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# Costs and consequences of an intervention-based program to reduce hospital-acquired pressure injuries in one health district in Australia

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**Abstract**

**Objectives.** The aims of this study were to determine the costs of hospital-acquired pressure injuries (HAPIs) in one local health district in Australia and compare the costs and consequences of an intervention-based program with current practice to reduce HAPI incidence and prevalence.

**Methods.** A retrospective cost–consequence analysis was conducted using HAPI incidence rate per occupied bed days, point prevalence rates, Australian Refined-Diagnosis Related Group (AR-DRG) costs and the costs of the program to reduce the HAPI rate. Data were analysed for two phases: preprogram implementation (1 June 2015–1 June 2016) and postprogram implementation (1 August 2016–31 July 2017).

**Results.** The HAPI intervention-based program resulted in a 51.4% reduction in the incidence of HAPI (from 1.46 per occupied bed day in 2014 to 0.71 per occupied bed day in 2017) and a 71.6% reduction in the prevalence of HAPI (from 6.7% in 2014 to 1.9% in 2017). The occurrence of HAPI added an average cost of A$3332 per episode, such that the overall program, including implementation, reduced costs by A$837 387. The greatest cost reduction was due to the cessation of washable and disposable underpads. The largest contributor to the cost of HAPI prevention was for education and training regarding HAPI prevention initiatives.

**Conclusions.** The HAPI intervention-based program halved the incidence and substantially reduced the prevalence of HAPI, with a 23.1% cost saving compared with the previous approach to preventing HAPIs.

**What is known about the topic?** HAPIs are costly to the individual, the organisation and health system. The prevention of HAPIs is a priority in Australia. There is limited research on the economic effect of HAPIs and the costs and consequences for hospitals of implementation strategies to reduce their incidence.

**What does this paper add?** This paper informs health policy and decision makers about the costs and consequences for a local health district of a program to reduce and prevent HAPIs. This paper reports the economic effect of HAPIs, including hospital episode costs per HAPI and length of stay, on one local health district.

**What are the implications for practitioners?** This cost–consequence analysis has shown that the program to reduce HAPIs resulted in a reduction in expenditure and positive patient outcomes. Such a program is potentially transferable to other healthcare settings.

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## Introduction

The prevention and management of hospital-acquired pressure injuries (HAPIs) can be costly to patients, organisations and the healthcare system. Pressure injuries (PIs) are painful skin injuries caused by unrelieved pressure, shear and friction.[1] Individuals who are medically compromised, unable to move or have a medical device in place are at high risk of developing a PI.[2–5]

The incidence and prevalence of HAPIs vary globally depending on patient acuity, demographics and varying methods for collecting and reporting PIs. Globally, HAPI prevalence rates range from 3% to 17.6% in Australia,[6–8] from 12% to 17% in Europe,[9,10] from 3.8% to 19.7% in the US[11,12] and from 4.7% to 7.1% in the UK.[13,14] Elsewhere internationally, HAPI incidence rates are in the range 1.5–45.5%.[15–18]

Individuals with HAPIs experience pain, immobility and insomnia.[19] They are susceptible to wound infections and delayed wound healing, leading to a longer hospital length of stay (LOS).[20] Increased LOS and the corresponding use of healthcare resources to treat HAPIs impose financial burdens on the healthcare system.[19–22]

Nguyen *et al*.[23] estimated that the total cost of HAPIs to the healthcare system in Australia was A$983 million in 2012–13, which represented approximately 1.9% of public hospital expenditure. In the UK, HAPIs were estimated to cost up to £2.1 billion in 2004, which was 4% of the National Health Service's expenditure.[24] In the US, the total cost of HAPIs was US$9.1–11.6 billion.[25] The desire to avoid such costs and improve patient care led the US to introduce disincentives in the form of financial penalties imposed on organisations where patients develop severe HAPIs.[26] The Queensland government has followed this model, whereby hospitals are financially penalised if a patient in their care develops a Stage 3, 4 or unstageable PI.[27]

HAPI prevention is an important area of patient safety and is a national priority in Australia. The Australian Commission on Safety and Quality in Health Care[28,29] listed HAPI prevention and management as one of the national standards to improve patient safety and quality of care. Patient care planning should incorporate the timely implementation of evidence-based strategies, which are likely to lower the rate of HAPIs and associated skin conditions. However, there is limited research on the economic effect of HAPIs and the costs and consequences of implementing strategies to reduce HAPIs.

Given that the cost of HAPIs increases the financial burden on an organisation, an evaluation of the costs and consequences of a program to prevent or reduce the incidence of HAPIs is warranted. Internationally, few studies have examined the costs and consequences of strategies for HAPI prevention, such as single medical devices, bundled HAPI prevention approaches and quality improvement projects.[30–34]

This study is part of a larger study[35] that investigated the factors contributing to the development of HAPIs in a local health district (LHD) in Australia, the findings of which were used to guide evidence-based initiatives for HAPI prevention. In this LHD, there was a 57% increase in the incidence of HAPIs and a 73% increase in prevalence over a 5-year period (2010–14).[35] Insights into the costs associated with strategies for HAPI prevention would help organisations inform health and policy decision making related to resource allocation and HAPI expenditure. To that end, the objectives of the present study were to determine the costs of HAPIs in one LHD and to compare the costs and consequences of a program of work implemented to reduce the incidence of HAPIs.

## Methods

### *Ethical considerations*

Ethics approval for the study was provided by the LHD's Human Research Ethics Committee. All patient records were deidentified before analysis.

### *Design*

A cost–consequence analysis was conducted from the perspective of the LHD (the healthcare provider). A top-down approach was used to determine the cost of HAPIs and a bottom-up approach was used to determine the cost of program initiatives.

#### *Target population*

The LHD is comprised of three acute tertiary hospitals, a subacute hospital and five district nursing community health centres. The LHD is located in an urban setting that provides primary, secondary and tertiary care to a population of 700 000 people. The sample included all patients who developed a PI that was documented as an HAPI, based on the International Classifications of Diseases (ICD) code ICD-10 L89 classification, in any of the four hospitals. The study considered two periods, namely a preprogram implementation phase (1 June 2015–1 June 2016) and a postprogram implementation phase (1 August 2016–31 July 2017). All patients documented as having an HAPI during these time periods were included in the study.

#### *Intervention-based program*

In 2015, the LHD established a district-wide HAPI prevention position to lead a practice change project to address the high number of HAPIs. The project was supported by a PI taskforce comprising of key stakeholders: directors of nursing, nurse managers, nurse consultants, nurse specialists, an audit and incident manager, chief nursing information officers, a dietitian and an occupational therapist. To determine the program initiative components, audits, surveys and interviews were conducted across the LHD. The development of the HAPI prevention program, and its implementation, were guided by the Promoting Action on Research Implementation in Health Services (PARiHS) framework[36,37] (Table 1, Fig. 1). The resources used to implement the program are detailed in Appendix 1.

### *Outcomes*

The primary outcome measures for the study was the reduction of HAPI incidence (calculated per 1000 occupied bed days (OBD)) and the annual HAPI prevalence. Prevalence data were calculated as the number of hospital patients audited with one or more HAPI (all stages) over the total number of hospital patients audited.

**Table 1. Hospital-acquired pressure injury (HAPI) prevention components**
PI, pressure injury

| Preprogram HAPI prevention components | HAPI intervention-based program components |
|---|---|
| Powered mattresses from various suppliers | Powered mattress from one preferred supplier (Independent Living Specialists, Australia) to improve consistency |
| Use of various skin protection barrier products not in line with best practice[38] | Use of 3-in-1 barrier cream cloth (Comfort Shield™ Sage owned by Stryker, Sydney, Australia) |
| Multiple plastic sheets and disposable and washable layers placed on beds of patients with or without incontinence, impairing microclimate and creating more friction | Removal of plastic sheets and washable and disposable underpads, and introducing the use of correctly sized incontinence pads |
| Nil interventions to reduce shearing | Prophylactic dressings (Mepilex Border, Molnlycke, Australia) applied to high-risk patients to reduce shear and friction |
| Several different incontinence products in each hospital | Standardisation of incontinence products to assist with consistency |
| Standard high-back chairs | Purchase of pressure-redistributing high-back chairs with memory foam (Embark Chair, Astris Lifecare, Australia) |
| Critical care standard hospital beds and hire of powered mattresses based on risk assessment | Purchase of therapeutic beds to assist with mobility and repositioning (Progressa, Hill-Rom, Australia and New Zealand) |
| Mandatory, online, yearly 2-h PI training undertaken by all nursing staff | Initial education campaign to improve PI prevention practices followed by regular in-ward practical education sessions delivered by nurse educators on a monthly basis or when a patient was identified at high risk of developing a PI |
| No assigned nursing or clinical lead in PI prevention | Employment of a district PI lead to drive PI prevention across the district |
| Hospital-specific wound committees | Formation of a district-wide taskforce to improve adherence to PI prevention |
| | Formation of speciality district implementation subcommittees, for example, PI emergency department committee and intensive care committee |

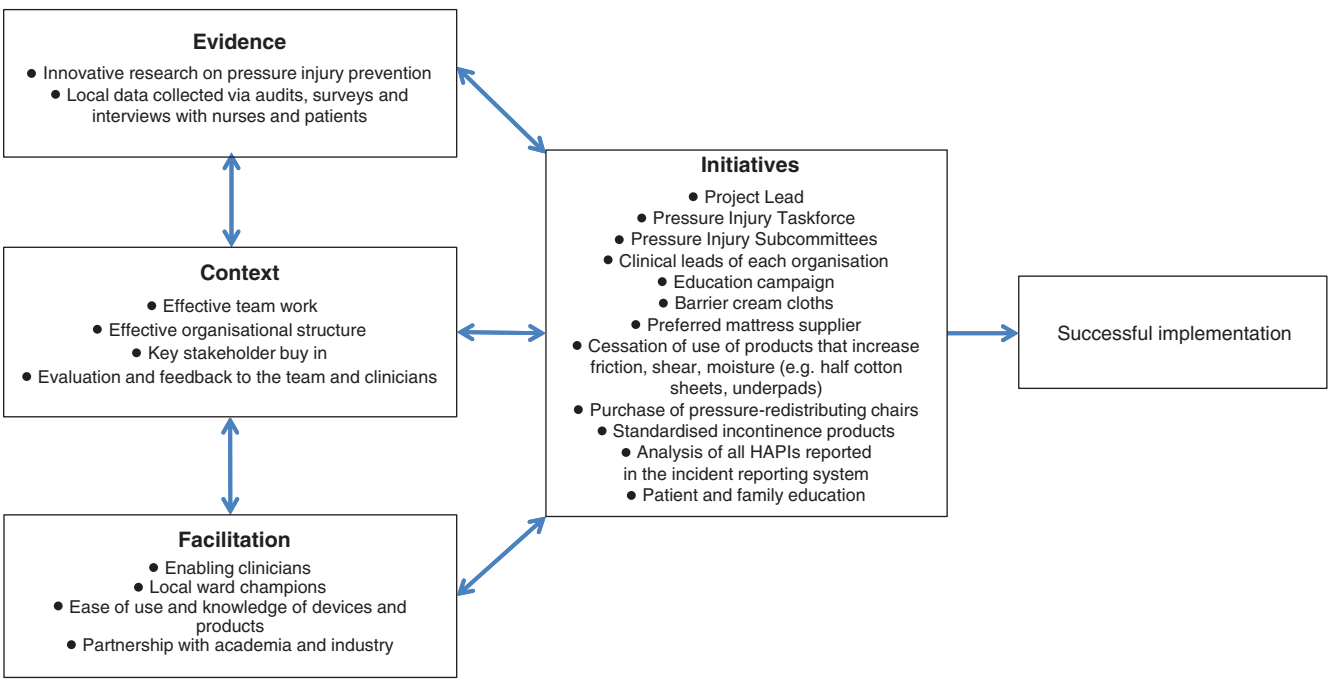


**Fig. 1.** Components of the program guided by the Promoting Action on Research Implementation in Health Service (PARiHS) framework.[36,39] Successful implementation of evidence-based research is reliant on three key interacting elements: the evidence, the context and facilitation. HAPIs, hospital-acquired pressure injuries.

## *Data collection and resource utilisation*

### *Cost of HAPI*

Retrospective data on overall episodes of care, including the corresponding Australian Refined-Diagnosis Related Group (AR-DRG) (https://www.accd.net.au/ArDrg.aspx?page=2, accessed 20 June 2017) classification for each episode, were obtained from the electronic medical records of patients who developed an HAPI during the study period. The occurrence of HAPIs was identified using a condition 'onset flag' for diagnoses present on admission in ICD-10 data (https://icd.who.int/browse10/2016/en, accessed 10 May 2017). Within the

classification system, each AR-DRG assigned to a patient took into account the presence of a PI. To investigate the effect of an HAPI on hospital LOS in both periods, the hospital LOS was calculated as the number of days between admission and discharge.

The effects of HAPIs on costs was investigated by adjusting the AR-DRGs assigned to episodes of care in the postprogram group to reflect the AR-DRG (and hence the accompanying cost weight) if the HAPI had not occurred. Data were not available to allow the same analysis to be undertaken for the preprogram study period. This was undertaken centrally by hospital coders by removing the specific codes associated with an HAPI for each episode of care and reclassifying each episode on the basis of the remaining diagnostic codes. This resulted in the AR-DRG for that episode that would have applied if the HAPI had not occurred. The difference between the AR-DRG with and without the HAPI provided an estimate of the effect of the HAPI on hospital costs.

Costs were summarised based on the difference in the cost weight applied to an AR-DRG for each event in which an HAPI occurred compared with the cost weight that would have applied to that event if the AR-DRG classification had excluded the occurrence of the HAPI. Changes in the AR-DRG cost weights were classified as increased, decreased or no change. All costs were estimated by applying the cost weights from the National Hospital Cost Data Collection's Round 20 Public Hospitals Cost Report for the 2015–16 financial year[40] to both the original and adjusted AR-DRGs.

### *HAPI prevention costs*

The costs of HAPI prevention strategies, including the program initiatives, were calculated by taking into account ward-specific physical health care use and labour time (Table 2). Unit cost information for each product for the preprogram and postprogram groups, including the use of the product/s on each ward, was obtained from inventory managers. The postprogram group costs accounted for the same items as the preprogram components, except for the additional costs of the use of 3-in-1 barrier cream cloths, changeover to a preferred rental mattress supplier, the purchase of pressure-redistributing chairs and the addition of an education campaign (Table 2). Labour time for delivery of the education campaign was costed at the rate that would be required to prepare and deliver the educational intervention.

### *Data analysis*

Data were analysed descriptively using IBM SPSS Statistics v24 (Armonk, NY, USA). The primary diagnosis for each patient was assigned to a Major Diagnostic Category (MDC),[41] which classifies all possible diagnoses into 25 diagnostic categories. This allowed a comparison of diagnosis types in the preprogram and postprogram periods. In addition, independent samples *t*-tests were conducted to compare the mean LOS for the preprogram and postprogram groups.

The cost of HAPI program initiatives was calculated by multiplying the average volume of each resource used (Table 2) by its unit price. This resulted in a total cost for HAPI prevention in the preprogram and postprogram periods. For the cost–consequence analysis, data were analysed by comparing the cost before the initiative and the costs following the initiative. This took into account the costs of treating HAPIs, as well as the costs of HAPI prevention.

Because data on adjusted AR-DRGs were not available for the preprogram group, the same mean cost weight (as described below) of an HAPI in the postprogram group was used for the preprogram group in order to obtain the overall cost of HAPIs. This was then multiplied by the number of patients with HAPIs in the preprogram group to obtain the overall cost of HAPI treatment. The cost of HAPI prevention interventions between 1 June 2015 and 1 June 2016 was added to the overall cost of HAPI treatment in that period to obtain the final amount spent by the LHD on HAPI prevention and management.

For the postprogram period, the mean cost weight of a PI was calculated using the difference between the original and adjusted AR-DRG for each episode of HAPI and then averaging these differences. This mean cost weight was multiplied by the number of patients in the group to obtain the overall cost of treating HAPIs. This cost was added to the overall cost of the HAPI program between 1 August 2016 and 31 July 2017 (Table 2) to obtain the final amount spent by the LHD on HAPI prevention and management.

**Table 2. Total district costs of program initiatives**

All values are in Australian dollars. Data were analysed for two phases: before (1 June 2015–1 June 2016) and after (1 August 2016–31 July 2017) program implementation

| Item | Costs ($) | | Cost ($) difference (% change) |
|---|---|---|---|
| | 2015–16 | 2016–17 | |
| Prophylactic dressings (Molnlycke, Australia) | – | 122 990 | +122 990 |
| Barrier products (Comfort Shield™ Sage owned by Stryker, Sydney, Australia) | 96 651 | 82 997 | –13 654 (14.1) |
| Plastic sheets, washable and disposable under sheet and half cotton sheet laundering | 307 775 | 142 861 | –164 914 (53.6) |
| Incontinence pads | 443 863 | 212 631 | –231 232 (52.1) |
| Mattress preferred supplier (Independent Living Specialists, Australia) | 1 290 492 | 934 670 | –355 822 (27.6) |
| Pressure-redistributing chairs (Embark Chair, Astris Lifecare, Australia) | 67 712 | 66 432 | –1280 (1.9) |
| Intensive care beds (Progressa, Hill-Rom, Australia and New Zealand) | – | 50 000 | +50 000 |
| Development of program and leadership initiatives | – | 6197 | +6197 |
| Educational materials | – | 302 | +302 |
| Dissemination and training | – | 72 274 | +72 274 |
| Total cost | 2 206 493 | 1 691 354 | –515 139 (23.3) |

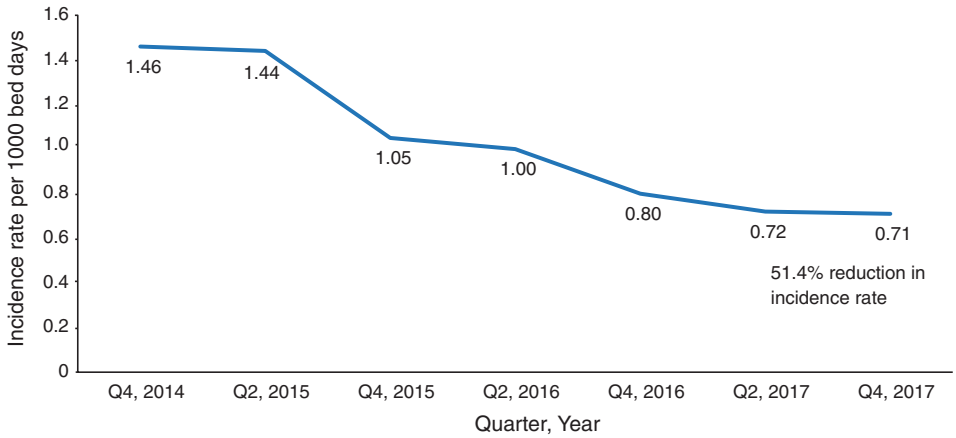


**Fig. 2.** Quarterly hospital-acquired pressure injury (HAPI) incidence rates per 1000 occupied bed days (OBD) from the fourth quarter (Q4) of 2014 to Q4 of 2017.

Postinitiative effects were examined as the difference between HAPI incidence and prevalence before and after the program. Similarly, the sum of the HAPI prevention interventions and the cost of HAPI treatment before the program period and the sum of the program initiatives and the cost of HAPI treatment following the program were compared.

## Results

### *HAPI incidence rate and prevalence*

Prior to the implementation of the program, 428 patients developed an HAPI (total number of admissions from 1 June 2015 to 1 June 2016 = 638 886). Following the program, HAPI occurrence decreased to 331 (total number of admissions from 1 August 2016 to 31 July 2017 = 666 606). As can be seen in Fig. 2, the HAPI incidence per OBD declined in each quarter, from 1.46 in the fourth quarter of 2014 to 0.71 in the fourth quarter of 2017. Furthermore, yearly point prevalence data showed a significant reduction in the HAPI prevalence rate by 71.6% (from 6.7% in 2014 to 1.9% in 2017; Fig. 3).

Appendix 2 presents the demographic and clinical characteristics of both groups. The most common diagnoses patients with HAPIs had were related to the respiratory, musculoskeletal and circulatory systems. There was a significant difference in mean (± s.d.) LOS for patients in the preprogram and postprogram groups (25.8 ± 27.8 vs 19.9 ± 18.5 days respectively; $t(757) = 3.31$, $P = 0.001$). On average, the postprogram group stayed in hospital 5.9 fewer days than the preprogram group.

### *Cost of the program*

The cost of the program to reduce HAPIs is presented in Table 2. Results indicate that the program yielded lower costs. The preprogram costs for HAPI prevention were A$2 206 493, and program costs were A$1 691 354. The net reduction in costs was calculated to be A$515 139. The biggest cost reduction was due to the cessation of use of washable and disposable underpads, and a change in the preferred suppliers for incontinence pads. The second biggest cost reduction was due to a change in the preferred supplier for mattresses, reducing costs by 27.6%, compared with the previous approach (several suppliers). The largest contributor to the program costs was the dissemination and training of staff on the HAPI prevention initiatives.

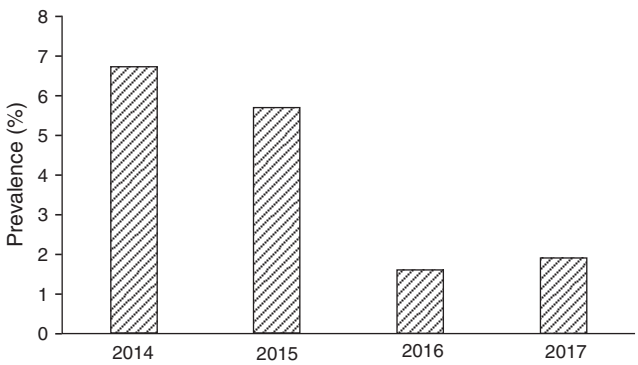


**Fig. 3.** Annual pressure injury point prevalence rates in the Local Health District in October 2014, 2015, 2016 and 2017.

**Table 3. Cost comparisons before and after program implementation**
All values are in Australian dollars. HAPI, hospital-acquired pressure injury

| Type | Costs ($) | | Difference ($) in costs (% reduction) |
|---|---|---|---|
| | Before | After | |
| Cost of initiative | 2 206 493 | 1 691 354 | 515 139 (23.3) |
| Cost of HAPI | 1 421 876 | 1 099 628 | 322 248 (22.7) |
| Total | 3 628 369 | 2 790 982 | 837 387 (23.1) |

### *Cost of treating HAPIs in the LHD*

The mean (± s.d.) cost weight of all episodes of care associated with an HAPI in the postprogram group was A$20 843 ± 37 156. Excluding the effect of HAPIs, the mean (± s.d.) cost weight of those episodes fell to A$17 521 ± 26 255. Thus, the mean (± s.d.) cost of an HAPI was A$3322 ± 19 479.

### *Comparisons of costs before and after the program*

In the preprogram group, 428 patients had an HAPI; therefore, the overall cost of PI care was A$1 421 876. The LHD spent

A$2 206 493 on HAPI prevention in the preprogram period (Tables 2, 3). The combined total cost spent on HAPI prevention and management in the preprogram period was A$3 628 369.

In the postprogram group, 331 patients had an HAPI; therefore, the overall cost of HAPI care was A$1 099 628. The LHD spent A$1 691 354 on HAPI prevention in the postprogram period (Tables 2, 3). Thus, the combined cost of HAPI prevention and management in the postprogram period was A$2 790 982. This represented a 23.1% reduction compared with the preprogram period in overall costs spent by the LHD for implementing a program to reduce HAPIs.

## Discussion

The primary aim of implementing initiatives was to reduce the incidence and prevalence rate of HAPIs. This study presents the results of a cost–consequence analysis to determine the costs of HAPI treatment and a program implemented to reduce the incidence of HAPIs in one LHD. The analysis demonstrates that the average cost to treat HAPI per episode of care was A$3322. Further, the program that was implemented facilitated substantial reductions in HAPI incidence per OBD (51.4%) and cost reductions (of A$837 387, or by 23.1%) compared with preinitiative strategies. The main costs incurred from the program were attributed to the education campaign to prevent HAPIs.

A cost–consequence analysis to evaluate this program was used because this approach provided a clear explanatory summary for health professionals and policy makers about the costs of delivering a program and its effects. As noted previously, HAPIs pose a significant economic burden on patients, organisations and the health system.[23,24,42] Further, other estimates of the burden of HAPIs emphasise the reduced quality of life, both physically and emotionally, experienced by patients.[27,43,44] Thus, the benefits of implementing a program to avoid HAPIs, and the substantial economic and emotional burden they place on the individual and health system, far outweigh the costs of implementing such a program.

In this study, the highest cost incurred in implementing the program was education and training; however, this was essential to enable practice change. Education and training also built strong collaborative relationships with key stakeholders; it enabled the delivery of bedside or ward education sessions to nurses and engaged patients in discussions on preventative measures.

The main cost reductions from the program were attributed to the cessation of use of unnecessary washable and disposable underpads, plastic sheets and streamlining the supplier for incontinence pads. Underpads and plastic sheets predispose a patient to skin injury by increasing friction and impairing the microclimate.[1,45,46] By removing these, a patient's risk of developing a PI were minimised and costs reduced. A further cost reduction was due to changing to one preferred mattress supplier rather than maintaining several suppliers. This reduced the overall annual cost on mattress hire by 27.6%.

The HAPI program also positively affected patient LOS. The postprogram group had a statistically significant shorter mean LOS than patients in the preprogram group, by almost 6 days. This suggests that there are added benefits of a reduction of LOS. It is possible that the HAPI program led not only to the prevention of HAPI, but also more rapid recovery time (an outcome that could be confirmed via a case-matched analysis).

In this study we used a top-down approach to determine the cost of HAPI; therefore, there are differences between our estimates of HAPI costs and those of other researchers who used a bottom-up approach.[23,42] Nonetheless, the present study estimated that HAPI episodes resulted in a higher cost than episodes without an HAPI by 19% of an average cost weight. This is comparable to the Independent Hospital Pricing Association's figure of 14.3% of an average cost weight in 2018.[40]

Although there were methodological differences in estimates of HAPI costs and evaluation design compared with some studies, our findings are consistent with other studies[47–50] demonstrating that initiatives to reduce HAPIs are cost-effective. These studies had used a multicomponent strategy and conducted economic evaluations to demonstrate varying levels of cost savings and positive patient outcomes.[47–49] Notably, one study conducted a cost–effectiveness analysis following the implementation of an HAPI best-practice strategy across an entire country and found that their strategy not only prevented HAPIs, but also yielded cost reductions to the health system (per patient episode of care) by 32.6%.[48] Other studies with single-component strategies have also shown cost savings and benefits to patients, including lower occurrences of HAPIs and enhanced care.[51,52] Considering the national focus on preventing HAPIs, coupled with impending hospital funding penalties for an HAPI, implementing a dominant intervention (one that is less costly and more efficacious than its comparator) would clearly be worth funding.

In this study, the three most common diagnoses patients had were related to the respiratory, musculoskeletal and circulatory systems. This is consistent with the current literature, where patients with these conditions are at higher risk of developing a PI.[2,53–55] For example, patients with vascular disease or perfusion issues, those with mobility limitations or those on mechanical ventilation are at heightened risk of developing HAPIs.

A number of the initiatives in a program for HAPI prevention are complex in nature and involve multiple components, such as audits, surveys, education, training, use of devices and products. The extent of HAPI burden in one organisation or district will determine the number and type of initiatives needed, and whether it is possible to reorganise existing resources. For example, meetings that were set up in relation to HAPIs in the LHD in the present study, such as the taskforce, occurred as a reorganisation of existing resources as opposed to an additional committee meeting that would cost more time and resources. Our program of work has shown that the existing context and resources available must be considered for the successful implementation of a tailored program to address serious clinical problems.

There are limitations to the present study that should be highlighted. First, the adjusted AR-DRGs were not available for the preprogram group, therefore the postprogram group data were used to determine the cost per HAPI episode for the preprogram group. The cost of HAPI treatment assigned to the preprogram group should be taken as indicative. Second, even though we found a reduction in the mean LOS by almost 6 days

after program implementation, we have not quantified the financial effect of this reduction. Furthermore, initiatives such as the web-based workforce package were viewed by nurses, yet no data were obtained on how many nurses viewed this. Finally, our analysis considered outcomes in terms of HAPI incidence, which has implications for patient quality of life of which the present study did not explore. Future research into the effects on the quality of life of patients who develop HAPIs are recommended in order to assess quality-adjusted life years.

## Conclusion

Following the program undertaken in this LHD, the incidence of HAPI decreased from 1.46 to 0.71 per OBD, and HAPI prevalence decreased from 6.7% to 1.9%. The program implemented led not only to a reduction in HAPI incidence by 51.4% and prevalence reduction by 71.6%, but also a reduction in costs by 23.1% (a cost reduction of A$837 387). The present cost–consequence analysis has shown that this program results in both a reduction in resource use and positive patient outcomes, and is likely to be transferable to other healthcare settings.

## Competing interests

None reported.

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**Appendix 1. Details of resources used to implement the program guided by the Promoting Action on Research Implementation in Health Services (PARiHS) framework[36,39]**

All costs are in Australian dollars. Program components were implemented based on Beeckman *et al*.,[38] National Pressure Ulcer Advisory Panel *et al.*[1] and Santamaria *et al.*[56] CNC, clinical nurse consultant; CNE, clinical nurse educator; DON, director of nursing; MASD, moisture-associated skin damage; PI, pressure injury

| Initiative | Initiatives per unit | Frequency/resources/staff involvement | Cost ($) |
|---|---|---|---|
| Local data collected (audits, surveys, interviews) | Surveys (20 min), audits (10 h), interviews (up to 8 h) | Approximately 1200 nursing staff | No difference[B] |
| Products | Prophylactic dressings | Use based on selection criteria for patients at high risk of developing an HAPI | 122 990 |
| | Barrier cream cloths | $6.60 per pack of 8 cloths; $12.50 per pack of 24 cloths | 82 997 |
| | Plastic sheets, washable and disposable sheets and half cotton sheet laundering | $0.18 per unit, $43.00 per roll; laundering $1.01 per unit; $0.18–0.74 per sheet depending on size | 142 861 |
| | Incontinence pads | From $0.16 to $0.87 (range from inserts to large tab pads[A]) | 212 631 |
| Education | | | |
| Development of an education package for nurses on PI prevention and MASD | 36 h | PI lead (20 h), CNC input (6 h) | 1822.50 |
| Presentations by PI Lead at district and hospital meetings and to CNEs | 30 min | 18 presentations | 546.75 |
| Presentations held by clinical leads and CNEs | 30 min | Presentations (monthly for 12 months) | No difference[B] |
| Web-based workforce package on PI prevention, MASD, prophylactic dressings | 20 min | No data on the number of nurses who have viewed this | No difference[B] |
| Nursing orientation presentation held by CNCs | 20 min | 15 presentations | 302.49 |
| A4 information flyers | 1000 information flyers | $0.19 per flyer | 190.00 |
| Training and education by CNEs to ward nurses on the new program[C] | 20 min per subject, 7 subjects on 53 wards | Average 3 times per week, each ward for 2 weeks, every 6 months, CNE (2 years) | ~71 766.24 |
| Feedback and monitoring | By wound champion | Weekly basis | No difference[B] |
| Leadership activities | | | |
| District PI subcommittees (MASD, intensive care, perioperative, and emergency) chaired by CNC | 1 h (×6 committees) | Monthly (12 months estimated in the postintervention phase) | 4374 |
| PI Taskforce chaired by district DON | 1 h | Monthly (12 months estimated in the postintervention phase) | No difference[B] |
| Local meetings on PI prevention | 1 h | Monthly for 2 years | No difference[B] |
| Meetings with clinical leaders (CNCs, NUMs) of each organisation | 0.5–1 h | Monthly for 2 years | No difference[B] |
| Nurse managers | 1–2 h | Monthly | No difference[B] |
| Development of a web-based HAPI incident and error review system | 2–3 h | Weekly | No difference[B] |
| Organisation visits | 2–4 h | Weekly | No difference[B] |
| Weekly planning sheet for communication | 1 h | Weekly | No data |
| State-wide meetings | 8 h | Bimonthly | No difference[B] |

[A]Note, a large tab pad is also known as a disposable diaper.

[B]These components represent a reorganisation of existing resources.

[C]Use of newly purchased products and devices, such as barrier cream cloths, incontinence pads, pressure-relieving chairs, prophylactic dressings, bed cradles, mattresses with preferred supplier, monitoring and review of reported HAPI incidents.

**Appendix 2. Sample characteristics of the preprogram and postprogram groups**

Data are given as the mean ± s.d. or as *n* (%). LOS, length of stay

| Characteristics | Preprogram group (*n* = 428) | Postprogram group (*n* = 331)[A] |
|---|---|---|
| Sex | | |
| Female | 193 (45.1) | 154 (46.5) |
| Male | 235 (54.9) | 177 (53.5) |
| Age (years) | 72.8 ± 18.0 | 77.2 ± 16.0 |
| LOS (days) | 25.8 ± 27.8 | 19.9 ± 18.5 |
| Major diagnostic category diagnosis | | |
| Diseases and disorders of the respiratory system | 78 (18.2) | 44 (13.6) |
| Diseases and disorders of the musculoskeletal system and connective tissue | 78 (18.2) | 62 (19.1) |
| Diseases and disorders of the circulatory system | 59 (13.8) | 43 (13.3) |
| Diseases and disorders of the digestive system | 35 (8.2) | 13 (4.0) |
| Diseases and disorders of the nervous system | 34 (7.9) | 37 (11.4) |
| Infectious and parasitic diseases, systematic or unspecified sites | 30 (7.0) | 13 (4.0) |
| Diseases and disorders of the kidney and urinary tract | 21 (4.9) | 18 (5.6) |
| Diseases and disorders of the hepatobiliary system and pancreas | 15 (3.5) | 9 (2.8) |
| Factors influencing health status and other contacts with health services | 15 (3.5) | 37 (11.4) |
| Neoplastic disorders (haematological and solid neoplasms) | 13 (3.0) | 11 (3.4) |
| Diseases and disorders of the skin, subcutaneous tissue and breast | 12 (2.8) | 12 (3.7) |
| Endocrine, nutritional and metabolic diseases and disorders | 11 (2.6) | 13 (4.0) |
| Pregnancy, childbirth and the puerperium | 5 (1.2) | 2 (0.6) |
| Newborns and other neonates | 5 (1.2) | 1 (0.3) |
| Mental diseases and disorders | 4 (0.9) | 2 (0.6) |
| Diseases and disorders of the female reproductive system | 3 (0.7) | 0 |
| Burns | 3 (0.7) | 3 (0.9) |
| Injuries, poisonings and toxic effects of drugs | 3 (0.7) | 2 (0.6) |
| Diseases and disorders of the blood, blood-forming organs, immunological disorders | 2 (0.5) | 1 (0.3) |
| Alcohol or drug use and alcohol- or drug-induced organised mental disorders | 1 (0.2) | 0 |
| General issues unrelated to principal diagnosis | 1 (0.2) | 0 |
| Diseases and disorders of the male reproductive system | 0 | 1 (0.3) |

[A]Information on diagnosis missing for seven patients (*n* = 324).