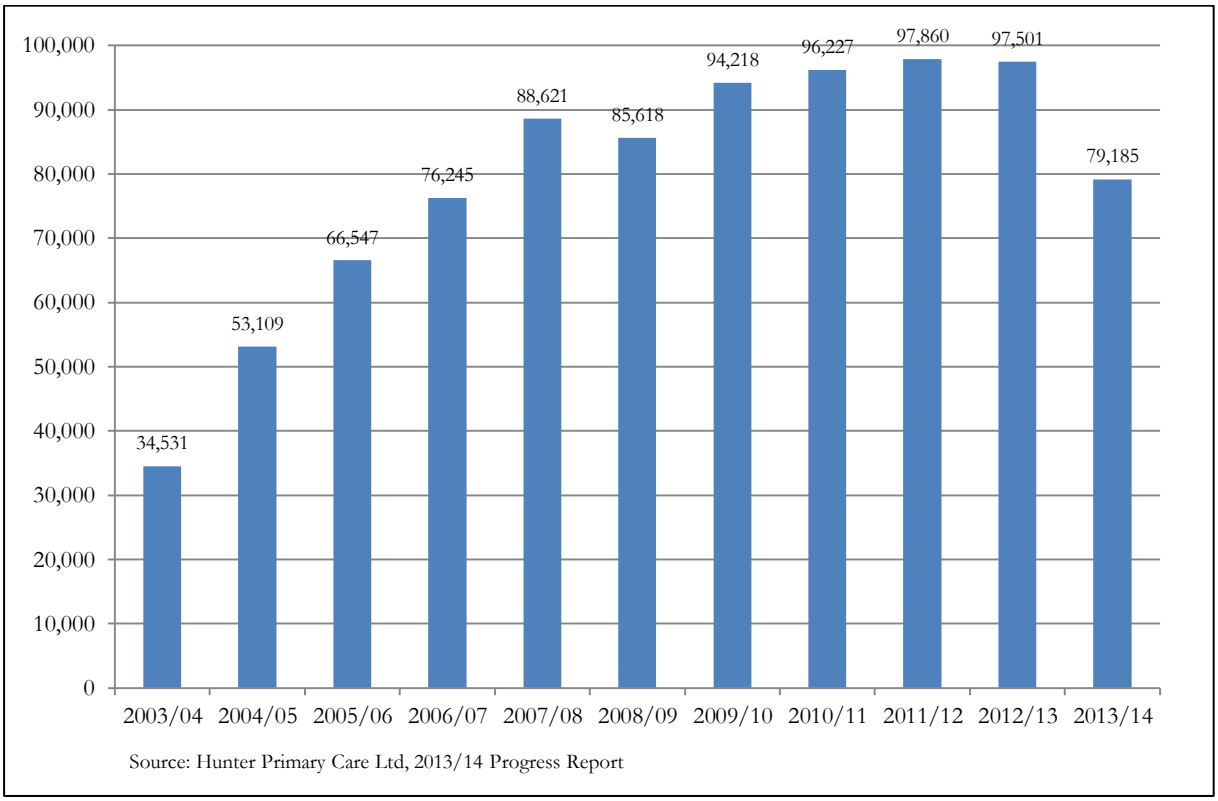
When the caller contacts the PSS an administration officer or a nurse determines why the person is calling and what advice or care they need. Generally the patient will either be:

- advised to ring 000
- advised to go to ED
- given an appointment in a GPAAH clinic
- given phone advice by the RN or the on-call GP, or
- provided with a home visit by the on-call GP.

Under its funding contract with the Commonwealth, the PSS is required to refer on to Healthdirect Australia (HDA) any patient who calls specifically asking for phone advice, even though the PSS is set up to provide this advice.

There has been a steady increase in call volumes, from around 34,500 in 2003 to over 79,000 in 2013/14, though volumes declined 19 per cent since 2012 (Figure 10).

Figure 10: Number of callers to the PSS service



Source: Hunter Primary Care Ltd, 2013/14 Progress Report

Timing of Calls

The busiest times for the call centre typically occur in the period when the call centre first opens on weekdays and weekends. In 2013/14, the highest call rates occurred from 5:30-8pm on weekdays (37.1 calls per hour), Sundays 8am-1pm (30.5 calls per hour) and Saturday 11:30am-6pm (30.4 calls per hour) (Table 4).

Table 4: PSS call volumes per hour by time period

Time Period	Incoming Calls	Handled Calls	Calls/hour	% Answered in 5 mins	Abandon Rate [i]
Weekday 5.30-8pm	25,288	24,068	37.1	86%	5%
Weekday 8-11pm	9,102	8,931	11.5	97%	2%
Weekday 11pm-8am	4,243	4,049	1.7	92%	5%
Saturday 11.30pm-6pm	9,097	8,781	30.5	91%	3%
Saturday 6pm-11pm	4,405	4,347	16.6	97%	1%
Saturday 11pm-8am	2,076	2,005	4.3	90%	3%
Sunday 8am-1pm	8,061	7,941	30.4	96%	2%
Sunday 1pm-6pm	6,628	6,571	25.1	99%	1%
Sunday 6pm-11pm	4,609	4,564	17.5	97%	1%
Sunday 11pm-8am	901	870	1.8	93%	3%
Public holiday 8am-11pm	4,440	4,315	28.1	92%	3%
Public holiday 11pm-8am	352	336	3.6	86%	4%
Total	**79,185**	**76,777**	**12.2**	**92%**	**3%**

Notes: i. Abandon rate does not include Healthdirect Australia's abondoned calls.

Call Outcomes

During 2013/14, the majority of PSS calls (60.7 per cent) resulted in a GP clinic appointment (Table 5). Approximately one in five callers were transferred to HDA for telephone advice, of which around half were subsequently returned to the PSS for a GPAAH clinic appointment. Consequently, the net outflow of PSS callers to HDA was around one in eight callers (12.3 per cent). This likely reflected the different set of symptoms provided by the patient to the HDA nurse than the sypmtoms presented to the original PSS operator.

Table 5: PSS call volumes by final disposition

Call Disposition	Total	%
Clinic Appointment	45,000	60.7
Net transfer to HDA	9,150	12.3
Attend ED	8,697	11.7
Own GP	5,740	7.7
Directed to another service [i]	2,365	3.2
Self-care (call-back if further concerns)	1,899	2.6
Referred to on-call GP	1,355	1.8
TOTAL	**74,206**	**100**

Notes: i. Alternative services include: ambulance service (000); pharmacists; and poisons hotline

A smaller proportion of PSS callers were either: referred to an Emergency Department (11.7 per cent); advised to attend the patient's own, in-hours, GP service (7.7 per cent); or self care (2.6 per cent). Together, these five categories accounted for 95 per cent of all disposition types.

2.4 Home Visits

During 2013/14, there were a total of 144 home visits undertaken, a tiny fraction of the 49,955 clinic appointments. Most home visits (78 per cent) were to Aged Care Facilities. The number of home visits have steadily declined over the past few years, from 279 in 2009/10 to 144 in 2013/14 (a 48 per cent fall).

2.5 Funded Transport

As with home visits, funded transport represents a small proportion of GPAAH activity. Over 2013/14, there were a total of 86 funded transport trips costing $2,729, an average of $32 per trip. Between 2009/10 and 2013/14, the number of funded transport trips fell two-thirds, from 271 in 2009/10 to 86 in 2013/14.

3. Literature Review

Within the context of this project's scope, a literature review was conducted to identify the types of economic evaluations conducted for other after-hours GP services, and the results of these evaluations. This review focuses particularly on studies which examined changes (if any) in treatment costs per patient following the introduction of a GP after-hours service.

A literature search was conducted using several electronic databases to identify peer reviewed publications. These databases included MEDLINE (Ovid); LIt.search (PubMed); The Cochrane Library; Web of Science; PsychINFO; SCOPUS; JSTOR; SAGE Journals Online; Springerlink; EconLit; EconPapers and Informit Health Collection. The search terms can be divided into two categories: (i) economic evaluation OR cost-benefit analysis; (ii) GP after hours care* OR/ AND * GP out of hours care. These terms were used together in varied combinations. Google Scholar was used to increase coverage of recently published research as well as the reference lists of the articles obtained. The search was limited to English language and publication years between 1990 and 2014.

Several cost studies have concluded that effective GP after-hours services saved costs to the health system, primarily by shifting patients from emergency departments to primary care. While no data was found that could absolutely quantify what patients would do if after-hours GP care was not available, proxy measures were used. These proxy measures included records of the number of ED presentations pre and post after-hours service availability, and surveys of patients regarding what they would have done if an after-hours service was not available.

International Studies

In a study of the impact on a Swiss municipal hospital (Stadtspital Waid, in Zurich), Eichler *et al.* (2013) used a before-and-after design to study the impact of a March 2009 implementation of a triage system and an ED-integrated out-of-hours GP unit (termed the 'H-GP unit'). Patients with ESI categories of 1-3 were directed to the ED, while lower acuity patients (ESI categories 4 and 5) were referred to the H-GP-unit. The authors found this implementation steadily reduced mean treatment costs per outpatient, from €350 (in 2007, pre-implementation) to €235 in 2011, a one-third decline, mainly due to the reduction in material costs (such as reduced diagnostic tests) and, to a smaller extent, reduced labour costs. In contrast, mean treatment costs per ED patient rose during this period, from €358 to €423, reflecting the shift in patient mix after triage towards

patients with higher acuity/complexity. This difference in treatment costs was also evident for patients within the same ESI-classes[2]; during 2011, mean treatment costs for ESI-4 and ESI-5 patients were around 40 per cent lower (€130 in money terms) in the H-GP unit than in the ED, even after adjusting for age and sex imbalances between cohorts. Eichler *et al.* (2013) estimated these savings in per-outpatient treatment costs translated to a 7 per cent (€0.42 million) decline in the hospital's annual costs relative to the counterfactual costs incurred if the H-GPunit had not been in place.

Van Uden *et al.* (2005) analysed the effect on ED caseload of the introduction of an out-of-hours primary care physician (PCP) co-operative[3] at the University Hospital Maastricht – in Maastricht, Netherlands – in January 2000. Using a pre-post intervention design, the authors analysed all patient records with out-of-hours primary and emergency care for the three-week period before, and the three-week period after, the co-operative was established. After the establishment of the unit, the authors found a 53 per cent fall in patients using emergency care, and a 25 per cent rise in patients using primary care. There were fewer hospital admissions, and fewer subsequent referrals to the patient's own physician and medical specialists. The number of new outpatient visits at the hospital, and the number of mortalities, were broadly unchanged. Though the authors did not undertake a detailed cost-benefit analysis, their analysis indicated that the introduction of the PCP unit reduced the hospital's annual expenditure by US$0.15 million; no baseline expenditure amount for the hospital was disclosed. This decline comprised a US$1.73 million fall in expenditure due to lower caseloads in the ED, offset by the US$1.58 million cost of the unit.

Australian Studies

Comino, Zwar and Hermiz (CZH) (2007) examined the performance of the NSW Macarthur GP After-hours Service (MGPAS), in terms of quality of care, satisfaction, efficiency and sustainability. The MGPAS was established on 1 May 2000 at Campbelltown Hospital, and was located near the hospital's ED. The authors used mixed methods (patient satisfaction and GP surveys, stakeholder interviews, and statistical data analysis) to evaluate the performance of the MGPAS. In surveying around half of all MGPAS-registered patients, the authors found that two-thirds of patients would have attended the ED if the MGPAS was unavailable. Though CZH (2007) did not attempt an evaluation of the economic impact of the MGPAS, their surveys

[2] During those times where the H-GP-unit was at full capacity, low-acuity patients were treated in the ED.
[3] In contrast to Switzerland, where solo GP clinics predominate, Dutch PCPs are typically organised into larger co-operatives similar to British and Danish systems (Fry, 2011). Reasons given for a co-operative form of organisation include physicians' job dissatisfaction due to high and increasing workload and poor work-private life balance (*van Uden et al.,* 2005).

indicated that GPs found the MGPAS to be cost-effective due to its hospital-centred location and thus proximity to various diagnostic services, the streamlining of GP resources and the employment of experienced GPs.

However, MHS staff acknowledged a need to streamline and improve referral processes between the MGPAS and ED with the expectation that patient throughput, and therefore cost efficiency, would increase as the MGPAS became more established with the ED and stakeholders. Outside of higher throughput, stakeholders' other efficiency measures included reducing the cost of GP services, and increasing the return from patient care (such as introducing patient fees or out-of-pocket expenses, or private billing). However, stakeholders questioned the feasibility of increasing the 'return' from patient care due to patients' limited ability and willingness to pay, the additional cost of managing patient billing services, and patient 'drift' to the ED where no fees applied (a counter-productive outcome).

Bolton and Thompson (2001) examined why the Canterbury GP After-Hours Service (CGPAHS) – which was located within the Canterbury Hospital ED and opened in October 1999 – was deemed not to be cost-effective and thus closed in December 2000. By comparing and contrasting the experience of CGPAHS against the more positive experiences of the after-hours GP service at Balmain Hospital, the authors opined that the basic problem with the CGPAHS was a lack of stakeholder engagement, insufficient communication, and a lack of co-ordination.

A lack of stakeholder engagement meant patient throughput was lower than optimal: the CGPAHS achieved 0.9 patients per hour; Bolton and Thompson (2001) stated the break-even patient turnover rate would have been three patients per hour. Consequently, the marginal cost of the CGPAHS (around $75/patient in 2000) vastly exceeded the Medicare rebate (around $23/patient). Low patient turnover led to unproductive staff and reduced job satisfaction, exacerbating the CGPAHS cost overhang. The lack of patient throughput also meant a lower level of savings for the ED, as a lower number of ESI-4 and ESI-5 patients were moved from the ED to the CGPAHS. The CGPAHS experience is instructive for other hospitals and regions considering after-hours GP services, as it highlights the importance of appropriate stakeholder consultation and engagement.

Pekarsky *et al.,* (2000) examined changes in health system costs pre and post the establishment of the Matitland After-Hours GP Service (MAGS) in October 1999. The authors found that the cost of providing after hours care following the implementation of MAGS *increased*, compared to

the pre-MAGS period, from $18.81 per capita to $19.86 per capita. The authors stated that the main reason for the increased costs was that, despite overall patient volumes dropping 15 per cent following the implementation of MAGS, non-MAGS expenditure in the post-implementation period did not decrease by the same proportion. This interesting outcome was driven by:

1. the authors' presumption that the level of Practice Incentive Payments (PIPs) to GPs was fixed in both the pre- and post-implementation period (Pekarsky *et al.,* 2000; p. 27). A more realistic scenario would have allowed the PIP to decline following the introduction of MAGS. For example, the authors noted that if the PIP were to have halved post-MAGS, then, all else equal, the per-capita cost would have *fallen* from $18.81 to $17.85.

2. while the number of ESI-4 and 5 patients presenting to the ED in the post-implementation period fell 62 per cent, this did not lead to a commensurate fall in ED variable costs. The authors attributed this to the propensity for ED staff to spend more time with the remaining (higher acuity) patients, thereby limiting the potential cost savings from reducing ED staff workload.

Finally, Fry (2008) reviewed existing national and international literature (1970-2008) to assess evidence of the impact of after hours care services on acute care utilisation. Fry found that after-hours care services reduced costs when duplication of services was minimised. The studies reviewed by Fry supported a 10-53 per cent reduction in the demand for acute services, due to the operation of an effective after-hours services. The impact of after-hours care services on ED patient loads and costs were greater when after-hours services were co-located with EDs, with primary care delivery enhanced when a collaborative relationship existed between ED staff, GPs, nurses, and other primary care clinicians.

4. Survey of GPAAH users

4.1 Questionnaire

Hunter Primary Care Ltd asked the following question of GPAAH users:

If this call service and our clinics were unavailable, what would you have done to get help today?

To reduce the potential for bias in a respondent's answer, two measures were used:

1. the question was asked without prompting the respondent with alternative choices for answers. The options (discussed below) were revealed to the respondent if, and only if, the respondent had difficulty answering the question.

2. in those cases where the options were revealed, the ordering of the options was randomly changed from respondent to respondent

The options presented to respondents were (in random order):

- Go straight to the ED
- Visit a GP during business hours
- Arrange a GP home visit
- Visit an after-hours GP
- Visit a chemist
- Phone Healthdirect Australia (HDA)

4.2 Sample composition

The survey was conducted from 30 December 2014 to 14 January 2015 (14 days in total), with a total sample of 1,680 users of the GPAAH service. 285 (17 per cent) of the respondents were users whose only contact with the GPAAH service was the telephone triage line (that is, the PSS), while the remainder – 1,395 – were GPAAH-clinic patients, most of whom had come into the clinic via the PSS.

For the former set of users, the questionnaire was conducted by the PSS staff via call backs, the day *after* the PSS user called the PSS. The one day lag between the initial call and subsequent call back was to:

- minimise the clinical risk associated with a caller experiencing a worsening condition while participating in the survey during the initial call.
- minimise the potential negative impact on caller throughput and abandoned call rates, particularly during peak times. As the survey took time to administer, there was a risk that unacceptably long queues of unanswered calls may form, which may result in higher call abandonment rates and potentially lower caller satisfaction with the PSS.

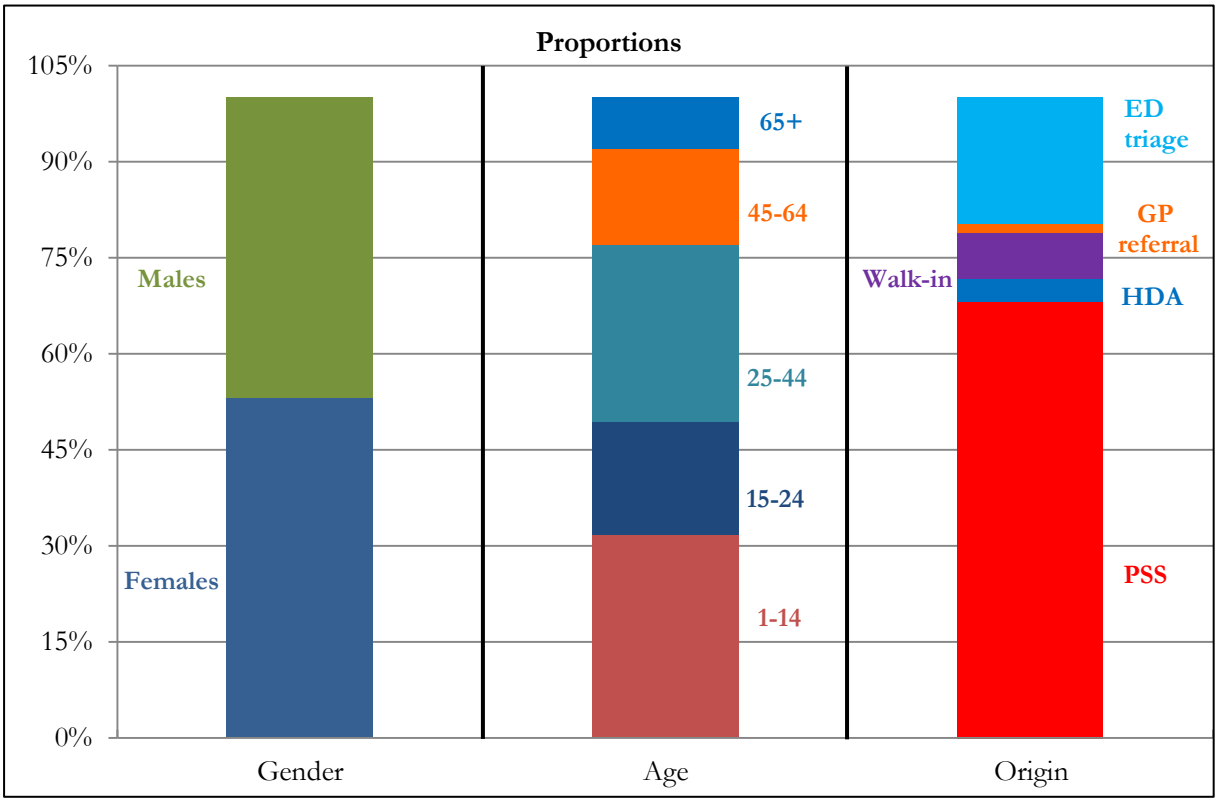
The call backs were done during non-peak times on the subsequent day.

The PSS survey response rate was 100 per cent. For the GPAAH clinic patients, the questionnaire was administered within the clinics just prior to the patient leaving the clinic. The response rate for clinic patients was 73.6 per cent (that is, a total of 1,867 clinic patients were requested to participate in the survey).

The sample of 1,395 clinic patients has the following characteristics (see Figure 11):

- 53 per cent of respondents were female, in line with the population value (54 per cent) over the 2013/14 financial year (see Figure 5)
- 32 per cent of respondents were aged 1-14 years, while 8 per cent of patients were aged 65 years and over. The corresponding population values for the 2013/14 period was 38 per cent and 6 per cent (see Figure 4)
- 68 per cent of respondents originated via the PSS, with ED triage accounting for another 20 per cent. The corresponding values for 2013/14 were 69 per cent and 18 per cent (see Figure 3)

Figure 11: Sample composition; selected characteristics



Consequently, the sample of GPAAH-clinic patients appears highly representative of the population of clinic patients in 2013/14. Furthermore, as the gender, age and patient origin shares reported above are reasonably stable year after year, our patient sample is also representative of the population of clinic patients during prior financial years.

The sample also appears representative of the individual clinics' characteristics. For example, in 2013/14, 69 per cent of Belmont clinic's patients entered via the PSS; the corresponding value for Belmont clinic's patient sample is 68 per cent (Table 6). These similarities are also evident for the other four clinics. Furthermore, the similarities between the sample and the 2013/14 population are also evident for patient age and gender, for each of the five individual clinics.

Table 6: Patient origin – sample vs population

Panel A: Survey Sample					
	PSS	**ED**	**Walk-in**	**HDA**	**GP**
Belmont	68%	20%	6%	4%	2%
CMN	73%	19%	3%	4%	0%
John Hunter	60%	25%	11%	2%	1%
Maitland	65%	27%	3%	3%	2%
Toronto	78%	2%	14%	5%	1%
OVERALL	**68%**	**20%**	**7%**	**4%**	**1%**
Panel B: All patients during 2013/14					
	PSS	**ED**	**Walk-in**	**HDA**	**GP**
Belmont	69%	20%	6%	4%	1%
CMN	80%	7%	4%	7%	1%
John Hunter	58%	28%	9%	4%	1%
Maitland	66%	25%	5%	4%	0%
Toronto	80%	0%	13%	6%	1%
OVERALL	**69%**	**18%**	**7%**	**5%**	**1%**

4.3 Survey findings

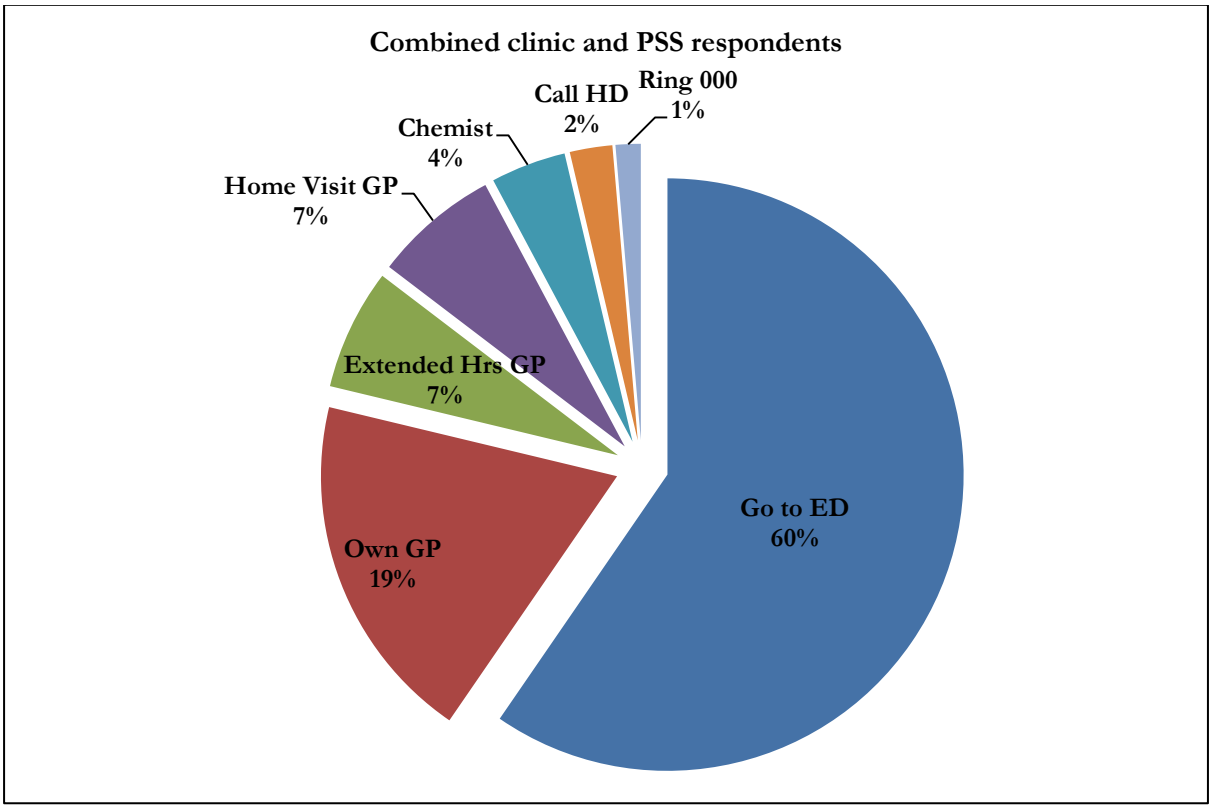
61 per cent of survey respondents indicated that they would have attended a hospital's emergency department (ED) or rung 000 if the GPAAH service had not been available (Figure 12). 19 per cent of respondents indicated they would have gone to their own GP (during business hours). A further 7 per cent stated they would have gone to either an extended-hours GP or arranged a GP home-visit (with an alternative home visit GP service).

It is not clear if those respondents who nominated "Go to ED" would have either rung 000 or arranged their own transport. The survey results imply the latter scenario (own transport), considering that "Ring 000" was a separate option for respondents. In our analysis of potential

cost savings – discussed in Section 6 – we examine how sensitive our baseline estimates are to changes in the relative shares of each response.

The shares in Figure 12 are similar across the two sub-samples: PSS-only; and clinic-only. For example, 59 per cent of clinic patients indicated they would have gone to the ED if the GPAAH service was unavailable, compared to 66 per cent for PSS callers (Figure 13). The slightly higher rate of ED responses for the PSS-only respondents may reflect their relative lack of information: their experience of the GPAAH service is limited to the PSS. In contrast, those clinic attendees triaged to the clinic via the PSS understand the service provided by PSS and the clinics. The PSS only group is also likely to be comprised or persons who are lower acuity relative to GPAAH (the 'advice only' group) as well as persons who are higher acuity (the group advised to ring 000 or go to ED); the people in the latter group may be understandably more likely to present to ED as their first alternative.

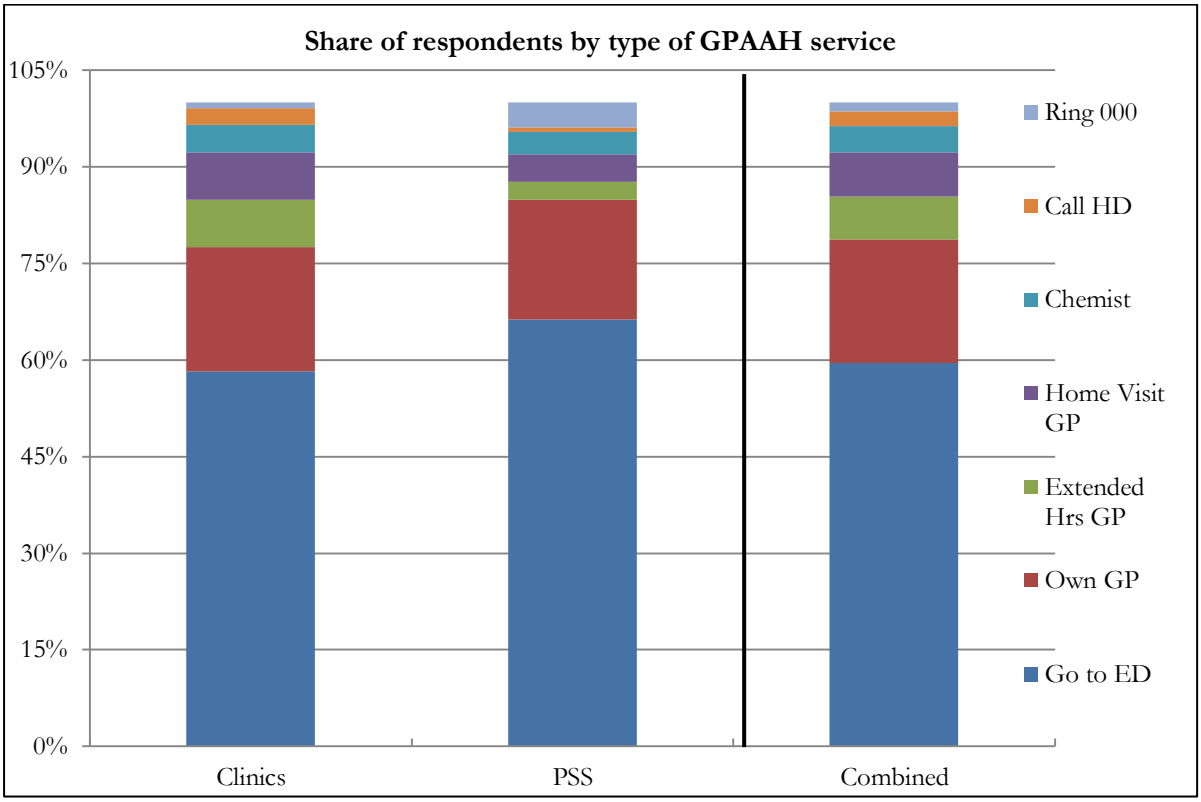
Figure 12: Survey respondents' answers



Similarities between the PSS-only and clinic sub-samples are also evident across the other five options. For example, the same share – 4 per cent – of PSS-only respondents and clinic respondents indicated they would have visited a chemist if the GPAAH service was unavailable (Figure 13).

The similarities between the two sub-samples provides confidence that our overall answers are not affected by whether the patient's knowledge of the GPAAH service was solely its telephone triage line; solely its clinics; or both.

Figure 13: Survey respondents' answers



5. Data used to estimate costs

In this section, we identify *per-patient costs* for both GPAAH and the key GPAAH alternatives (Emergency Department, GP After Hours Services, GP Home Visits and GP In Hours).

Data items and sources for calculation of these costs are outlined below (Table 7), with a detailed description of data items provided in Appendix A.1.

Table 7: Data for estimating per patient costs associated with patient pathway

Data Item	Data source
Costs associated with GPAAH call centre (incl. wages, utilities, resources)	HPC (2014)
Costs associated with GPAAH clinics (incl. wages, utilities, medical and non-medical resources)	HPC (2014)
Costs associated with GPAAH management (incl. wages, promotional/advertising and administrative expenses)	HPC (2014)
ED costs per patient for ESI Category 4 and 5[4].	HNE Health data, on average cost per patient (ES1 4 and 5) for 2013-14 *See Appendix A.1 for a detailed description of the data.*
GP Extended-Hours Services within the Hunter Medicare Local area	Medicare Benefit Scheme (MBS) billing rates for 2013-14. Medicare Group A11(1); A11(2); A22(1) [1]
GP Home Visits within the Hunter Medicare Local (HML) area	Estimation based on MBS billing rates provided within the HML area for 2013-14 (Medicare item numbers 597 and 599, which are a subset of Group A11)[1]
GP during Hours Costs within the HML area	Estimation based on: a) MBS billing rates provided within the HML area for 2013-14[1] b) A GP survey conducted by Hunter Primary Care Ltd

[1] Data on total services provided and total billings for Medicare Groups and Items are available from Medicare statistics, http://medicarestatistics.humanservices.gov.au/statistics/med_locals.jsp

Costs for other after-hours alternatives in the Patient Survey including 'visiting a chemist', calling 'Health Direct' and 'ring 000', (see Figure 12) are not costed in this analysis, as :

1. the volume of responses for these alternatives within the patient survey was very small – for example, 'ring 000' was chosen by only 1 per cent of GPAAH patients

2. the public costs of some of these alternative services – in particular 'visiting a chemist' – are likley to be negligible. (Note that we are focusing on the cost of the *service* provided by a chemist, not the cost of the medicines, which is not a part of this analysis)

[4] The GPAAH model is designed to service patients who are low acuity (ESI 4 and 5) and who have presentations which cannot wait until the following day. Thus we restrict our ED cost comparator to ESI-4 and 5 patients only.

Our analysis considers only those health system costs that are likely to vary between the actual ('with-GPAAH') scenario and the counterfactual 'no-GPAAH' scenario; the 'marginal cost' associated with each service. An algebraic representation of this framework is provided in Appendix A.3.

As such, our analysis is based on:

- Identifying the marginal costs of GPAAH and its alternative services, which include hospital EDs, extended-hours GPs, and GP home-visit services
- Identifying the fixed costs of each of the various services, which are all those costs not identified as variable. As well as being patient-independent, fixed costs are those costs which cannot be reasonably changed over a one-year period (the 2013/14 financial year)

5.1 GPAAH service costs

For the GPAAH service, we treated all of the GPAAH service's income during the 2013/14 financial year as patient-dependent. In 2013/14, GPAAH's income totaled $7,551,932. While some of this income – such as direct funding from the Commonwealth Government – is block-funded, this income is based on patient volumes being greater than zero. In the counterfactual scenario, GPAAH would not exist and so its patient volumes would be zero. Consequently, in the counterfactual scenario, we assumed GPAAH's income would also be zero.

However, it is possible that some of GPAAH's income in 2013/14 may have remained even if it ceased to exist during that financial year. However, liaison with Hunter Primary Care Ltd (HPC) indicated some difficulty in separating fixed and variable income streams, since the counterfactual scenario remains untested for HPC staff. Hence, in the interests of ensuring our cost study is sufficiently conservative, we treated all of GPAAH's income as dependent on patient volume.

5.2 ED costs

ED per patient costs data was provided by Hunter New England Health, for ESI Category 4 and 5 patients. ED costs data are drawn from the District Network Return (DNR) submitted to the Ministry of Health for the 2013/14 financial year.[5] All expenses which appear in the Audited Financial Statement were included.

[5] The DNR is a mandatory reporting requirement for all Local Health Districts (LHDs) and Specialty Health Networks (SHNs). Guidance for preparing and submitting the DNR is documented in the Cost Accounting Guidelines (CAG). The CAG incorporates the Australian Hospital Patient Costing Standards (AHPCS), applying it to within the NSW setting. The data comes from various financial, patient administration, and billing systems.

As both fixed and variable costs were included, we estimated the variable component by using the ratio of variable costs to total costs, obtained from Table 32 (*National and State/Territory average cost for admitted and non-admitted ED presentations combined by line item, Round 16*)[6] of IHPA (2014). This table contained the per-patient total cost of ED presentations for each Australian state and territory, disaggregated into labour, imaging, pathology and other variable costs, as well as fixed costs like depreciation and the cost of capital.

We estimated the total per-patient cost in the 2011/12 financial year to be $629.38 for EDs in NSW hospitals, and the variable per-patient cost to be $506, implying a variable cost-to-total cost ratio of 0.8[7]

5.3 Costs of other services

We used a similar approach for the non-ED alternatives to GPAAH. That is, we focused on the variable costs of each service, where the variable costs were the sum of:

1. Billing data from Medicare Australia (see Table 7 for more details) This MBS data provided total MBS billings and total services to facilitate a calculation of MBS billing per service, taken to be a proxy of the cost per patient for 'after-hours services' within the Hunter Urban Region in 2013/14.
2. The estimated value of patients' out-of-pocket expenses (if any)

We recognise that this approach may lead to a conservative estimate of variable costs for non-ED alternatives, to the extent that the sum of these two categories is less than the actual cost of servicing an additional patient. For example, in the no-GPAAH scenario, there may be additional costs associated with increasing both physical capacity and staffing for some (or all) of the GPAAH alternatives to service the additional patient volumes that result from GPAAH ceasing to exist.

A detailed description of the Medicare groups, subgroups, and item numbers – used to estimate the non-ED alternatives to GPAAH – is provided in Appendix A.1.

[6] This table is available at: http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/content/333427400706CC34CA257CB60027A24C/$File/chapter-4-tables.xlsx (accessed 11 February 2015).

[7] IHPA (2014) estimated the total per-patient cost in NSW to be $600 (in 2011/12). As this excludes payroll tax and the cost of capital, we inflate this cost by $29 to reflect our estimate of the omitted costs. See the Appendix for more details.

6. The net cost of the GPAAH service

In this section, we examine the net costs to the GPAAH region health system. As outlined in Section 1.1, we include costs borne by:

- Medicare Australia
- the Commonwealth government directly
- HNE Health, and
- individual users of GPAAH and its alternative services, as proxied by the amount of any out-of-pocket expense.

The 'net cost' is defined as:

- the health system cost with GPAAH in the system – this is the cost of the 'actual' scenario, *less*
- the health system cost without GPAAH – this is the cost of the 'counterfactual' scenario.

To estimate the net health system costs, we use the framework outlined in Section 1, and the data sources outlined in Table 7 and Appendix A.1.

6.1 Net cost of the overall GPAAH service

One of the inputs into our net cost estimates is the number of GPAAH patients – 86,532 during 2013/14 – that are likely to go to each of the alternative primary-care services in the absence of GPAAH. To estimate these flows, we apply the results from our patient survey (see Section 4.3) to the 86,532 patients seen by the GPAAH service during 2013/14.

Table 8 reveals, unsurprisingly, that EDs receive the largest number of GPAAH users – 52,743 – in the counterfactual 'no-GPAAH' scenario. This reflects the high proportion (61 per cent) of GPAAH users who nominated EDs as their most likely alternative to GPAAH. In-hours GPs receive the second largest number of GPAAH users (22,148) though, as a proportion of total in-hours GP volumes across the GPAAH region, this change is less than 1 per cent.

Table 8: GPAAH patients into the GPAAH alternatives in the counterfactual scenario

Over the 2013/14 financial year [i]			
	Number	**% change**	**% share of total GPAAH users**
HNE Health EDs	52,743	50%	61%
In-hours GPs	22,148	0.7%	26% [ii]
Home-visit GP	5,923	32%	7%
Extended hours GPs	5,717	5%	7%
TOTAL	**86,532**		100%

Notes: i. Patients into the alternative services are based on the answers from the GPAAH patient survey
ii. This share includes the proportion of survey respondents who nominated either going to a Chemist (4 per cent of respondents) or ringing Heathdirect Australia (2 per cent) (see Figure 12)

Using these inputs and the associated equations outlined in Appendix A.3, Table 9 presents our baseline estimates of the net cost of the GPAAH service. We estimate that the GPAAH service saved the health system $10.5 million during the 2013/14 financial year. Over 2013/14, the health system spent $7.5 million with the GPAAH service, compared to $18.1 million without GPAAH, a saving of 58 per cent.

Looking at the costs avoided as a result of GPAAH being in existence, around $16.6 million in savings were from ED presentations avoided, and a further $1.5 million in combined savings from patients not using either in-hours GPs, extended-hours GPs, or GP home visits. Offsetting this was the $7.5 million cost to the health system of the GPAAH service.

Table 9: Baseline net costs for the 2013/14 financial year

Net cost	**-$10,542,398**
Of which:	
- Saving from closing GPAAH	$7,551,932
- Cost of extra ED attendances	-$16,583,825
- Cost of extra in-hours GP attendances	-$386,467
- Cost of extra GP home visits	-$781,316
- Cost of extra extended-hours GP attendances	-$342,722
If 'Net cost' is:	< 0 -- GPAAH is a net SAVING to the health system > 0 -- GPAAH is a net COST to the health system

Notes: See the Appendix for a discussion of variables and data sources

The finding that avoided ED presentations are the greatest source of cost saving is consistent with the related literature (Section 3). As previously discussed, several studies found that effective GP after-hours services resulted in cost savings for the health system, by shifting low-acuity patients from EDs to relatively less expensive (and more appropriate) primary-care alternatives.

6.2 Sensitivity analysis

Our baseline estimate of net costs indicates that avoided ED attendances are the biggest driver of costs. This is not a surprise since:

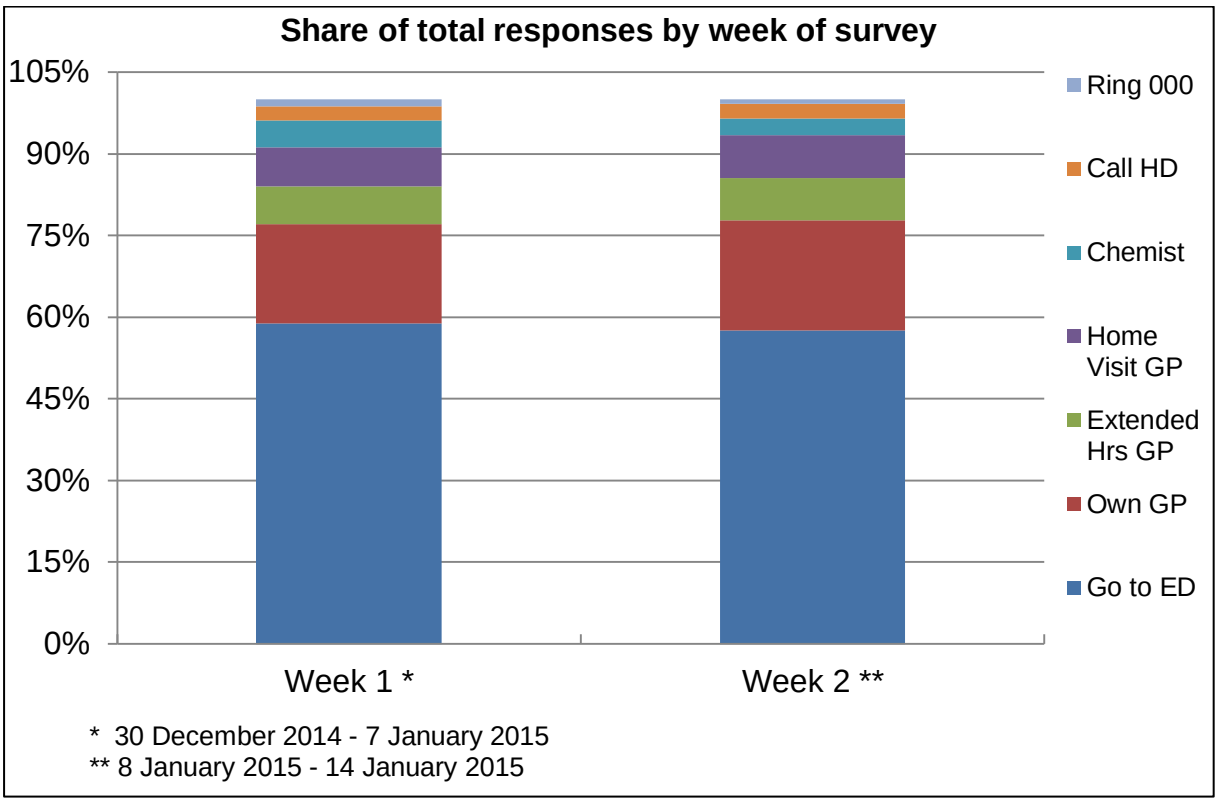
1. Of all the alternative services to GPAAH, ED has the highest marginal cost. We estimate the ED marginal cost to be around $402 compared to: $132 for GP home visits; $60 for extended-hours GPs; and $53 for in-hours GPs.
2. Of all the alternative services to GPAAH, EDs absorb the greatest number of GPAAH users; 61 per cent of GPAAH users said they would have gone to an ED if GPAAH did not exist.

This implies that our sensitivity analysis should focus on ED volumes and marginal costs. We do this by using the variation in the relative shares of each of the GPAAH alternatives identified from the survey of users and examine how changes in these response shares impact our baseline findings.

6.2.1. Relative shares of GPAAH alternatives

Our survey of GPAAH users was conducted over a 14-day period (30 December 2014 to 14 January 2015). This raises the potential for variation in responses depending on when the survey was conducted. However, the extent of variation is small. For example, in the first week of the survey, 59 per cent of survey respondents indicated they would have gone to an ED if GPAAH did not exist. This is close to the 58 per cent share recorded over the survey's second week (Figure 14). Similar inter-week response shares are observed for the other alternatives.

Figure 14: GPAAH users' responses



Due to the modest inter-week variation in response shares, our net cost estimates were found to be virtually the same irrespective of whether the entire sample period was used, or certain sub-periods. That is, our net cost estimates were robust to the choice of sample sub-period.

Table 10 shows three estimates of health system costs, based on three sets of response shares: (i) PSS callers only; (ii) clinic patients only; and (iii) both clinic patients and PSS callers ('Clinics and PSS'), which is what we reported in Table 9.

Our net cost estimates are larger when the response shares were based only on PSS callers (-$13.1 million), compared to the net cost estimated using only the clinic patients' response shares (-$10.0 million). As four-fifths of our sample consisted of clinic patients, our 'baseline' net costs – which used responses from both PSS callers and clinics patients – are close to the net costs estimated using only the clinic patients' response shares. The variations in net costs shown in Table 10 are driven almost entirely by the (avoided) cost of ED attendances.

Table 10: Response shares and net cost estimates

	Response shares from:		
	PSS callers	**Clinic patients**	**Clinics & PSS**
Net cost	**-$13,143,424**	**-$10,014,461**	**-$10,542,398**
Of which:			
- *Saving from closing GPAAH*	$7,551,932	$7,551,932	$7,551,932
- *Cost of extra ED attendances*	-$19,508,606	-$15,927,933	-$16,583,825
- *Cost of extra in-hours GP attendances*	-$98,939	-$412,713	-$386,467
- *Cost of extra GP home visits*	-$920,484	-$842,754	-$781,316
- *Cost of extra extended-hours GP attendances*	-$167,327	-$382,993	-$342,722
If 'Net cost' is:	< 0 -- GPAAH is a net SAVING for the health system > 0 -- GPAAH is a net COST for the health system		

Hence, our net cost estimates are somewhat sensitive to the sample of response shares used, though in each case there are large cost *savings* from having GPAAH in existence. Even under the smallest net cost scenario ('Clinic patients'), the GPAAH service saves the health system $10.0 million. Consequently, our baseline findings are robust to changes in response shares.

6.2.2. ED marginal costs

As discussed in Section 5.2, our estimate of ED marginal costs is based on:

- actual total per-patient ED costs for the GPAAH region, multiplied by:
- the ratio of variable costs to total costs, obtained from IHPA (2014), across NSW hospital EDs

As we need to estimate the ED marginal costs for the GPAAH region, we examine the sensitivity of our baseline findings to changes in these estimates. We consider two scenarios:

1. ED marginal costs are 20 per cent lower than in our baseline (dubbed 'Low ED cost'). As the magnitude of net health system costs is positively related to ED marginal costs, this scenario assesses how sensitive the net cost is to a large (20 per cent) reduction in ED marginal costs.
2. ED marginal cost estimates are equal to the NSW-wide ED marginal cost, from IHPA (2014) ('NSW ED cost'), expressed in 2014 prices.

For reference, we include our estimate of ED marginal cost used to obtain our 'baseline' net cost estimates (see Table 9). Table 11 reports the resulting estimates of net costs for the health system under each scenario.

Table 11: ED marginal costs and net cost estimates

	ED marginal cost scenarios:		
	Low ED cost	**NSW ED cost[i]**	**Baseline**
ED marginal cost	$321.81	$587.01	$402.26
ED marginal cost: deviation from baseline	-20%	26%	--
Net cost	**-$7,225,633**	**-$18,158,859**	**-$10,542,398**
Of which:			
- Saving from closing GPAAH	$7,551,932	$7,551,932	$7,551,932
- Cost of extra ED attendances	-$13,267,060	-$24,200,286	-$16,583,825
- Cost of extra in-hours GP attendances	-$386,467	-$386,467	-$386,467
- Cost of extra GP home visits	-$781,316	-$781,316	-$781,316
- Cost of extra extended-hours GP attendances	-$342,722	-$342,722	-$342,722
If 'Net cost' is:	< 0 -- GPAAH is a net SAVING for the health system > 0 -- GPAAH is a net COST for the health system		

Notes: i. As IHPA (2014) provides costs in 2012-year prices, these prices are converted to 2014-year levels using the *Medical and hospital services* sub-group in the Australia-wide Consumer Price Index, from ABS (2015).

Our net cost estimates are somewhat sensitive to ED marginal costs, with the 'Low ED cost' scenario resulting in net health system costs of -$7.2 million, around two-fifths of the net cost (-$18.2 million) in the 'NSW ED cost' scenario (Table 11). Within this range lies our baseline estimate of net health system costs (-$10.5 million).

It is worth noting that the marginal ED cost in the 'low ED cost' scenario ($321.81) is lower than the marginal cost of ED presentations by ESI-5 patients, which across the four public hospitals, was $376.93 during 2013/14. Hence, the net cost estimates in the 'low ED cost' scenario are lower in magnitude than would be the case if we had used the marginal cost of ED presentations by ESI-5 patients. That is, the health system cost savings with GPAAH would be higher if we had used the more realistic ED marginal cost of $376.93, rather than $321.81. Consequently, the findings in Table 11 are conservative estimates of the health system cost savings with GPAAH.

Though there is a large degree of variation in net cost estimates, all three scenarios imply significant cost savings for the health system from having GPAAH in existence.

6.2.3. Summary

In summary, our sensitivity analyses reveal that our baseline findings are robust – both qualitatively and, to a large extent, quantitatively – to changes in key parameters of our model. These parameters are ED marginal costs and the relative shares of the GPAAH alternatives nominated by GPAAH users in the counterfactual ('no-GPAAH') scenario.

6.3 Scenario analysis of ED response shares

In this section we examine how our net cost estimates vary as we explore alternative scenarios around the potential choices made by GPAAH users if GPAAH were to no longer exist. The analysis in this section differs from our prior discussion in that we are not exploring sampling error – the sensitivity of our net cost estimates to variation in the sample's response shares. Instead, we explore the implications of relaxing our assumption that GPAAH patients' actions in the counterfactual scenario are consistent with their survey responses, particularly for respondents who nominated ED.

61 per cent of our survey respondents nominated either presenting to ED or ringing 000 as their alternative to GPAAH (Figure 12). In this section we consider four alternative scenarios for the *ED presentation rate*, the proportion of GPAAH patients that could present to an ED: 50 per cent, 40 per cent, 30 per cent, and 20 per cent. These choices are approximately 10-percentage point decrements of the likely ED presentation rate (61 per cent) from our survey.

In each of the four scenarios, the response shares for the non-ED GPAAH alternatives are calculated based on their relative shares from the survey. For example, 19 per cent of survey respondents nominated 'Own GP' as their GPAAH alternative (see Figure 12), almost half of non-ED responses (39 per cent). This proportion is used to determine the 'Own GP' share in each of the four scenarios. We use the same approach for the other non-ED alternatives.

Table 12 shows our net health system cost estimates under each of the four alternative scenarios. The table confirms our prior comments that the magnitude of net health system costs are positively related to the number of low-acuity patients that are shifted from EDs to the relatively less expensive GPAAH service. As the ED presentation rate declines from 61 per cent (the presentation rate used to estimate our baseline net costs) to 30 per cent, the magnitude of cost savings declines, from $10.5 million to $2.3 million. A lower ED presentation rate implies there

are less numbers of GPAAH users presenting to ED, thereby reducing the cost savings to the health system from having GPAAH in the system.

Table 12: ED presentation rates and net cost estimates

	ED presentation rates:			
	50%	**40%**	**30%**	**20%**
Net cost	**-$7,767,681**	**-$4,872,325**	**-$2,279,610**	**$513,445**
Of which:				
- *Saving from closing GPAAH*	$7,551,932	$7,551,932	$7,551,932	$7,551,932
- *Cost of extra ED attendances*	-$13,247,998	-$9,767,135	-$6,635,084	-$3,272,130
- *Cost of extra in-hours GP attendances*	-$681,053	-$988,448	-$1,249,671	-$1,541,459
- *Cost of extra GP home visits*	-$966,576	-$1,159,891	-$1,353,207	-$1,546,522
- *Cost of extra extended-hours GP attendances*	-$423,986	-$508,783	-$593,580	-$678,377
If 'Net cost' is:	< 0 -- GPAAH is a net SAVING for the health system > 0 -- GPAAH is a net SAVING for the health system			

In fact, with a ED presentation rate of 20 per cent – that is, where only one-in-five GPAAH patients decide to attend an ED in the absence of GPAAH – the GPAAH service represents a cost *dissaving* for the health system. That is, the health system cost with GPAAH is $0.5 million higher than the cost without GPAAH (Table 12). In this scenario, the GPAAH service, in effect, adds a layer of cost to the service, by only shifting a modest number of patients from EDs to cheaper primary-care alternatives.

Note that, in the GPAAH scenario, 10 per cent of patients managed by the GPAAH service initially had presented to ED and were then referred from ED to the GPAAH clinic. In the no-GPAAH scenario, a presentation rate of 20 per cent therefore means that the 10 per cent who previously presented to ED now remain in ED and an additional 10 per cent – who previously would have directly accessed the GPAAH service – now present to ED.

There are no data available that could absolutely quantify what patients would do if the GPAAH service was removed, for the simple reason that this counterfactual has not occurred since the GPAAH service commenced. However, it is worth noting that the ED presentation rate assumed in the fourth scenario (20 per cent) is inconsistent with the findings of the survey – which is highly representative of the GPAAH user population (see Section 4.2). The findings from the fourth scenario are also inconsistent with most Australian and international evidence, which

concluded that effective GP after-hours services saved costs to the health system, primarily by shifting patients from EDs to cheaper primary care alternatives.

Comparing the third (30 per cent) and fourth (20 per cent) scenarios in Table 12, one can estimate the 'breakeven ED presentation rate': the ED presentation rate which results in neither a cost saving nor a dissaving (that is, a net cost of zero) to the health system from having GPAAH in the system. The breakeven ED presentation rate is found to be close to 22 per cent (21.84 per cent). This equates to around 18,900 GPAAH patients during 2013/14. For ED presentation rates higher (lower) than 21.84 per cent, GPAAH represents a net cost saving (dissaving) for the health system.

6.3.1. Summary

Our above analysis suggests that our net cost estimates are sensitive to the ED presentation rate. There are scenarios (an ED presentation rate of less than 21.8 per cent) in which the GPAAH service represents a cost dissaving for the health system. However, these scenarios are likely to be highly improbable, as they are inconsistent with the responses from GPAAH users and with the majority of domestic and international evidence.

Furthermore, our scenario analysis actually *strengthens* our baseline findings: even under less improbable scenarios around ED presentation rates – such as only three-in-ten GPAAH users presenting to ED in the absence of GPAAH – we still find that the GPAAH service saves the health system money.

6.4 The focus of our costing analysis

Our above costings focused on the entire GPAAH service; we did not attempt to disaggregate the overall costings into costs associated with each of the two key components of the GPAAH service (the PSS and the clinics). We did not attempt this for a few reasons:

1. An inability to identify the *marginal* costs associated each component. For example, while we estimated the health-system cost of the PSS at $1.4 million in 2013/14, we were unable to identify the patient-dependent component

2. Potential bias from an insufficiently small sample of PSS-only users. During the 2013/14 financial year, PSS callers who did not go to a clinic represented 43 per cent (34,185) of total callers. Less than 1 per cent of these callers (285) were surveyed in our PSS-only sample (see Section 4.2). In contrast, our GPAAH sample (1,680) – consisting of both

PSS callers and clinic patients – represented over 2 per cent of the GPAAH population (49,955 patients). To the extent that potential sample bias is an issue, it is likely to be more of an issue for the PSS-only sample than for the combined sample.

3. Difficulty in estimating the costs of the counterfactual scenario – for the PSS-only users, there is only one alternative phone advice service: Healthdirect Australia (HDA). However, we were unable to obtain the costs (neither total nor variable) for HDA, which, in combination with the first point, meant a costing of just the PSS was not possible. Also, our survey questionnaire was based on the overall GPAAH service; we did not ask GPAAH users what they would have done if *only* the PSS did not exist.

4. Potential magnitudes of savings – even if the first three points were achievable, the PSS-only component of the overall savings are unlikely to be large. To see why this is so, consider the following:

   - total (that is, fixed and variable) PSS-only costs are estimated to be $1.4 million in 2013/14. In the (unlikely and implausible) extreme that:
     i. HDA costs in 2013/14 were zero and
     ii. all of the $1.4 million in total PSS-only costs were variable,

     the health system would save $1.4 million, under this implausible extreme, from removing the PSS.

   - assuming the above combination of unrealistic conditions were possible, this would result in the net cost of GPAAH of -$9.1 million, compared to our baseline estimate of -$10.5 million (Table 9).

   - that is, even under this fanciful scenario, the GPAAH service would still save the health system money; the health system cost without GPAAH would be $9.1 million more than with GPAAH.

7. Assumptions and Limitations

As our analysis is a cost study, it has some inherent limitations, which are noted below. Furthermore, our analysis makes several assumptions – largely to ensure our findings are conservative – which are also discussed below.

As our analysis was a cost study, it focused solely on health system *costs*; we did not consider whether the GPAAH service achieves better health outcomes than its alternatives. Consequently, we did not consider potential *benefits* accruing to low-acuity patients, such as reduced waiting times – compared to attending an ED – and potentially better care. Benefits to GPs or ED staff (in the form of improved workloads or job satisfaction) are also not considered.

We assumed that GPAAH patients are equivalent to low-acuity ED patients; those with an Emergency Severity Index (ESI) of 4 or 5. For this reason, our baseline ED marginal costs are a (volume-weighted) average of the cost of treating ESI-4 and ESI-5 patients. Our sensitivity analysis of ED costs was partly designed to explore how much our net cost estimates were impacted by using a lower ED cost, such as the cost of treating ESI-5 patients in EDs.

In reducing ED presentations, the GPAAH service is also likely to impact on the use and total cost of ancillary services such as ambulance transport. These flow-on reductions to ancillary services were not costed within our study, partly due to the small proportion (1 per cent) of GPAAH users who nominated 'ring 000' as their response to our survey question.

Our analysis of actual vs. counterfactual scenarios is static, based on a given volume of patients over the 2013/14 financial year. As such, our methodology assumes that GPAAH patients' actions in the counterfactual scenario are consistent with their survey responses. This may not always be the case, particularly for GPAAH alternatives like EDs, due to their relatively higher 'transaction costs' (in the form of waiting times), which may deter patients from going to an ED.

As our analysis is static, we do not consider potential second-round effects flowing from the removal of GPAAH which may impact patient flows. For example, one potential 'no-GPAAH' scenario is that Healthdirect increases its patient visibility within the GPAAH region network, promoting patients to use this service instead of EDs or the other alternatives.

We also assumed that marginal costs for the GPAAH alternatives are the same between the 'actual' and 'counterfactual' scenarios. However, it is possible that there may be system rigidities

that lead to marginal costs increasing as patient volumes increase. A lack of available staff or other resources – and the resulting costs incurred to find extra resources – may be one reason for this. On the other hand, these rigidities may lead to a *decline* in ED per-patient costs, as more patients are seen by the same number of ED staff (though quality of care for patients may be negatively impacted).

Our estimate of the marginal costs of each alternative service to GPAAH was the sum of billing data from Medicare Australia, and the estimated value of patients' out-of-pocket expenses (if any). We recognise that this approach may lead to downwardly-biased estimates of variable costs. For example, in the no-GPAAH scenario, there may be additional costs associated with increasing both physical capacity and staffing for some (or all) of the GPAAH alternatives to service the additional patients that result from GPAAH ceasing to exist. These additional costs may result in higher out-of-pocket costs for patients – to the extent that MBS billings do not sufficiently cover the additional costs – and thus a higher marginal cost than what we assumed.

8. Cost savings: extra considerations

This section discusses measures to increase the potential health system cost savings discussed in Section 6.

8.1 Greater integration between GPAAH and hospital EDs

As shown in Section 6, avoided ED presentations are the biggest source of cost savings for the health system. This suggests that improving patient flows from EDs to the relatively less expensive GPAAH service may result in even greater cost savings.

In 2013/14, 60 per cent of ED presentations (by number) were low-acuity patients (ESI-4 or ESI-5). Of this, around one-seventh (8 percentage points) were transferred to GPAAH. While this transfer has been increasing over time (see Figure 9), it remains low relative to the volume of ESI-4 and ESI-5 patients presenting to EDs.

To estimate the potential cost savings, we again focus on the marginal costs of treating a low-acuity patient (ESI-4 or ESI-5) in ED versus in a GPAAH clinic. We consider three transfer rates of low-acuity patients from EDs to GPAAH clinics: (i) 10 per cent; (ii) 12 per cent; and (iii) 15 per cent. These figures are percentages of total low-acuity patients presenting to EDs. The actual transfer rate in 2013/14 was 8 per cent. As such, the corresponding *incremental* transfer rates are: 2 per cent, 4 per cent, and 7 per cent, respectively.

In consultation with Hunter Primary Care Ltd, these rates are chosen to ensure that the existing physical capacity – which is fixed in our analysis – of the GPAAH clinics is maintained. The fixed inputs are assumed to be the physical size of the GPAAH clinics and the IT infrastructure.

Our estimates of potential cost savings range from $0.55 million to $2.2 million, with the lower end of the range reflecting a 10 per cent ED-to-GPAAH transfer rate, and the upper end reflecting a 15 per cent ED-to-GPAAH transfer rate (Table 13).

These savings are *additional* to those reported in Table 9. Including the results from Table 9 suggests that, by keeping GPAAH in the system *and* by increasing the ED-to-GPAAH transfer rate, the health system could save between $9.5 million (10 per cent transfer rate) and $11.2 million (15 per cent transfer rate).

Table 13: ED-to-GPAAH transfer rates and health-system costs [i]

	Transfer-rate scenarios [ii]		
	10%	**12%**	**15%**
Extra GPAAH patients (no.)[iii]	1,809	3,929	7,110
Extra GPAAH patients (%)	4%	8%	14%
Cost in GPAAH	$172,545	$374,754	$678,067
Costs avoided in ED	-$727,774	-$1,580,669	-$2,860,010
Net cost	-$555,230	-$1,205,915	-$2,181,943
If 'Net cost' is:	< 0 -- SAVING for the health system		
	> 0 -- COST for the health system		

Notes: i. Based on patient volumes and costs for the 2013/14 financial year
ii. Transfer rate is expressed as a percentage of ESI-4 and ESI-5 patients treated in EDs
iii. In excess of those already transferred from ED to GPAAH (8,792 in 2013/14)

While our findings suggest further savings could be achieved from increasing transfer rates, a caveat to our results is that capacity constraints may potentially bind under one or more of our scenarios. For example, the third scenario (15 per cent transfer rate) implies a one-seventh increase in GPAAH clinic volumes, which may require additional physical capacity (which we have not costed) as well as additional labour and other variable resources (which we have costed). Additional physical capacity, if required, would reduce the potential cost savings from increasing the rate of patients transferred from EDs to GPAAH clinics.

The collaborative partnership between GPAAH and HNE Health – aimed at ensuring patients receive the most appropriate care – has seen the ED-to-GPAAH transfer rate increase over time. Over the past three years, GPAAH and HNE Health have improved inter-departmental relationships, and our above findings imply that this should be encouraged and strengthened.

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Appendix

A.1 Data sources for costing non-ED alternatives to GPAAH

In constructing the marginal costs of GP-based alternatives to GPAAH, we have principally relied on publicly available Medicare Benefit Scheme (MBS) data for the Hunter Medicare Local (HML) area in 2013/14, http://medicarestatistics.humanservices.gov.au/statistics/med_locals.jsp.

This data provides both the volumes of services and the total MBS benefits per Medicare Item, allowing calculation of the per service benefit which we have taken as a proxy of per patient cost for that Medicare Item within the region.

A.1.1. After-hours GP services

Table 14 details the Medicare groups, subgroups and item numbers used to develop costings for the selected (non-ED) GPAAH alternative after-hours services. In summary:

- **Per-Patient Cost for 'After-Hours GP Services'**: sum of total benefits divided by sum of total services for the HML area, Medicare Groups: A11 ('After Hours'); A22 ('GP after-hours attendances to which no other item applies'); and A23 ('Other non-referred after-hours attendances to which no other item applies').
- **Per-Patient Cost for 'Home Visit GP Services'**: sum of total benefits divided by sum of total services for selected items in for the HML region, Medicare Groups: A11 ('After Hours'), 599 and 597.

Table 14: Medicare codes used to determine service costs

Medicare Group/ Item Number	Description	Service Type Applicable
A22, '5020'	*GP after-hours attendances to which no other item applies*, Level B consultation	*Non-urgent* extended-hours and after-hours GP services (at GP consulting rooms) for consultations lasting less than 20 minutes
A22, '5000', '5040', '5060'	*GP after-hours attendances to which no other item applies*, Level A, C and D consultation	*Non-urgent* extended-hours and after-hours GP services (at GP consulting rooms) for brief (Level A) or longer (C or D) consultations.
A22, '5028', '5049' and '5023', '5043'	*GP after-hours attendances to which no other item applies*, Residential aged care and other home visits	*Non-urgent* extended-hours and after-hours GP services at institutions other than GP clinics
A11.1, '597'	*General Practitioner - After Hours,* Urgent After Hours Professional Attendance by a General Practitioner	*Urgent* extended-hours and after-hours GP services (typically used for after-hours GP home visits)
A11.2, '599'	*General Practitioner – Transitional Hours*, Urgent Attendance Unsociable After Hours Professional attendance by a General Practitioner	*Urgent* extended-hours and after-hours GP services (from 11pm-7am). Typically used for after-hours GP home visits

Note: non-GP related items are excluded.

The MBS data contains a number of limitations:

- MBS data shows the government contribution and not the patient out of pocket contribution which then still needs to be estimated. That said, users of after-hours GP services are typically bulk-billed; for example, across New South Wales, Medicare bulk-

billings represented 87 per cent (by number) of various – mainly after-hours – GP services.[8] Due to the high proportion of bulk-billings, users of after-hours GP services have minimal out-of-pocket expenses.

- Since all GP-based services (in-hours GPs; after-hours GPs; and GP after-hours home visits) can potentially use the same item numbers, the aggregated MBS data does not necessarily allow one to differentiate the per-patient costs of each of these GP-based alternatives to GPAAH.

- GPAAH services also bill against several of the above Medicare Items (namely '5020') and need to be excluded from the calculation for alternative 'after-hours GP services'. GPAAH client numbers of MBS billings are able to be subtracted from Hunter Medicare Local totals, and in this way the GPAAH services contribution can be excluded from the calculation of the average billing per patient.

A.1.2. In-hours GP services

In contrast to users of after-hours GP services, users of in-hours GP services can either be:

- bulk-billed, which requires no out-of-pocket expenses for users
- charged a concessional fee or
- charged a private fee, which does have an out-of-pocket expenses for users

To determine the (volume-weighted) average fee charged by in-hours GPs within the GPAAH region, Hunter Primary Care Ltd conducted a survey of 13 GPs within the HML network. Due to the proprietary nature of the survey, only postcode-related information was provided by Hunter Primary Care Ltd[9].

[8] The Medicare groups (selected item numbers in brackets) included were: A1; A7 (item numbers: 2-4); A11 (item number: 597); A11 (item number: 599); A18; and A22. The data was obtained from: http://medicarestatistics.humanservices.gov.au/statistics/mth_qtr_std_report.jsp (accessed 24 February 2015).
[9] The postcodes surveyed were: 2290, 2305, 2320, 2282, 2320, 2287, 2285, 2304, 2286, 2291, 2323 and 2289.

A.2 Estimates of NSW-wide ED per-patient costs

As discussed in Section 5.2, we use NSW-wide data from IHPA (2014) to estimate ED per-patient costs for the HML area. Table 15 shows how we arrived at our estimate of NSW-wide total per-patient ED costs of $629.38.

Table 15: Estimate of ED per-patient total costs across NSW (ESI 4 and 5)

	Per-patient value
NSW-wide total ED cost (Source: IHPA, 2014) [i]	$600.00
For NSW, payroll tax was omitted from IHPA (2014). But it is provided for Tasmania	
- Payroll tax as share of total cost in Tasmania (from IHPA, 2014)	*3%*
NSW-implied payroll tax (based on Tasmania's share)	$15.38
For all states, the cost of capital was omitted from IHPA (2014)	
- Assume capital costs equal building depreciation	
Building depreciation in NSW (Source: IHPA, 2014)	$14
Capital costs in NSW	$14
REVISED NSW-wide total ED cost (=$600 + 15.38 + 14)	**$629.38**

Notes: i. Includes pathology and imaging costs.

A.3 Algebraic formulation of costing approach

This section presents an algebraic formulation of our approach to estimating the health-system costs under the actual (with-GPAAH) and counterfactual (without-GPAAH) scenario.

Let HSC^{GPAAH} be the health-system cost (HSC) with GPAAH, and let $HSC^{Ex-GPAAH}$ be the HSC without GPAAH. Then,

$$\boldsymbol{HSC^{GPAAH} = Cost^{GPAAH} + Cost^{ED} + Cost^{GP} + Cost^{XGP} + Cost^{GPHV}} \tag{1}$$

where:

- $Cost^{GPAAH}$ is the total cost of a GPAAH visit
- $Cost^{GP}$ is the total cost of an in-hours GP visit
- $Cost^{ED}$ is the total cost of treating a low-acuity (ESI-4 and ESI-5) patient in ED
- $Cost^{XGP}$ is the total cost of extended-hours GP (XGP)
- $Cost^{GPHV}$ is the total cost of a GP home visit (GPHV).

Separating the costs in equation (1) into fixed and variable costs gives:

$$\begin{aligned}\boldsymbol{HSC^{GPAAH}} = &\boldsymbol{(FC^{GPAAH} + VC^{GPAAH}) + (FC^{ED} + VC^{ED}) + (FC^{GP}} \\ &\boldsymbol{+ VC^{GP}) + (FC^{XGP} + VC^{XGP}) + (FC^{GPHV} + VC^{GPHV})}\end{aligned} \tag{2}$$

where VC^i and FC^i are, respectively, the variable cost (VC) and fixed cost (FC) of service *i*.

Now consider the health-system costs without GPAAH. By imposing the assumption that:

- fixed costs are the same between the with-GPAAH and no-GPAAH scenarios, and
- variable costs can change between the with-GPAAH and no-GPAAH scenarios

the health-system cost in the no-GPAAH scenario is:

$$\begin{aligned}\boldsymbol{HSC^{Ex-GPAAH}} = &\boldsymbol{(FC^{GPAAH} + VC_*^{GPAAH}) + (FC^{ED} + VC_*^{ED}) + (FC^{GP}} \\ &\boldsymbol{+ VC_*^{GP}) + (FC^{XGP} + VC_*^{XGP}) + (FC^{GPHV} + VC_*^{GPHV})}\end{aligned} \tag{3}$$

where VC_*^i is the variable cost of service *i* in the no-GPAAH scenario. VC_*^{GPAAH} equals zero.

As variable costs are patient-dependent, we use the following functional forms for VC^i and VC_*^i:

- $VC^i = a^i \cdot P^i$
- $VC^i_* = a^i \cdot P^i_*$

where, for each service *i*: a^i is the marginal cost of patient *i*; P^i is the volume of patients in the with-GPAAH scenario; and P^i_* is the volume of patients in the no-GPAAH scenario. P^{GPAAH}_* equals zero. We assume that the per-patient costs do not vary between the two scenarios. We substitute these expressions for the variable costs into equations (2) and (3).

The (net) cost to the health system, NC, of not having GPAAH is then the difference between the health-system costs:

$$NC = HSC^{GPAAH} - HSC^{Ex-GPAAH} \tag{4}$$

Substituting equations (2) and (3) into (4), and cancelling out common terms, gives:

$$NC = a^{GPAAH} \cdot P^{GPAAH} + a^{ED} \cdot (P^{ED} - P^{ED}_*) + a^{GP} \cdot (P^{GP} - P^{GP}_*) + a^{XGP} \cdot (P^{XGP} - P^{XGP}_*) + a^{GPHV} \cdot (P^{GPHV} - P^{GPHV}_*) \tag{5}$$

To solve the model, we need information on a^i, P^i, and P^i_*, for each service *i*.

Our costing analysis is based on comparing actual patient volumes in 2013/14 with a counterfactual scenario in which GPAAH does not exist. In the counterfactual scenario, we simply redistribute GPAAH users to alternative options. As total patient volumes are the same across the two scenarios, we have the following result:

$$\sum_i P^i = \sum_i P^i_*$$

with P^{GPAAH}_* equal to zero.

We obtain patient volume data from HNE Health (for P^{ED}), HPC (2014) (for P^{GPAAH}), and Medicare Australia (for all the other services). To obtain P^i_*, we use the responses from the survey of GPAAH users. For example, 61 per cent of GPAAH users stated they would have used ED if GPAAH did not exist. Hence, $P^{ED}_* = P^{ED} + 0.61 * P^{GPAAH}$.

We apply the same approach to get P^i_* for the other non-GPAAH services.

If $NC < 0$, health-system costs with GPAAH are *lower* than without GPAAH; the presence of GPAAH leads to a financial saving for the HNE health system. If $NC > 0$, health-system costs with GPAAH are *higher* than if GPAAH did not exist. Finally, $NC = 0$ implies that health-system costs would be the *same* whether or not GPAAH existed.