

Cost analysis of an integrated aged care program for residential aged care facilities

Rod Ling^{1,2,13} BCom, PhD, Health Research Economist

Andrew Searles^{1,2} BEc, PhD, Health Research Economist

Jacqueline Hewitt³ RN, MNurs(AdvPrac), Clinical Nurse Consultant

Robyn Considine^{2,4} BA, DipEd, Dip Med Sci, Consultant

Catherine Turner⁵ RN, MIHM, Executive Manager

Susan Thomas⁶ BN, MPH, PhD, Postdoctoral Research Fellow

Kelly Thomas⁷ BPsych, GDipPsych, Injury Management Advisor

Keith Drinkwater⁸ RN, BHA, Primary Care Executive

Isabel Higgins⁹ RN, PhD, Conjoint Professor of Nursing, Older Person Care

Karen Best¹⁰ GCertACM, General Manager, Residential Care Services

Jane Conway¹¹ RN BHSc, BNurs(Hons1), Grad Cert HRM; Med (FET), DEd, Professor of Teaching Learning and Scholarship

Carolyn Hullick¹² BMed, FACEM, Emergency Physician

¹Hunter Medical Research Institute, Lot 1, Kookaburra Circuit, New Lambton Heights, NSW 2305, Australia. Email: andrew.searles@hmri.org.au

²University of Newcastle, School of Medicine and Public Health, University Drive, Callaghan, NSW 2308, Australia.

³Hunter New England Local Health District, Patient Flow Unit, Rankin Park Campus, Lookout Road, New Lambton Heights, NSW 2305, Australia. Email: jacqueline.hewitt@hnehealth.nsw.gov.au

⁴Consan Consulting, PO Box 560, The Junction, NSW 2291, Australia. Email: robyn.considine@newcastle.edu.au

⁵Hunter New England Central Coast Primary Health Network, 159 The Entrance Road, Erina, NSW 2250, Australia. Email: cturner@hneccphn.com.au

⁶Hunter New England Population Health, Locked Bag 10, Wallsend, NSW 2287, Australia. Email: susan.thomas3@hnehealth.nsw.gov.au

⁷Suncorp, GPO Box 1464, Sydney, NSW 2000. Email: kelly_0407@outlook.com

⁸Hunter Primary Care, 123 King Street, Newcastle, NSW 2300, Australia. Email: kdrinkwater@hunterprimarycare.com.au

⁹University of Newcastle, Older Person School of Nursing and Midwifery, University Drive, Callaghan, NSW 2308, Australia. Email: isabel.higgins@newcastle.edu.au

¹⁰Anglican Care Hunter and Central Coast Residential Care Services, 87 Toronto Road, Booragul, NSW 2284, Australia. Email: karenbest@anglicancare.com.au

¹¹School of Rural Medicine, University of New England, Armidale, NSW 2351, Australia. Email: jconway4@une.edu.au

¹²Hunter New England Local Health District, Emergency Medicine and Clinical Governance, Lookout Road, New Lambton Heights, NSW 2305, Australia. Email: carolyn.hullick@hnehealth.nsw.gov.au

¹³Corresponding author. Email: rod.ling@hmri.org.au

Abstract

Objective. To compare annual costs of an intervention for acutely unwell older residents in residential aged care facilities (RACFs) with usual care. The intervention, the Aged Care Emergency (ACE) program, includes telephone clinical support aimed to reduce avoidable emergency department (ED) presentations by RACF residents.

Methods. This costing of the ACE intervention examines the perspective of service providers: RACFs, Hunter Medicare Local, the Ambulance Service of New South Wales, and EDs in the Hunter New England Local Health District. ACE was implemented in 69 RACFs in the Hunter region of NSW, Australia. Analysis used 14 weeks of ACE and ED service data (June–September 2014). The main outcome measure was the net cost and saving from ACE compared with usual care. It is based on the opportunity cost of implementing ACE and the opportunity savings of ED presentations avoided.

Results. Our analysis estimated that 981 avoided ED presentations could be attributed to ACE annually. Compared with usual care, ACE saved an estimated A\$921 214.

Conclusions. The ACE service supported a reduction in avoidable ED presentations and ambulance transfers among RACF residents. It generated a cost saving to health service providers, allowing reallocation of healthcare resources.

What is known about the topic? Residents from RACFs are at risk of further deterioration when admitted to hospital, with high rates of delirium, falls, and medication errors. For this cohort, some conditions can be managed in the RACF without hospital transfer. By addressing avoidable presentations to EDs there is an opportunity to improve ED efficiency as well as providing care that is consistent with the resident's goals of care. RACFs generate some avoidable ED presentations for residents who may be more appropriately treated *in situ*.

What does this paper add? Telephone triaging with nursing support and training is a means by which ED presentations from RACFs can be reduced. One of the consequences of this intervention is 'cost avoided', largely through savings on ambulance costs.

What are the implications for practitioners? Unnecessary transfer from RACFs to ED can be avoided through a multicomponent program that includes telephone support with cost-saving implications for EDs and ambulance services.

Additional keywords: economic evaluation, emergency department, telephone triage, patient transfer.

Received 22 December 2016, accepted 1 December 2017, published online 1 February 2018

Introduction

For older people, a stay in hospital can increase the risk of falls, pressure injuries, infections, delirium and general deconditioning.¹ This risk is higher for residents from residential aged care facilities (RACFs).^{2,3} For RACFs, transferring acutely unwell residents to hospital emergency departments (EDs) is a challenge, as these transfers can result in increased confusion and distress for residents, particularly those with dementia.^{2,4,5} However, there is evidence that unwell residents can be appropriately managed within RACFs with support from external services such as telephone triage.^{6–9} In some cases, these services help resolve health issues in-house, reducing resident transfers to hospital. Another potential benefit of telephone triage services is an opportunity for more efficient use of ambulance and ED resources. We define an avoidable presentation as the transfer of an RACF resident to an ED when they could have been managed *in situ*.

Studies have found that telephone triage can effectively reduce avoidable ED presentations. O'Connell *et al.* examined a Missouri telephone triage service and found a significant decrease in ED use.¹⁰ In an economic evaluation of an UK nurse telephone consultation service, Lattimer *et al.* concluded that the service may reduce hospital emergency admissions over 'the long-term'.⁸ However, such findings are not unanimous. Vedsted *et al.* examined impacts on ED attendance after the introduction of a telephone triage service and found no significant change.¹¹

In 2010, focus groups were held in the NSW Hunter region among representatives from RACFs that referred acutely unwell patients to an ED.⁵ Facilitators for better resident management included: access to telephone clinical support from registered nurses (RNs) with expertise and additional education in aged and

acute care; improved staff training; guidelines for common emergencies; and a health provider partnership fostering positive relationships.⁵ The findings contributed to the design of the Aged Care Emergency (ACE) program, piloted in 2011 with telephone support from RNs in the John Hunter Hospital ED, NSW.^{12,13} Under a partnership between Hunter Medicare Local (Hunter ML) and Hunter New England Local Health District (HNELHD) the pilot was extended in 2012, allowing the telephone clinical support service for RACFs to run 7 days a week, 23 hours a day.¹⁴

The aim of the ACE program is to manage acutely unwell residents at the RACF and, where clinically appropriate, prevent avoidable ED presentations. RN advice during ACE calls usually involves one of three outcomes: management by staff within the RACF; a visit to the RACF by a general practitioner (GP); or transfer of the patient to an ED by ambulance. The ACE program standardises care with evidence-based algorithms as a basis for clinical guidelines (The ACE guidelines).¹⁵ An advanced practice nurse (APN) coordinates the ACE program, providing RACFs with face-to-face training and online reference materials for: clinical handover and transfer of patients; management of deteriorating patients; and the ACE guidelines. Goals of care are defined for ED transfers by the RNs in partnership with patients and their families, clarifying the purposes of ED visits. Regular meetings are convened by the APN to maintain collaborative relationships between RACFs, GPs, EDs, Hunter ML and NSW Ambulance. Patient cases are presented along with discussion of common issues, such as medication management.

By 2014, 69 RACFs located in the Hunter, Taree and Great Lakes regions of NSW, were participating in the ACE program. Combined, these RACFs represented 5922 beds and were associated with six EDs based in public hospitals ranging in type from small rural to tertiary referral.

This paper reports results of a cost analysis that compared the value of resources used by the ACE intervention in 2014 against those estimated to be used under usual care, and a comparison of consequences of the intervention and those expected through usual care. The study was undertaken from the perspective of the ACE's healthcare providers: Hunter ML, HNELHD (covering public hospitals), participating RACFs and the Ambulance NSW. Research was conducted between September 2014 and March 2015. This costing analysis was conducted alongside a qualitative evaluation of the effectiveness of the ACE program which is part of the ongoing appraisal of the ACE program.⁴ Approval for the study was obtained from the HNELHD Human Research Ethics Committee (reference number: 14/06/18/5.10).

Methods

A costing analysis was undertaken from the perspective of healthcare providers to measure the consumed resources (costs) of the ACE intervention.¹⁶ Costs include additional resources required to deliver the intervention and downstream costs saved,¹⁷ such as avoided ED presentations that would have occurred under usual care. Cost analyses can be combined with patient outcomes – such as health-related quality of life – to produce cost–utility analyses, or used in comparisons relevant to multiple perspectives, as in a cost–benefit analysis.¹⁸ As patient level outcome data was not available for this study, only a cost analysis is presented. Patient outcomes have been covered in an ongoing qualitative evaluation of the ACE program, papers on which are referenced below.^{4,12–14,19}

Literature review

A literature review identified pertinent issues. First, ED presentations costs can be based on the utilisation of specific resources per patient stay (e.g. bed cost, nursing, physician time, medications, ancillary services) or, alternatively, standardised costs using metrics.²⁰ This study based costs per ED presentation on an official average ED cost for the state of NSW.²¹ Second, costing ED presentations for RACF patients must include resources for ambulance transport, both as a cost item and for calculating cost avoided.²⁰ Third, a precedent exists for using a time factor to annualise costs captured for only part of a year.⁸ Fourth, although pre- and post-intervention designs are frequently used for examining interventions to reduce ED presentations, this approach may limit measurement of the association between specific interventions and effects, as other factors may be present.²² Hence, other study designs were considered. Fifth, to facilitate comparison, costs should be presented in a common denominator or unit.¹⁶ The ACE costing expresses annualised cost across RACFs as 'per 100 RACF beds', to make results comparable between different sized facilities.

Service data

The available data on ACE calls and ED presentations for RACF residents was obtained from the Hunter ML call centre and the HNELHD electronic patient management systems. Raw data contained separate records for:

- 1) Calls to RNs on behalf of identified RACF residents; and
- 2) ED presentations of identified RACF residents.

The data covered ~14 weeks between June and September 2014 and was based on 920 records. The administrative data included all ED presentations for people over the age of 75 years to Belmont, Calvary Mater, John Hunter, Maitland Manning and Tomaree hospitals. It included presentation times, triage data, disposition diagnoses and duration. This was the only data available. The method of annualisation will be described below and possible biases in the data are addressed in the sensitivity analysis.

Once downloaded, the data was stored in Microsoft Excel (Microsoft, Redmond, WA, USA). Patient names were removed and data sorted by date and patient identification number to recognise:

- 1) Calls to ACE without associated ED presentations within 48 hours;
- 2) Calls to ACE with associated ED presentation within 48 hours;
- 3) ED presentations without associated calls to ACE in the previous 48 hours (i.e. ED presentations where there was no association with ACE).

RACFs were stratified according to their level of ACE implementation. This task was undertaken by the ACE APN who used three descriptive categories: high, medium and low implementation. Implementation categorisation was based on: regularity of calls to ACE; regularity of ED presentations; and regularity of ACE meeting attendance.

Cost data

Where possible, actual costs were included in the evaluation. However, where actual costs were unavailable, estimates were made with reference to published data. Nursing wages were determined by the NSW nurses' and midwives' award;²³ wages for aged care staff were derived from the aged care award;²⁴ telephone costs were based on published costs of the provider, Telstra.^{25,26} The average cost of an ED presentation in NSW was sourced from the Independent Hospitals Pricing Authority website.²¹ Ambulance charges (pick up and per kilometre) were based on emergency journey charges as published by the NSW Ministry of Health.²⁷ For each ED presentation, ambulance travel distances were estimated with data from two websites: Whereis.com and Google Maps (www.maps.google.com). These costs were validated by members of the research team.

From their internal records, Hunter ML staff were able to make annual data available on ACE administration wages, consultants' costs, training attendances by RACFs, venue hire and catering, and the ACE learning materials, guidelines and website. Bed numbers for each RACF were sourced from the DPS Guide for Aged Care (<https://www.agedcareguide.com.au/nursing-homes>).

Most primary cost data was gathered in 2014 Australian dollars, and required no inflation adjustment. However, the Independent Hospitals Pricing Authority²¹ estimate of average ED presentation cost was adjusted to 2014 Australian dollars from 2011–12 Australian dollars with reference to the Health Implicit Price Deflator.²⁸

Costing analysis

A key assumption of our analysis was that all calls to ACE not resulting in an ED presentation within 48 h were avoided ED

presentations with associated avoidance of ED and ambulance costs. As part of the training for ACE, RACF staff were instructed to call the ACE telephone line when a resident was acutely unwell and the staff member believed the resident needed transfer to an ED. Given that a percentage of calls may have been made for less serious events requiring only advice, the level of avoided presentations was varied in the sensitivity analysis. Note that potentially avoidable ED presentations are 'opportunity costs', representing the value of resources that might be allocated to other patients requiring ambulance transfer and ED care (an underlying assumption is that EDs and ambulance always have patient queues).

Total annual expenditures were estimated for:

- 1) ACE service operation (i.e. costs based on observed data); and
- 2) Usual care (i.e. costs based on the observed data plus the costs of ED presentations assumed to be avoided by ACE calls).

Net cost of ACE was calculated by the formula:

$$\text{ACE costs} - \text{usual care costs}$$

The values from the 14 weeks of available service data that pertained to service levels and associated costs were multiplied by 3.7 (52 weeks/14 weeks) to provide annualised values. This data included mainly winter months, where increased rates of hospital presentations may be expected among RACF residents.²⁹ To consider the possible impact of extra ED presentations over winter, we varied point estimates downward in the sensitivity analysis. All ambulance transfers from RACFs to EDs were costed according to distances from the nearest ambulance station to the RACF, to the designated hospital and directly back to the ambulance station. Journeys returning patients to each RACF were costed according to distances from the nearest ambulance station to the hospital, to the designated RACF and directly back to the ambulance station.

Where residents were admitted from ED to hospital, it was assumed that the admissions would have occurred under either ACE or usual care. These equivalent costs appear for both ACE and usual care.

Results

Of the RACF implementation levels, there were 18 (26.1%) RACFs in the high implementation category, 21 (30.4%) in medium and 30 (43.5%) in the low implementation category. Results are expressed as ratios of costs per 100 RACF beds (Table 1).

Table 2 shows estimates of annual calls made to ACE by RACFs. Standardised numbers of total calls per 100 beds decrease by implementation level: from 34.4 calls per 100 beds for high implementers, and 24.1 and 17.9 per 100 beds respectively for medium and low implementers. High implementers had the lowest rate of ED presentations at 29.5 per 100 beds.

Similarly, annual estimated calls without subsequent ED presentations – which we equated to avoided ED presentations – descend by implementation level: 26.9 for high implementers; 17.7 for medium; and 11.6 for low. In total, there were an estimated 981 saved ED presentations, as total calls without ED presentations were 1059; and on the basis of the collected data, we estimated that 78 calls were to report resident deaths and ask

Table 1. Residential aged care facilities (RACFs) by Aged Care Emergency program implementation level and bed numbers

Implementation level	RACFs		Total beds		Average beds
	<i>n</i>	%	<i>n</i>	%	<i>n</i>
High	18	26.1%	1697	28.66%	94.3
Medium	21	30.4%	1801	30.41%	85.8
Low	30	43.5%	2424	40.93%	80.8
Total	69	100.0%	5922	100.00%	85.8

Table 2. Estimated annual calls to Aged Care Emergency (ACE) and emergency (ED) presentations by residential aged care facility (RACF) implementation level

Totals subject to rounding error		<i>n</i>	Per 100 beds <i>n</i>
Calls to ACE			
Not followed by ED presentations ^A			
RACF implementation level			
High		457	26.9
Medium		320	17.7
Low		282	11.6
Total ^A		1059	17.9
Followed by ED Presentations			
RACF implementation level			
High		126	7.4
Medium		115	6.4
Low		152	6.3
Total		394	6.6
Total calls to ACE			
RACF implementation level			
High		583	34.4
Medium		435	24.1
Low		435	17.9
Total		1452	24.5
ED presentations			
Not following ACE Calls			
RACF implementation level			
High		375	22.1
Medium		464	25.8
Low		732	30.2
Total		1571	26.5
Following ACE Calls			
RACF implementation level			
High		126	7.4
Medium		115	6.4
Low		152	6.3
Total		394	6.6
Total ED Presentations			
RACF implementation level			
High		501	29.5
Medium		579	32.2
Low		884	36.5
Total		1965	33.2

^AAssumed to be 'avoided presentation' except for 78 calls made to ACE to report resident deaths.

for advice regarding management of the death. These calls have been accounted for in our costing.

Table 2 shows that ACE service has potential for further utilisation, as across all implementation groups, 80% of ED

presentations were made without prior calls to ACE (1571/1965). However, rates of these presentations declined as implementation increased: low, 30.2; medium, 25.8; and high, 22.1, showing greater use of the ACE service among high implementation RACFs.

Table 3 shows the net costs for ACE, where negative results indicate a cost saving (i.e. ACE costs less than usual care). In terms of total costs, ACE was estimated to incur lower costs than usual care by an annual total amount of A\$921 214. ACE generates additional annual costs for RACFs and Hunter ML of A\$43 067 and A\$347 472 respectively. However, savings are created for ambulance services (A\$918 680) due to reduced transfers and the ED through reduced presentations (A\$393 073). Per 100 RACF beds, savings are A\$15 513 for ambulance and A\$6638 for EDs. The net cost of ED admissions is \$0, as we assumed that all hospital admissions in the data would have occurred with or without ACE.

For ACE versus usual care, the level of savings increased positively with implementation level. Overall saving among high implementers was A\$26 924 per 100 beds, and A\$14 083 and A\$8692 for medium and low implementers (Table 3).

Tables 2 and 3 present data that allow a calculation of the cost of the ACE service per call (RACF costs (A\$43 067) + Hunter Medicare Local Cost (A\$347 472) = (A\$390 539) ÷ total calls (1452)), which is A\$268.

Sensitivity analysis was conducted by estimating savings with lower levels of avoided ED presentations. This is an attempt to adjust for any bias by: a) basing annual estimates on data from winter months; and b) assuming that all calls to ACE avoid an ED presentation. This showed that with a 10% decrease in avoided ED presentations, the ACE program would still save A\$795 383 per year. If the number of ED presentations avoided were 20% below those estimated, then the ACE program would still save A\$669 553 annually.

Discussion

This analysis compared estimated costs of ACE with that of usual care for 1 year. The overall estimated cost avoided due to ACE was A\$921 214. These savings were largely due to reductions in ambulance transfers and ED presentations, making associated resources available for use by other members of the community requiring emergency healthcare. Sensitivity analysis showed

that ACE saves significant resources even when the estimates of avoided ED presentations are reduced. The reported savings increased among RACFs with higher levels of ACE implementation. Cost per call was found to be \$268, which is higher when compared with findings of other studies of telephone triage services.^{8,10,30,31} About 80% of all ED presentations from RACFs were not associated with prior ACE calls (Table 2).

Although this study did not include patient-level outcome data, an ongoing qualitative evaluation of the program has shown that the related consequences of ACE include better relations between RACF staff, EDs and ambulance personnel and an up-skilling of RACF staff.^{14,19} RACF staff reported that the prevention of avoidable ED presentations usually saved residents much discomfort and disorientation, both in EDs and on their return to RACFs.⁵ Through adopting ACE guidelines, RACF staff are more empowered to manage residents who become acutely unwell.⁴ This finding is supported by the present research, which found that RACFs of high implementation transferred the lowest number of residents per 100 RACF beds (Table 2). This is also consistent with a report of a telemedicine intervention that reported that more engaged RACFs had fewer hospitalisations.⁶

The ACE program intervention is not used to its full potential, as ~74% of RACFs associated with the ACE program were not in the high implementation group (Table 1). Although the present study identified savings from ACE, the cost per phone call of A\$268 is relatively high when compared with those found in other studies.^{8,10,30,31} However, as pointed out by Cullen and Wilson, cost-effectiveness is usually achieved in telephone triage services with large scale operations; they found that the average cost per call for six general practice triage services was A\$162,³⁰ whereas the Western Australia Health Call Centre telephone triage service had a per-call cost of A\$23.³² The ACE program receives a relatively small number of calls compared with major triage services for general populations. It also has costs for administrative staff, education materials and regular meetings to support the multiple program elements.

This study has limitations. First, as a cost analysis, results can only be interpreted as measures of resources used and saved by ACE without specific consideration of the outcomes, particularly for patients.¹⁶ The researchers had no patient-level data on safety, comfort and health of patients, as would have been necessary for a cost-effectiveness study. Consideration of these

Table 3. Estimated net annual costs of the Aged Care Emergency (ACE) program by residential aged care facility (RACF) implementation level and cost area

Positive values denote a net cost due to ACE, negative values denote a net saving due to ACE

	High-implementation RACFs		Medium-implementation RACFs		Low-implementation RACFs		Total costs	
	Cost (A\$)	Per 100 beds (A\$)	Costs (A\$)	Per 100 beds (A\$)	Costs (A\$)	Per 100 beds (A\$)	Costs (A\$)	Per 100 beds (A\$)
RACFs	\$16 364	\$964	\$10 984	\$610	\$15 720	\$649	\$43 067	\$727
Hunter Medicare Local	\$103 404	\$6093	\$103 452	\$5744	\$140 616	\$5801	\$347 472	\$5867
Ambulance	-\$398 206	-\$23 465	-\$260 908	-\$14 487	-\$259 566	-\$10 708	-\$918 680	-\$15 513
ED presentations	-\$178 458	-\$10 516	-\$107 161	-\$5950	-\$107 454	-\$4433	-\$393 073	-\$6638
ED admissions	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	-\$456 896	-\$26 924	-\$253 633	-\$14 083	-\$210 684	-\$8692	-\$921 214	-\$15 556

issues for ACE has been given in papers produced by an ongoing qualitative evaluation of ACE.^{4,12,14,19} Second, it was assumed that all ACE telephone calls not resulting in a subsequent ED presentation were avoided ED presentations. It is inevitable that some calls were only for advice. Third, the study assumed that the sample data period of June–September 2014 is representative of the whole of 2014. This period includes mostly winter months when RACF hospitalisations may be higher. Sensitivity analysis used varied estimated numbers of avoided presentations to compensate for possible biases in both these limitations. Fourth, due to lack of data it was not possible to account for extra costs incurred and saved where ambulances must wait with patients outside EDs while beds are prepared.

There are important implications from our findings. First, the ACE intervention makes a significant annual opportunity saving for health system resources, valued at an estimated A\$921 214. The resources associated with these costs, particularly for ambulance and ED, become available for other patients. Second, the ACE program is underutilised, as a majority of ED presentations do not involve ACE phone calls, suggesting room for increased implementation and savings. With these findings, ACE is working with medium and low implementation RACFs to assist them in progressing to the high implementation level. It is further noted that care costs for patients not transferred to hospital due to ACE will defer to primary health services, which are not included in this analysis. GP care is an alternative option to ED attendance and supports continuity of care.

Conclusion

The ACE service is a significant opportunity cost saver, helping to avert avoidable ED presentations. The program can lift implementation levels among client organisations and save further opportunity costs. It will also improve ambulance and ED availability for cases that are more urgent.

Competing interests

The authors declare there are no competing interests.

Acknowledgements

The authors acknowledge the cooperation of the Hunter Valley residential care facilities participating in the ACE program at the time of the study.

References

- Aminzadeh F, Dalziel WB. Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Ann Emerg Med* 2002; 39: 238–47. doi:10.1067/mem.2002.121523
- Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. *Age Ageing* 2010; 39: 306–12. doi:10.1093/ageing/afq008
- Dwyer R, Gabbe B, Stoelwinder JU, Lowthian J. A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities. *Age Ageing* 2014; 43: 759–66. doi:10.1093/ageing/afu117
- Ling R, Searles A, Considine R. Aged care emergency (ACE) service: evaluation study. Newcastle: HunterNew England Central Coast Primary Health Network; 2015.
- Stokoe A, Hullick C, Higgins I, Hewitt J, Armitage D, O’Dea I. Caring for acutely unwell older residents in residential aged care facilities: Perspectives of staff and general practitioners. *Australas J Ageing* 2016; 35: 127–32. doi:10.1111/ajag.12221
- Grabowski DC, O’Malley AJ. Use of telemedicine can reduce hospitalizations of nursing home residents and generate savings for Medicare. *Health Aff* 2014; 33: 244–50. doi:10.1377/hlthaff.2013.0922
- Hagan L, Morin D, Le’pine R. Evaluation of telenursing outcomes: satisfaction, self-care practices, and cost savings. *Public Health Nurs* 2000; 17: 305–13. doi:10.1046/j.1525-1446.2000.00305.x
- Lattimer V, Sassi F, George S, Moore M, Turnbull J, Mullee M, Smith H. Cost analysis of nurse telephone consultation in out of hours primary care: evidence from a randomised controlled trial. *BMJ* 2000; 320: 1053–7. doi:10.1136/bmj.320.7241.1053
- O’Connell B, Hawkins M, Considine J, Au C. Referrals to hospital emergency departments from residential aged care facilities: stuck in a time warp. *Contemp Nurse* 2013; 45: 228–33. doi:10.5172/conu.2013.45.2.228
- O’Connell JM, Johnson DA, Stallmeyer J, Cokingtin D. A satisfaction and return-on-investment study of a nurse triage service. *Am J Manag Care* 2001; 7: 159–69.
- Vedsted P, Christensen MB. The effect of an out-of-hours reform on attendance at casualty wards. The Danish example. *Scand J Prim Health Care* 2001; 19: 95–8. doi:10.1080/028134301750235303
- Conway J, Higgins I, Hullick C, Hewitt J, Dilworth S. Nurse-led ED support for residential aged care facility staff: an evaluation study. *Int Emerg Nurs* 2015; 23: 190–6. doi:10.1016/j.ienj.2014.11.005
- Hullick C, Conway J, Higgins I, Hewitt J, Dilworth S, Holliday E, Attia J. Emergency department transfers and hospital admissions from residential aged care facilities: a controlled pre-post design study. *BMC Geriatr* 2016; 16: 102. doi:10.1186/s12877-016-0279-1
- Conway J, Dilworth S, Hullick C, Hewitt J, Turner C, Higgins I. A multi-organisation aged care emergency service for acute care management of older residents in aged care facilities. *Aust Health Rev* 2015; 39: 514–6. doi:10.1071/AH15049
- Emergency Care Institute NSW. Aged Care Emergency. Sydney: Emergency Care Institute NSW; 2016. Available at: <http://www.ecinsw.com.au/ace> [verified 21 January 2016]
- Drummond M, Sculpher MJ, Torrance GW, O’Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. 3rd ed. Oxford: Oxford University Press; 2005. 379 p.
- McIntosh E, Clarke PM, Frew EJ, Louviere JJ, editors. Applied methods of cost–benefit analysis in health care. Oxford, UK: Oxford University Press; 2010.
- Gray AM, Clarke PM, Wolstenholme JL, Wordsworth S. Applied methods of cost-effectiveness analysis in health care. Oxford UK: Oxford University Press; 2011.
- Conway J, Higgins I. The implementation of a nurse led model of care for older people in the emergency department at John Hunter hospital – evaluation report. Sydney: Australia; 2012.
- Ackermann RJ, Kemle K, Vogel RL, Griffin RC Jr. Emergency department use by nursing home residents. *Ann Emerg Med* 1998; 31: 749–57. doi:10.1016/S0196-0644(98)70235-5
- Independent Hospital Pricing Authority. National hospital cost data collection Australian public hospitals cost report 2011–2012, round 16. Canberra: Independent Hospital Pricing Authority; 2014.
- Fletcher RH, Fletcher SW, Fletcher GS. Clinical epidemiology, the essentials. 5th ed. Baltimore: Wolters Kluwer/Lippincott Williams & Wilkins; 2014.
- Industrial Relations Commission of New South Wales. Public health system nurses’ and midwives’ (State) award 2011. Sydney: NSW Ministry of Health; 2014 Available at: <http://www.health.nsw.gov.au/careers/conditions/Awards/nurses.pdf> [verified 10 December 2014]

- 24 Fair Work Commission. Aged care award 2010. Sydney: Fair Work Commission; 2014 Available at: https://www.fwc.gov.au/documents/documents/modern_awards/pdf/MA000018.pdf [verified 10 December 2014]
- 25 Telstra. Business line plans. Newcastle, Australia: Telstra; 2014. Available at: <http://www.telstra.com.au/small-business/office-phones/business-line-plans/#tab-everyday> [verified 10 December 2014]
- 26 Telstra. Flexible plan to suit your budget. Newcastle, Australia: Telstra; 2014. Available at: <https://www.telstra.com.au/mobile-phones/plans-and-rates> [verified 10 December 2014]
- 27 Ministry of Health NSW. Ambulance service charges. Sydney: Ministry of Health NSW; 2014. Available at: http://www0.health.nsw.gov.au/policies/pd/2014/pdf/PD2014_016.pdf [verified 3 May 2016].
- 28 Australian Institute of Health and Welfare (AIHW). Health expenditure Australia 2012–13. Canberra: AIHW; 2014.
- 29 Dwyer R, Stoelwinder J, Gabbe B, Lowthian J. Unplanned transfer to emergency departments for frail elderly residents of aged care facilities: a review of patient and organizational factors. *J Am Med Dir Assoc* 2015; 16: 551–62. doi:10.1016/j.jamda.2015.03.007
- 30 Cullen M, Wilson A. Health call centres – the financial and healthcare benefits. Sydney: McKesson Asia-Pacific, Medibank Health; 2005.
- 31 Spaulding AB, Radi D, Macleod H, Lynfield R, Larson M, Hyde T, Dehnel P, DeVries AS. Satisfaction and public health cost of a statewide influenza nurse triage line in response to pandemic H1N1 influenza. *PLoS One* 2013; 8: e50492. doi:10.1371/journal.pone.0050492
- 32 Department of Health and Ageing. After hours primary medical care trials: national evaluation report. Canberra: Department of Health and Ageing; 2002.