Pressure injury in Australian public hospitals: a cost-of-illness study

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Abstract

Objective. Pressure injuries (PI) are largely preventable and can be viewed as an adverse outcome of a healthcare admission, yet they affect millions of people and consume billions of dollars in healthcare spending. The existing literature in Australia presents a patchy picture of the economic burden of PI on society and the health system. The aim of the present study was to provide a more comprehensive and updated picture of PI by state and severity using publicly available data.

Methods. A cost-of-illness analysis was conducted using a prevalence approach and a 1-year time horizon based on data from the existing literature extrapolated using simulation methods to estimate the costs by PI severity and state subgroups.

Results. The treatment cost across all states and severity in 2012–13 was estimated to be A$983 million per annum, representing approximately 1.9% of all public hospital expenditure or 0.6% of the public recurrent health expenditure. The opportunity cost was valued at an additional A$820 million per annum. These estimates were associated with a total number of 121 645 PI cases in 2012–13 and a total number of 524 661 bed days lost.

Conclusions. The costs estimated in the present study highlight the economic waste for the Australian health system associated with a largely avoidable injury. Wastage can also be reduced by preventing moderate injuries (Stage I and II) from developing into severe cases (Stage III and IV), because the severe cases, accounting for 12% of cases, mounted to 30% of the total cost.

What is known about the topic? The literature has identified that in the Australian health care system, wound management is one of the most frequently performed procedures. However, the overall economic cost of PI to the public hospital system is largely unknown.
What does this paper add? This study provides reliable estimates, based predominantly on Australian data, of the number of cases and treatment costs associated with PI in public hospitals, disaggregated by state and severity. The paper also attempts to quantify the opportunity cost of PI, which leads to extra hospital length of stay. The estimated costs give an indication of the economic waste to the health system due to avoidable injury.
What are the implications for practitioners? This study is relevant and important in the context of rising healthcare costs. It highlights an area for potential improvement in quality of care (i.e. better hospital experience for patients) and efficiency (i.e. reducing economic waste) in the hospital sector. It also reveals the paucity of data available to support cost estimation, from the prevalence and incidence rates to the treatment cost by disease severity, which further highlights an under-researched area.

Introduction

Pressure injury (PI) is considered one of the most common causes of iatrogenic harm to patients.[1] It is associated with sustained pain, discomfort and increased immobility and mortality rates in addition to decreased quality of life in both acute and long-term care settings.[2,3] It also carries a substantial financial burden

associated with ongoing care incurred by individuals and families, the healthcare system and society. As a preventable condition, PI prevalence is being measured nationally and internationally as an indicator of quality of nursing care in health facilities, and complainants in litigation can be awarded substantial costs.[4–6] In Australia, The National Safety and Quality Health Service Standards provide health service leaders guidance on areas to target in improvement strategies. Standard 8, Preventing and Managing Pressure Injury, requires health service organisations to implement evidence-based systems to prevent PIs and to manage them when they do occur.[7] Yet, hospital-acquired PI remains an unsolved problem.

The treatment for PIs is known to be costly; however, there is little precise information on prevalence and costs.[8] The prevalence rate, and subsequently estimated number of PI cases, varies significantly from one study to the next. Studies have reported prevalence rate estimates ranging from 2 to 23%[2,9–17] and incidence rates between 1.5 and 38%.[18–22] In Australia, the overall reported PI prevalence between 1983 and 2002 ranged between 3 and 36.7%.[23] The variation is associated with healthcare setting (acute care vs long-term care vs home care), disease specific (e.g. spinal cord injury, cardiovascular etc.) and data collection methods (e.g. hospital surveys, patient-level data).[34] More specifically, state-wide audits estimate PI prevalence in hospitals ranges from 9.5 to 17.6%.[10] Studies in nursing home and long-term care settings estimate the prevalence of PI to be around 8.9%.[25,26]

Similarly, studies investigating the financial burden associated with PIs have presented a wide range of estimates along several dimensions, such as degree of severity (Stage I to IV),[27] additional length of stay (LOS) attributable to PIs and whether PIs occurred in medical or surgical patients.[16,19,22,28] The variation in cost per case is substantial, with estimates ranging between US$500 and US$40 000 in the US[9,29] and from £1214 for Stage I to £14 108 for Stage IV in the UK.[17] Findings suggest that personnel costs, such as nursing and carers' time, contribute a large proportion of the total treatment cost, whereas the use of medical materials, special beds and mattresses only make a minor contribution.[30] For severe cases, complications that lead to delayed healing, additional diagnostic tests and monitoring and extended LOS are a major determinant of cost.[16] Subsequently, there is a wide range of cost estimates associated with PI treatment across countries (from millions to billions of dollars),[2,8,9,16,30,31] representing between 0.4 and 6.6% of a country's health expenditure.

There have been studies on the prevalence and economic losses of PI in Australia. Graves *et al*. estimated the impact of PI on in-patient LOS, as well as the opportunity cost of bed days lost using 2001–02 data.[19,32] Jackson *et al*.[33] reported that PI ranked among the top five hospital-acquired complications (by total additional system cost). Based on data from 2005–06 (Victoria) and 2006–07 (Queensland), Jackson *et al*. reported the total number of PI cases to be 2873, representing a prevalence of 0.2% (much lower than the prevalence estimated in other studies[1,34,35]) and a total cost of A$22.9 million for the public hospitals in these two states.[33] It is noted that this prevalence rate, and thus estimated cost, was likely to be underestimated. Jackson *et al*.[33] derived the estimates from data collected retrospectively using the Diagnosis-Related Group (DRG) system,

whereas the state reports[1,34,35] estimated their prevalence rates from prospective prevalence surveys where PI was recorded through direct skin inspection, which was more likely to be more accurate. Antonio and Conrad[36] presented an evaluation of the Wound Care Improvement program in the Ballarat Health Service (Victoria), in which prevalence data by PI stage were collected for 2009, 2011 and 2012. That study also estimated cost saving attributable to the reduction of PI; however, the sample was small and not representative of Victoria or wider Australia. The most recent study, by Graves and Zheng,[37] estimated the direct healthcare costs of chronic wounds in Australia to be A$1.13 billion (±0.72 billion) for the 2010–11 financial year. None of these studies estimated the costs disaggregated by PI stage.

The states of Victoria, Queensland, Western Australia and South Australia have conducted regular PI audits and introduced hospital-acquired PI as a quality control indicator, rationalising that PI is largely preventable in the hospital setting if appropriate and timely screening, skin assessment and prevention strategies are applied. These efforts have generated some data on PI for Australian public facilities.[1,10,34,35,38–40] Yet, the annual PI cost to the public hospital system and, more broadly, to Australian society, as well as the impact of PI severity on costs, remain largely unknown.

In the present study, we investigate the direct treatment cost related to PI, as well as the indirect opportunity cost of bed days lost due to preventable PIs, by PI severity and Australian states and territories, in the context of public hospitals. We retain our focus on the costs of treatment, and do not estimate the cost of prevention, which has been the focus of cost-effectiveness studies.[41,42]

Methods

A cost-of-illness analysis was conducted using a prevalence approach and a 1-year time horizon, based on data from the existing literature extrapolated using simulation methods. The PI treatment cost was estimated in the public hospital setting, disaggregated by stage (from Stage I to IV)[7] and by state and territory. This cost was a direct health system cost that included nursing time for risk assessment, monitoring and repositioning, skin dressings, moisturiser, antibiotics and analgesics and supporting surfaces. The indirect opportunity costs associated with extended LOS represented the value that should have been produced (in terms of the value of benefits for patients with other illness who could have been treated) if PI were to be completely prevented. This cost was disaggregated by state and territory. The direct and indirect costs were then summed to give an overall estimate of the costs to the Australian public hospital system and society more broadly.

Direct treatment cost

We used existing data from the published and grey literature to estimate: (1) the number of patients with PIs, by stage and state; (2) the average treatment cost for each PI stage; and (3) the total treatment cost, by stage and by state.

Number of patients with PI cases

The estimation of PI cases was based on the number of in-patient cases at risk of PI and the prevalence rate. A wide range

of prevalence rates has been reported in Australia, from as low as 0.2% in the study of Jackson *et al.*[33] to 17.6% in the Western Australia Wound Prevalence Survey.[10] To incorporate uncertainty around the true prevalence, we fitted a beta distribution, which is suitable for parameters bounded by 0 and 1, using the minimum (0.2%) and maximum (17.6%) values reported in the Australian literature.[1,7,32–34,38,39] The number of cases with PI was then calculated as the product of the estimated prevalence rate and the number of in-patient cases (discharges), sourced from Australian hospital statistics 2012–13.[43]

Average treatment cost of each PI stage

We used the average treatment cost per case by stage (from Stage I to IV) estimated in a UK study by Dealey *et al.*[16] Although data derived from Australia would be preferred, to our knowledge these data are not available. Jackson *et al.*[33] only provide the average cost per case, not disaggregated by stage, whereas Graves and Zheng[37] used estimated cost per case from the international literature. The system of PI staging in the UK is comparable to that used in Australia, as defined by the Pan Pacific Clinical Practice Guidelines.[27] In addition, the translation of costs related to use of dressings, medication, equipment and nursing time for the management of PIs is considered to be a reasonable approximation, given the similarities in the Australian and UK public health systems.

The treatment cost in Dealey *et al.*[32] was estimated by the bottom-up costing method using 2011 data. It took into account daily resources for PI treatment, such as nursing time, special mattresses, dressings and medication. The marginal cost of bed day (£300) was included only for PI associated with cellulitis and osteomyelitis. To avoid double counting the bed day cost (which was included in the estimation of opportunity cost PI discussed below), we removed it from the treatment cost per case. All costs in UK 2011 prices were converted to Australian 2012–13 prices using the web tool by Shemilt *et al.*[44] (see Table 1). The stage-specific cost per case was generated from a uniform distribution with the minimum and maximum values specified as ±10% of the average cost per stage.

Total treatment cost

Total treatment cost was calculated as the product of the number of PI cases and the cost per case, and disaggregated by PI stage (using shares of PI cases by severity) and state (using number of discharges). The associated standard deviations were computed from a simulated sample generated by a mixed distribution of beta (the number of PI cases) and uniform (treatment cost per case) distributions.

Indirect opportunity cost

From a societal perspective, the indirect opportunity cost of PI is represented in part as the costs associated with bed days lost due to preventable cases. That is, if PI is completely prevented, there would be more bed days available for treatment of other illness. In the literature, this value is approximated by 'willingness to pay' for those bed days.[32] Other societal costs, such as those related to lost productivity for carers or the intangible cost arising from reduced quality of life, were not included due to a lack of data that would support their valuation.[45]

The calculation of the opportunity cost associated with lost bed days due to PI involved: (1) identifying the number of bed days wasted due to PI (extended LOS); (2) calculating average opportunity cost per bed day; and (3) estimating the total opportunity cost of extended bed days.

Additional bed days

The independent effect of PI on LOS estimated by Graves *et al.*[31] was used in the analysis. The mean (± s.d.) estimate of 4.31 (± 1.26) days for additional LOS was used to specify the gamma distribution parameters (α and β) for the simulation. The disaggregation of LOS by PI stage was based on Dealey *et al.*[16] due to a lack of data from Australian studies. This choice ensures consistency because treatment cost per case by stage was also sourced from the same study.

Average opportunity cost per bed day

In the Australian public hospital context, the opportunity cost (or willingness to pay) for a bed day can be approximated by the average casemix-adjusted cost per bed day. The average cost per overnight discharge for each state of Australia was extracted from the Australian Hospital Statistic collection 2012–13.[43] Overnight discharge cost is used because PI is associated with extended LOS.

Total opportunity cost of extended bed days

The total value of bed days lost due to PIs for each PI stage was then calculated as the product of the number of bed days lost and average cost per bed day. The former was estimated from the number of PI cases and the average extended LOS per case.

Table 1. Treatment cost per case, by pressure injury stage and health state and mean cost per patients
Data were sourced from Dealey *et al.*[16] Costs in A\$ were calculated using the web-based tool developed by Shemilt *et al.*[44] PI, pressure injury

	Normal healing (£)	With critical colonisation (£)	With cellulitis (£)	With osteomyelitis (£)	Mean cost (£) 2011	Mean cost (A\$) 2013
Stage 1 (28 days)	1196.44				1196.44	2746.85
Probabilities	100%					
Stage 2 (92 days)	4314.80	5726.08	6647.92	6846.64	4506.99	10 347.40
Probabilities	90%	5%	2.5%	2.5%		
Stage 3 (127 days)	7209.79	8978.90	9177.02	9451.34	7597.14	17 441.93
Probabilities	80%	10%	5%	5%		
Stage 4 (155 days)	8799.35	10 958.50	11 200.30	11 535.10	9785.77	22 466.71
Probabilities	60%	10%	15%	15%		
Mean cost of PI (weighted average)					3708.12	8513.30

Because the extended LOS was generated from a gamma distribution and the number of PI cases was generated from a beta distribution, the opportunity cost, as the product of extended LOS, PI case and cost per bed days, was generated from a mixed distribution.

The variables and assumptions underlying the estimation process are summarised in Table 2. We obtained point estimates and confidence intervals (CI) for the prevalence rates, LOS and treatment costs using appropriate probability distributions under the Monte Carlo simulation with 10 000 draws. Stata 13 (Stata-Corp, College Station, TX, USA) was used for all estimations.

Results

Our estimates suggest that the prevalent number of cases of PI for Australian public hospitals for 2012–13 was 121 645 (95% CI 100 846–142 444). The resulting treatment cost across all states and PI stages was estimated to be A$983 million (95% CI A$815–1151 million) per annum, representing approximately 1.9% of all public hospital expenditure (A$42 billion in the same period)[46] or 0.6% of the public recurrent health expenditure (A$132 billion).[46]

Tables 3 and 4 give the number of cases and associated treatment costs disaggregated by state and PI stage. As expected, the three largest states of New South Wales, Victoria and Queensland shouldered approximately 75% of the total cases and cost for Australia. The estimates also indicate that the large cost burdens came from Stage II and IV (30% of cost), the former due to its largest share of PI cases and the latter due to its high treatment cost per case.

The total number of bed days lost for Australia was estimated at 524 661 (95% CI 366 067–683 254) per annum and the resulting opportunity cost was valued at A$819 million per annum (95% CI A$572–1067 million). The disaggregation of extra

Table 2.   Key variables for the estimations
MDC, major diagnostic category; PI, pressure injury; LOS, length of stay

	Variable	Assumptions and calculations	Sources	Notes
A	No. in-patient discharges	No. in-patients discharged in public hospital, assuming that overnight discharges do not include patients with PI	Australia Hospital Statistics 2012/13[43]	
B	Overall PI prevalence rate	Range 0.2%–17.6%; beta distribution drawn from the prevalence rate range (sample = 10 000)	Jackson *et al.*[33], Graves *et al.*[32], States of Victoria, Queensland, Western Australia pressure ulcer reports[1,10,34,35,38–40]	One range of prevalence rate applied for all states
C	Prevalence rates for individual PI stages	Prevalence rate for each PI stage = overall prevalence rate × share by each stage; beta distribution drawn from the prevalence rate for each stage	Graves *et al.*[32] for prevalence rate, Victorian, Queensland, Western Australian pressure ulcer reports for stage share[1,10,34,35,38–40]	One range of stage-specific prevalence rate for all states
D	No. PI cases	All stages: A (no. discharges) × B (overall prevalence rate) By stage: A (no. discharge) × C (stage-specific prevalence rate)	Calculation from previous parameters (A, B, C)	
E	Treatment cost per case for each stage	Uniform distribution using ±10% of the average cost (per case) for each stage (A$); costs converted from British pounds (2011) to Australian dollars (2012; see Table 3)	Dealey *et al.*[16], Shemilt *et al.*[44]	Stage-specific treatment cost per case is the same for all states
F	Total cost	D (no. PI cases) × E (treatment cost per case)	Calculation	Total cost for each stage
G	Extended LOS	Mean (u) = 4.31 bed days; standard error (s) = 1.26; gamma distribution with $\alpha = \frac{u^2}{s^2}$ and $\beta = \frac{s^2}{u}$	Graves *et al.*[32]	Average extended LOS (all stages together)
H	Opportunity cost per bed day	Opportunity cost per bed day is the 'value per bed day' that the public hospital system is willing to pay; opportunity cost per bed = average cost per casemix-adjusted separation/average LOS	Grave *et al.*[32]	Opportunity cost per bed day calculated for each state
I	Total opportunity cost due to bed days lost	D (no. PI cases) × G (extended LOS) × H (opportunity cost per bed day)	Calculation from previous parameters (D, G, H)	

Table 3. Number of pressure injury (PI) cases per annum, by state and PI stage (2012–13)

NSW, New South Wales; Vic., Victoria; Qld, Queensland; WA, Western Australia; SA, South Australia; Tas., Tasmania; ACT, Australia Capitol Territory; NT, Northern Territory

State	Stage I		Stage II		Stage III		Stage IV		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
NSW	16 985	1482	19 769	1725	2465	215	2843	248	42 062	3669
Vic.	11 428	997	13 301	1160	1658	145	1913	167	28 300	2469
Qld	9248	807	10 764	939	1342	117	1548	135	22 901	1998
WA	4998	436	5817	507	725	63	837	73	12 376	1080
SA	4052	353	4717	411	588	51	678	59	10 035	875
Tas.	910	79	1059	92	132	12	152	13	2254	197
ACT	778	68	906	79	113	10	130	11	1928	168
NT	722	63	840	73	105	9	121	11	1788	156
Total	49 120	4285	57 173	4987	7128	622	8223	717	121 645	10 612

Table 4. Total cost of pressure injury (PI) treatment per annum by state and PI stage (2012–13)

NSW, New South Wales; Vic., Victoria; Qld, Queensland; WA, Western Australia; SA, South Australia; Tas., Tasmania; ACT, Australia Capitol Territory; NT, Northern Territory

	Total treatment cost (A$ million)									
	Stage I		Stage II		Stage III		Stage IV		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
NSW	44.28	3.86	194.17	16.94	40.81	3.56	60.64	5.29	339.90	29.65
Vic.	29.80	2.60	130.64	11.40	27.46	2.40	40.80	3.56	228.69	19.95
Qld	24.11	2.10	105.72	9.22	22.22	1.94	33.02	2.88	185.06	16.14
WA	13.03	1.14	57.13	4.98	12.01	1.05	17.84	1.56	100.01	8.72
SA	10.57	0.92	46.32	4.04	9.74	0.85	14.47	1.26	81.09	7.07
Tas.	2.37	0.21	10.41	0.91	2.19	0.19	3.25	0.28	18.22	1.59
ACT	2.03	0.18	8.90	0.78	1.87	0.16	2.78	0.24	15.58	1.36
NT	1.88	0.16	8.25	0.72	1.73	0.15	2.58	0.22	14.45	1.26
Total	128.07	11.17	561.55	48.99	118.02	10.30	175.36	15.30	983.00	85.75

bed days and opportunity costs by states are presented in Tables 5 and 6. Again, the greatest numbers of lost bed days and opportunity cost accrued to New South Wales, Victoria and Queensland.

The total economic burden of PI to Australia, estimated by the sum of treatment and opportunity costs, amounted to $1.8 billion per annum, of which 55% was attributable to treatment cost. Because most PI cases were of Stage I and II (which are not generally anticipated to extend LOS), the overall estimated treatment costs were higher than the opportunity costs.

Discussion

The present study provides the most comprehensive estimates of the economic burden of PI in Australia to date, including the treatment cost per case by PI stage, total cost of PI treatment by PI stage and for individual states, and the opportunity cost associated with bed days lost due to PI. We show that the estimated overall economic burden of PI for society is substantial.

Although our findings are generally consistent with the costs associated with PI treatment estimated in the literature, there are a few major differences between our estimates and those from comparable Australian studies. Compared with Graves and Zheng,[37] the number of PI cases per annum was smaller in the present study (121 645 vs 236 295). This was driven by assumptions regarding the distribution of the data and the range of prevalence rates. We used Australian data for the prevalence

rates, whereas Graves and Zheng[37] used the rates derived from the international literature applied to Australian hospital figures for the number of discharges. Compared with state audit reports,[10] our prevalence estimates by state were lower, representing a conservative approach to cost estimation. Our estimate for the average cost per PI case, based on Dealey et al, (A$8513) was lower than that reported in Jackson et al.[16] (A$9297), and higher than that of Graves and Zheng[36] (range $A2371–$A7139). Although Graves and Zheng[36] extracted the average cost per PI case from the international literature, they did not include the estimates from Dealey et al.[16] and Jackson et al.[33] This resulted in lower estimated treatment costs.

The cost estimate presented here is within the range estimated for other countries. Our estimate of total cost for PI treatment was lower than other high-income countries, both as a percentage of public hospital (1.9%) and public recurrent health expenditure (0.6%). Studies have indicated that treatment for PI costs range between 0.4 and 3.2% of the UK national health budget,[8,31] 1.2% for The Netherlands and 5.2% for Spain.[30] Similarly, various US studies indicate that PI accounts for approximately 3.9% of in-patient hospital costs per annum.[9,41]

Our cost estimate is likely to understate the total burden of PI for society because we did not include the treatment cost in long-term and home care settings, or the less tangible costs associated with quality of life lost and the opportunity cost of

Table 5. Total number of extra bed days per annum, by state and pressure injury stage (2012–13)

NSW, New South Wales; Vic., Victoria; Qld, Queensland; WA, Western Australia; SA, South Australia; Tas., Tasmania; ACT, Australia Capitol Territory; NT, Northern Territory

State	Stage I		Stage II		Stage III		Stage IV		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
NSW	27 814	8092	109 316	23 297	18 382	3715	25 903	5117	181 416	27 979
Vic.	18 714	5444	73 550	15 675	12 368	2500	17 428	3443	122 060	18 825
Qld	15 144	4406	59 519	12 685	10 008	2023	14 103	2786	98 775	15 233
WA	8184	2381	32 165	6855	5409	1093	7622	1506	53 380	8232
SA	6636	1930	26 080	5558	4386	886	6180	1221	43 282	6675
Tas.	1491	434	5858	1249	985	199	1388	274	9722	1499
ACT	1275	371	5009	1068	842	170	1187	235	8313	1282
NT	1183	344	4647	990	782	158	1101	218	7713	1189
Total	80 440	23 401	316 146	67 377	53 161	10 744	74 913	14800	524 661	80 915

Table 6. Total annual opportunity cost of pressure injury (PI; A$ million), by state and PI stage (2012–13)

NSW, New South Wales; Vic., Victoria; Qld, Queensland; WA, Western Australia; SA, South Australia; Tas., Tasmania; ACT, Australia Capitol Territory; NT, Northern Territory

States	Stage I		Stage II		Stage III		Stage IV		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
NSW	39.69	11.55	156.00	33.25	26.23	5.30	36.96	7.30	258.88	39.93
Vic.	28.33	8.24	111.35	23.73	18.72	3.78	26.38	5.21	184.78	28.50
Qld	25.63	7.46	100.72	21.47	16.94	3.42	23.87	4.72	167.15	25.78
WA	15.14	4.40	59.48	12.68	10.00	2.02	14.10	2.78	98.72	15.22
SA	9.17	2.67	36.04	7.68	6.06	1.22	8.54	1.69	59.81	9.22
Tas.	2.57	0.75	10.10	2.15	1.70	0.34	2.39	0.47	16.76	2.58
ACT	2.39	0.70	9.41	2.00	1.58	0.32	2.23	0.44	15.61	2.41
NT	2.74	0.80	10.76	2.29	1.81	0.37	2.55	0.50	17.85	2.75
Total	125.65	36.55	493.85	105.25	83.04	16.78	117.02	23.12	819.56	126.40

PI to patients and families. Nonetheless, our results indicate that PIs impose a large economic and importantly avoidable burden to Australia (although, still substantially less than the top diseases by expenditure). It would be possible to have a more comprehensive understanding of the economic burden of this adverse event if better data (e.g. prevalence rates, resources required for PI treatment and quality of life associated with PI) were available in both long-term and home care settings.

Although PI is not a completely avoidable adverse event, some jurisdictions have recently introduced financial penalties to incentivise hospitals to improve quality and avoid hospital-acquired PIs. Well-known examples include the US implementation of the hospital-acquired condition reduction program and the exclusion of certain PI cases considered preventable in the hospital setting from Medicare payment (since early 2008).[47,48] In Australia, Queensland's activity-based funding model for 2012–13 also includes pressure injury Stage III and IV as adverse events for which there is a reduced payment for hospitals.[49] Because the penalty is designed in the form of a reduction in government reimbursement to public hospitals, it does not represent a cost from a health system perspective (although it does represents a cost from an individual hospital perspective). As such, these payments are not included in the current analysis. The extent to which these payments have an impact on improved quality of care and either the prevalence rates or reported cases of PI across different stages will become apparent with appropriate evaluation over the next few years.

The present study has several limitations, most of which relate to data availability. First, the data were derived from several different Australian and UK studies, and we assumed these data are generalisable to the Australian public hospital context. Nevertheless, we incorporated a range of values and distributions to capture the uncertainty. Second, we made various assumptions with regard to the uniformity of prevalence rates, extended LOS and treatment cost per case across different states of Australia. Subsequently, there is some degree of uncertainty involved in our final estimations. The total cost estimates fall well within the range indicated in the international literature.[8,9,30,31,41]

The present study, together with the paucity of data available to support cost estimates, highlights an under-researched area. Further robust data are required to support estimates of the economic burden associated with this prevalent and costly adverse event and, importantly, comparative evaluation of the cost-effectiveness of strategies to prevent PIs. For instance, facilities should develop a systematic collection of PI incidence and prevalence data to inform health managers on strategic planning, resource allocation and to track improvement, especially when hospital-acquired PI is regarded as a quality indicator (Standard 8, Preventing and Managing Pressure Injury, of the National Safety Health Quality Standards is an example[42]). In the present study, the impact of PI on the quality of life of patients, and their families, has been largely unexplored. However, the estimates available for time to heal in the literature, with even a Stage I PI estimated to take on average 28 days to heal,[16] suggest the impact on quality of

life may be expected to be considerable. Finally, data collection for PI in the long-term care setting (home and nursing home), such as prevalence, outpatient visits, medications, social services and informal care, should receive more funding attention. This would enable future research to fully capture the cost of PI outside the public hospital setting, which no doubt represents a substantial additional economic burden for the health system and for society as a whole.

Competing interests

None declared.

Acknowledgement

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