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The incidence, duration and cost of futile treatment in end-of-life hospital admissions. A retrospective multi-centre cohort study.

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Abstract

Objectives. To estimate the incidence, duration and cost of futile treatment for end-of-life hospital admissions.

Design. Retrospective multi-centre cohort study involving a clinical audit of hospital admissions.

Setting. Three Australian public-sector tertiary hospitals.

Participants. Adult patients who died while admitted to one of the study hospitals over a six-month period in 2012.

Main Outcome Measures. Incidences of futile treatment among end-of-life admissions; length of stay in both ward and intensive care settings for the duration that patients received futile treatments; health system costs associated with futile treatments; monetary valuation of bed days associated with futile treatment.

Results. The incidence rate of futile treatment in end-of-life admissions was 12.1% across the three study hospitals (range 6.0% to 19.3%). For admissions involving futile treatment, the mean length of stay following the onset of futile treatment was 15 days, with 5.25 of these days in the intensive care unit. The cost associated with futile bed days was estimated to be $12.1 million for the three study hospitals using health system costs, and $988,000 when using a decision maker's willingness to pay for bed days. This was extrapolated to an annual national health system cost of $153.1 million and a decision maker's willingness to pay of $12.3 million.

Conclusions. The incidence rate and cost of futile treatment in end-of-life admissions varied between hospitals. The overall impact was substantial in terms of both the bed days and cost incurred. An increased awareness of these economic may help garner support for interventions designed to reduce futile treatments. We did not include emotional hardship or pain and suffering, which represent additional costs.

Strengths & Limitations

- This is the first attempt to estimate the costs associated with futile treatment across a whole of hospital setting.
- Our estimates of the costs associated with futile treatment are highly dependent on the perspective taken.
- We articulated the process for making determinations of futile treatment judgements yet these are inherently value-laden and subjective.
- The retrospective nature of the review process also had the potential to produce bias in clinical judgements.
- Our results only describe futile treatment in end-of-life hospital admissions, rather than a comprehensive estimate of the nature of futile treatment.
- Increased awareness of the extent of futile treatment and its impacts should stimulate action to reduce the problem.

Introduction

Advances in medical technology allow clinicians in acute hospitals to save lives and lengthen the time to death. Some interventions have little chance of conferring a meaningful benefit to the patient[1]. While a value-laden and contested term, such treatments are often referred to as 'futile' [2 3] and more recently as 'potentially inappropriate' [4] or 'non-beneficial' [5]. There is evidence - that for various reasons - doctors provide treatment that they perceive as futile [6-8]. These can prevent patients from experiencing a good death, cause distress to family members and medical staff, and use us scarce resources[9]. Studies limited to paediatric or adult intensive care settings have investigated the relationship between hospital administered futile treatment and resource use [10 11]. Information on the cost of futile treatment that occurs across the broader hospital setting is unavailable. Futile treatments in many cases will be an inappropriate use of scarce health care resources. Information that quantifies the frequency and magnitude of this problem is valuable for decision makers in both the hospital and broader health care setting. It may stimulate interventions designed to reduce its frequency. The aims of this study are to estimate the incidence and duration of futile treatment in end-of-life hospital admissions and to assign a monetary value to the hospital bed days that were used for futile treatments.

Method

A retrospective cohort study was used to identify cases of futile treatment among 907 consecutive adult admissions to three tertiary referral hospitals in Australia. Each admission ended in death and occurred over six months between March and September 2012. This was the maximum number of admissions that data collected be collected from given the finding available. Admissions were sourced from the medical records of the study hospitals. Patients aged under 18 years were excluded, as were patients declared dead on arrival, even if they were placed on life support to facilitate organ donation. We exclude information that would identify the hospitals. Multi-centre ethics approval for

the study was obtained for all the relevant hospitals and universities. Access to patients' medical records was granted by the state health department.

Identifying futile treatment:

The assessment of futile treatment emerged from four consecutive steps, consisting of an initial nurse led medical chart audit followed by three rounds of review by senior medical staff. An overview of this process is shown, Figure 1.

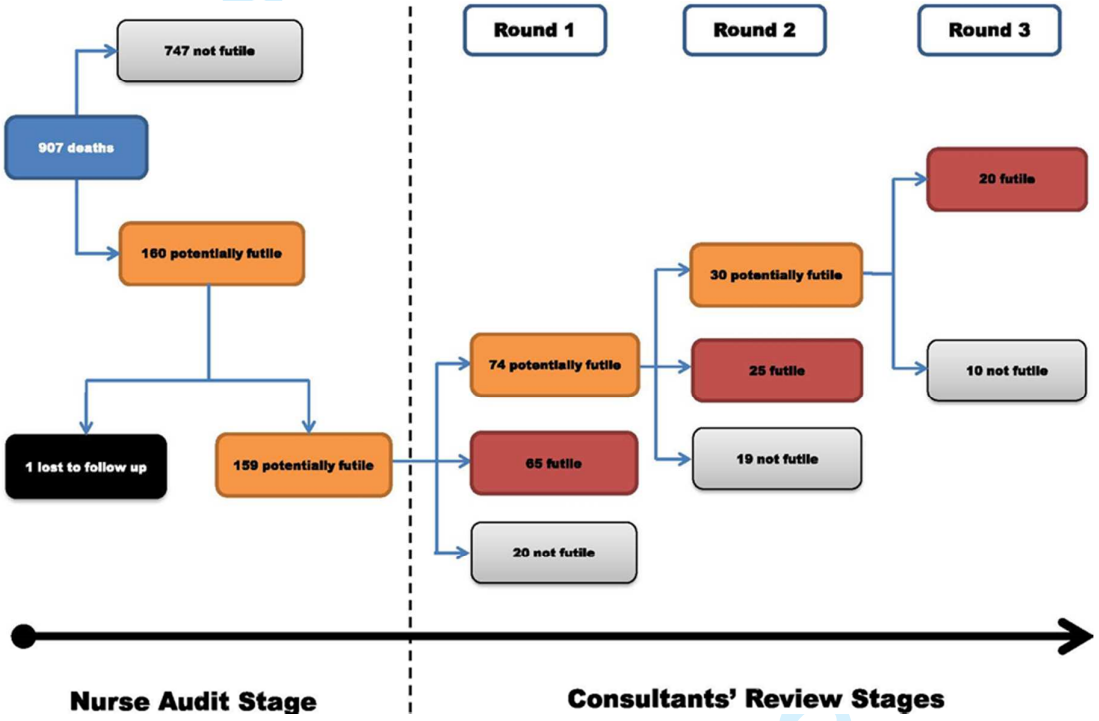

Figure 1: Processes used to judge whether futile treatment occurred during the final admission of 907 patients. Only those admissions judged as 'potentially futile' were carried forward to additional review rounds.

Two registered nurses were trained for the task and reviewed medical charts from all 907 end-of-life admissions at the three hospitals. This nurse audit was guided by the Brisbane Futility Audit Tool, a 47-item instrument developed using the Supportive and Palliative Care Indicators Tool (SPICT™)

criteria [12] and from a review panel of experienced clinicians and researchers in end-of-life care. A copy of the audit tool is included in Appendix 2. Inter-and intra-rater consistency in the application of the tool was ascertained and confirmed after every 200 cases reviewed.

The nurse audit classified each admission as receiving treatment prior to death that was 'potentially futile' or 'not futile'. The nurses judged whether or not they thought futile treatment was provided, based on this definition: *"futile treatment is treatment that does not bring benefit to the patient in terms of: improving the patient's quality of life; significantly prolonging the patient's life of acceptable quality; or involving burden that outweighs benefit."*

This definition was synthesised from semi-structured interviews with doctors from the same three hospitals; further detail regarding this component of the study is reported in a previous publication[1].

The research nurses also rated how confident they were about this judgement on a scale of 0% to 100%. Cases where the nurses were more than 70% confident that no futile treatment was provided were screened out at this point; the remainder were classified as 'potentially futile'.

Three further screening stages were used to classify the remaining 159 'potentially futile' cases. Hospital-based doctors with experience in end-of-life care from the three study hospitals were invited to participate in this process. A total of 55 consultants were involved from a range of specialties including emergency medicine, internal medicine and geriatrics, oncology, cardiology, surgery, palliative care, renal medicine, endocrinology, intensive care, neurology, haematology, respiratory medicine and psychiatry.

Round 1 of review consisted of a detailed case summary of each 'potentially futile'. Each de-identified cased was randomly assigned to five consultants and each consultant reviewed up to 25 admissions using scoresheets containing instructions and the definition of futile treatment as used by the nurse auditors, Appendix 3. Cases were assigned so that no two reviewers had more than ten admissions in common. Consultant reviewers were required to independently classify admissions as involving treatment that was 'futile' or 'not futile'. Only when four out of five or 80% of consultants

agreed was an assessment of futile treatment made. For admissions identified as 'futile', reviewers were asked to indicate the date on which they believed the futile treatment commenced. In many cases, this meant that there were a number of different nominated dates for each admission classified as involving futile treatment. For Round 2 the 74 admissions that had failed to achieve an 80% consensus were randomised to a further five consultants who repeated the procedure described above. A consensus of 60% or above across the first two rounds was required for an assignment of futile treatment in the admission. The 30 remaining Round 2 admissions that failed to achieve a 60% consensus were referred to Round 3. This was a panel of six consultants who discussed each case until a final determination was made.

Incidences, length of stay and cost of futile treatment

The incidence rate of futile treatment within each hospital was calculated as the number of admissions found to have involved futile treatment at the conclusion of the review process, as a proportion of the total number of end-of-life admissions for the six months between March and September 2012.

The lengths of stay after futile treatment commenced was estimated as the number of days in a hospital bed until the date of death in hospital. Due to variation among the start dates specified by the different consultants that reviewed each admission, we assumed that futile treatment began on the mean number of days post-admission for all reported dates. Using the earliest date would lengthen the duration of futile treatment and using the latest date would shorten it. A sensitivity analysis was used to explore the impact of adopting the earliest and latest dates on lengths of stay and cost outcomes. Days spent receiving futile treatment were either in medical wards or the intensive care unit.

A mean cost per bed day was estimated using accounting values, where the annual operating expenditure of Australian public hospitals was divided by the number of annual patient bed days. This figure was then adjusted to reflect the relative cost of bed days occurring in the Ward and ICU,

with the ICU cost based on the estimate derived by Rechner et al [13]. All costs were then inflated to 2016 Australian prices using a national inflation index specific to medical and hospital services [14]. A resulting cost of $2,351 and $6,141 was found for each Ward and ICU bed day, respectively. Cost calculations are summarised in Table 1.

Table 1 Hospital bed day costing items in Australian public hospitals

Item	Estimate	Source	Date
National public hospital expenditure	$44,435,000,000	AIHW[15]	2014
National public hospital patient bed days	18,267,000 days	AIHW [16]	2014
ICU days	392,000 days	AIHW [16]	2014
Ward days	17,875,000 days	AIHW [16]	2014
Average national cost per hospital bed day (Ward and ICU combined)	$2,433	Calculation[a]	2014
Cost per ICU bed day in 2002	$2,670	Rechner 2005 [13]	2002
CPI inflator (medical and hospital services)	2.3%	ABS [14]	2002 - 2016
Cost per ICU bed day in 2016	$6,141	Calculation[b]	2016
Cost per Ward day in 2016	$2,351	Calculation[c]	2016

[a] Total public hospital expenditure divided by the total public hospital bed days
[b] Cost per ICU bed day in 2002 multiplied by the inflation factor
[c] Total public hospital expenditure, less expenditure on ICU days (applying the 2016 ICU bed day cost calculated in (b)), divided by annual public hospital Ward days

The accounting cost of a bed day reflects historical spending by health services. Hospital decision-makers thinking prospectively may not value bed days in this way. Thus, an alternate approach was used, where bed days were valued in terms of a hospital CEO's willingness to pay for them. This method provides an indication of a bed day's value in achieving desired hospital outcomes, often referred to as the economic opportunity cost [17]. The willingness to pay estimates were informed by a 2017 study by Page et al. [18] and $216 was used for a Ward day and $436 for an ICU day. We assumed that while the accounting method represented a societal perspective on the costs of futile treatment, the willingness to pay of hospital CEOs represented the perspective of hospital decision-makers who might choose programmes in the future to reduce futile treatments.

To estimate the expected costs associated with futile treatment on a national level, we extrapolated by assuming the average incidence and length of stay associated with futile treatment among the three study hospitals was representative of other major Australian public hospitals. After excluding children's hospitals, we defined major Australian hospitals as those with an ICU accredited for advanced clinician training by the College of Intensive Care Medicine, and a public hospital classified by the National Health Performance Authority as a "Major Hospital". The full list of hospitals is in Appendix 1.

To allow for the uncertainty in the estimates statistical distributions were fitted to the data. We chose a Beta distribution to represent the incidence of futile treatment across the three hospitals, as this distribution is a good fit to the binomial distribution parameters, is restricted to the interval 0 – 1 and is continuous. Gamma distributions were used for lengths of stay, as they are positive and right-skewed. To generate results that show uncertainty, the distributions were randomly sampled 1,000 times using a simulation method. The parameters for the distributions were derived from the observed data from the three hospitals. Fixed values were applied to the bed day costs assigned to each sample; 95% uncertainty intervals around the means were derived from 1,000 simulations.

There was no patient involvement in this research.

Results

At the end of the review process, 110 of the total 907 end-of-life admissions (12.1%) among the three hospitals were found to have involved futile treatment. The lowest mean incidence rate of futile treatment was at Hospital A (6%) relative to Hospitals B (12.8%) and C (19.6%). The distribution of the incidences of futile treatment across the hospitals after accounting for uncertainty is shown in Figure 2.

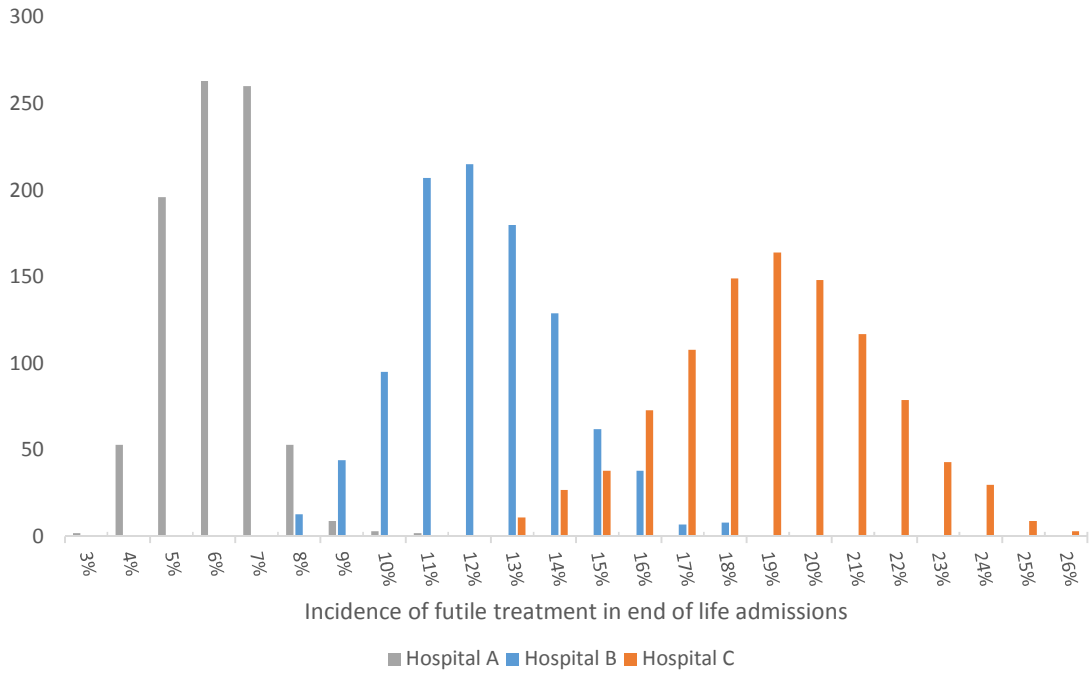

Figure 2 Incidence of futile treatment in end of life admissions for the three hospitals. Beta distributions are used to reflect the uncertainty around the mean incidence of futile treatment. The X axis is the incidence of futile treatment across the distribution. The Y axis is the number of samples from the Beta distribution that produced each incidence rate. A total of 1,000 samples were generated for each hospital.

For admissions involving futile treatment, the mean lengths of stay following the onset of futile treatment across all three hospitals was 15.0 days. This consisted of 9.8 days spent in a Ward and 5.3

days in the ICU. When examining the relative frequency of days spent receiving futile treatment across the distribution (Figure 3), it can be seen that over 50% of admissions where futile treatment was provided were associated with 3 or fewer futile bed days. This reflects the nature of hospital admissions data where a relatively small number of admissions with long lengths of stay create an average length of stay that is higher than most patients [19].

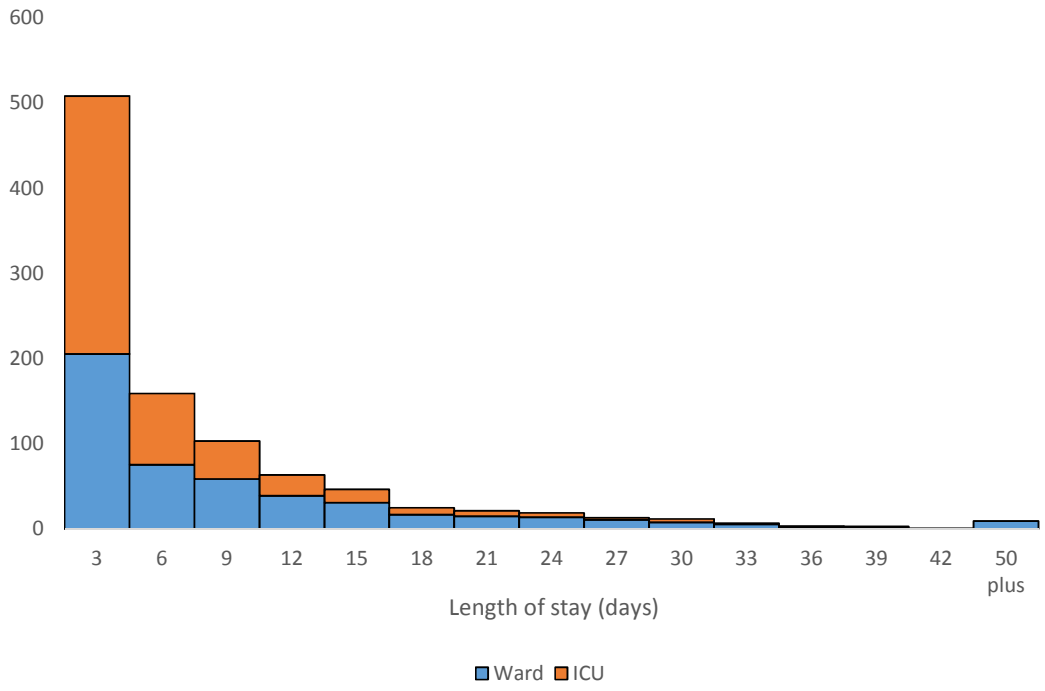

Figure 3 Length of stay while receiving futile treatment across the three study hospitals combined. The Gamma distribution was used to reflect the uncertainty around the mean length of stay. The X axis is the number of days spent receiving futile treatment across the distribution. The Y axis is the number of samples from the Gamma distribution that produced each length of stay. A total of 1,000 samples were generated.

The mean lengths of stay for receiving futile treatment was similar in Hospitals A (12 days) and B (12.7 days), but higher in Hospital C (19.4 days), Figure 4. The number of ICU days as a proportion of the total futile length of stay ranged from 30% in Hospital A to 39% in Hospital C.

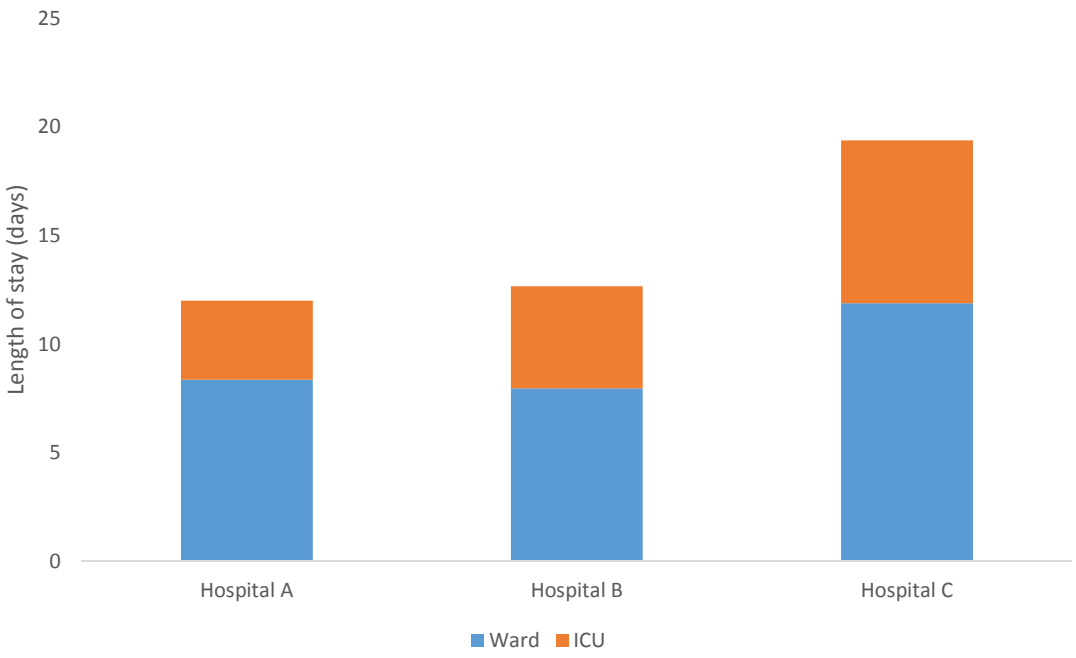

Figure 4 Mean length of stay while receiving futile treatment, by hospital

When results were generalised to a year, a total of 3,313 bed days were associated with futile treatment across the combined study hospitals, with approximately 35% of these occurring in the ICU, Table 2. When accounting costs were attributed to both Ward and ICU days, the estimated total health system cost was $12.4 million across the three hospitals. The estimated willingness to pay by hospital CEOs for the bed days used for futile treatment was $988,000.

Table 2 Total bed days and costs associated with futile treatment over 12 months

Item	Hosp A (n=333)	Hosp B (n=324)	Hosp C (n=250)	All (n = 907)
Annual ward days	328	650	1,141	2,160
95% uncertainty interval	297-359	600-703	1,075-1,029	2,029-2,318
Annual ICU days	143	382	716	1,153
95% uncertainty interval	132-155	358-406	677-758	1,074-1,230
Annual cost to the health system ($ thou)	1,671	3,923	7,008	12,350
95% uncertainty interval	1,577-1,762	3,716-4,126	6,709-7,352	11,759-12,954
Annual hospital Willingness to Pay ($ thou)	135	310	554	988
95% uncertainty interval	128-143	293-327	529-580	942-1037

When extrapolated to reflect the national impact of futile treatment in major tertiary hospitals, an estimated 41,222 bed days per year were attributed to futile treatment. This translated to an annual national health system cost of $153.1 million and a hospital willingness to pay of $12.3 million.

A sensitivity analysis to test the date at which futile treatment was estimated to have begun is shown, Figure 5. The earliest and latest dates recorded by all clinicians to have reviewed each futile case were tested. When the earliest date for futile treatment was applied, a total of 4,586 bed days were attributed to futile treatment (2,997 in the Ward and 1,529 in the ICU), translating to a total cost of $16.4 million and willingness to pay of $1.3 million. This reduced to 2,035 when the latest dates

were applied (1,291 in the Ward and 745 in the ICU) at a cost of $7.6 million and willingness to pay of $604,000.

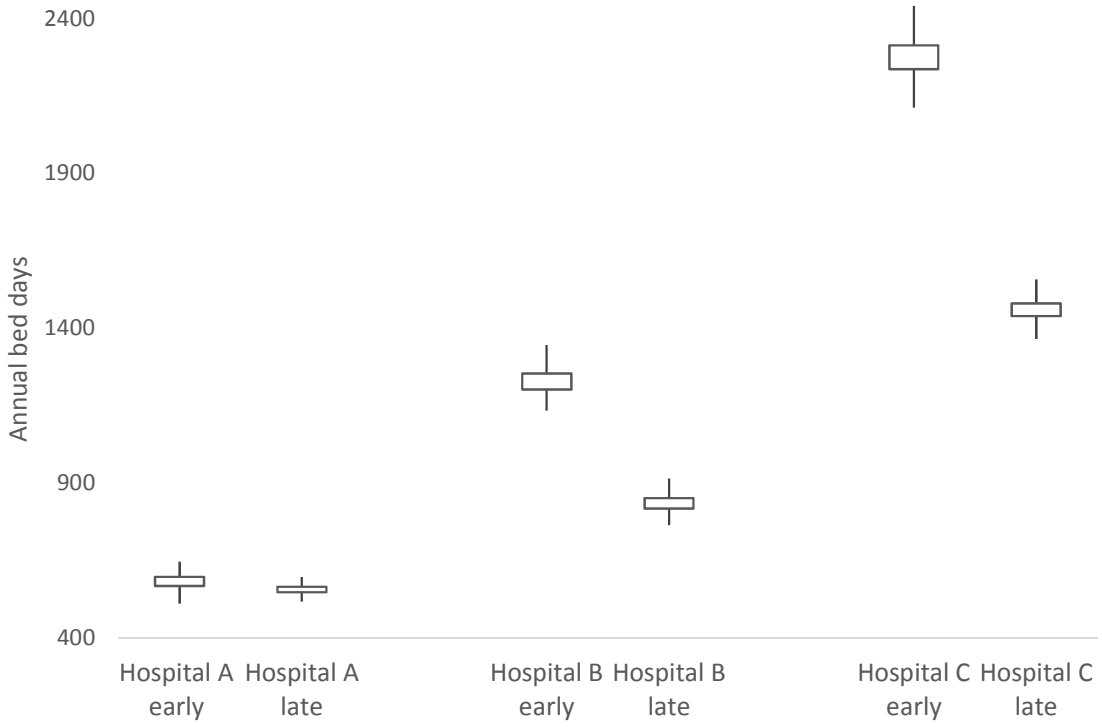

Figure 5: Annual bed days spent receiving futile treatment when applying the earliest and latest dates of futile treatment onset. Boxes depict the 25th and 75th percentile values across the bootstrapped means, vertical lines join the minimum and maximum observations.

Discussion

Estimates of the total number of hospital bed days lost to futile treatment in end-of-life admissions across three major tertiary hospitals are reported, and valued in monetary terms that reflect both the societal and hospital decision maker perspectives. Futile treatment was associated with a total of 3,313 bed days per year, translating to a value of $12.1 million to the health system and $988,000 to hospital decision makers.

This is the first attempt to estimate the costs associated with futile treatment across a whole of hospital setting. We found that both the incidence of futile treatment and the length of stay attributable to futile treatment varied between hospitals. Hospital C was associated with the highest incidence of futile treatment, as well as the longest average length of stay following the onset of futile treatment. Hospital A was found to have both the lowest levels of futile treatment and the shortest associated length of stay. The reasons for these differences are not known. While all three hospitals were similar in their geographic location and accredited training status, there nonetheless may be differences in the admitted patient cohorts and clinician preferences that drive the treatment decisions made. A 2016 study in an earlier phase of this project identified a number of hospital-specific factors that may contribute to the provision of futile treatment, including the degree of specialisation, the availability of routine tests and interventions, and organisational barriers to diverting a patient from a curative to a palliative pathway [20].

Our estimates of the costs associated with futile treatment are highly dependent on the perspective taken. When a societal perspective was adopted, in which the cost per hospital bed day was derived as a hospital's total operating expenses per patient bed day, total costs were more than twelve times higher than what hospital CEOs would be willing to pay to free up that day. This may reflect hospital funding arrangements in Australia, where hospitals receive funding allocations up to a specified level of activity. It also may reflect the 'fixed' nature of many hospital cost items, such as permanent staffing and building overheads, that are fixed regardless of hospital activity. We suggest that the societal perspective provides a more accurate picture of the total costs of futile treatments to the health care system as well as an incentive to drive system-wide change. Nonetheless, a CEO's willingness to pay is likely to be an important consideration in decision making processes regarding changes to hospital-specific policies or practices.

Our research method has limitations. Although we articulated the process for making determinations of futile treatment judgements are inherently value-laden and subjective. Deciding when treatment

becomes futile requires the perspectives of patients and family members as well as multiple clinicians. The retrospective nature of the review process also had the potential to produce bias in clinical judgements. For example, the knowledge that a particular medical intervention was unsuccessful may have influenced an assessment that the intervention was futile, when such an assessment may not have been reasonably apparent in real time. Our focus on hospital admissions ending in death ignored the potential for hospital administered futile treatment to occur in cases where patients were discharged and later died in a hospice, residential care or home setting. In addition, while futile treatment may also occur in a non-hospital setting, this was beyond the scope of the study. As such, our results describe futile treatment in end-of-life hospital admissions, rather than a comprehensive estimate of the nature of futile treatment.

The nature of death has changed dramatically over the past century. Advances in the prevention of disease, as well as ongoing investment with effective health care interventions, have resulted in significantly improved life expectancy and declining mortality rates across the globe. Australians are now much less likely to die young, and far more likely to die in old age of chronic and degenerative disease [21]. Death has become an increasingly medicalised experience. More than half of Australian deaths now occur in hospital, with 32% occurring in residential care and just 14% in the home [22]. These factors, combined with an ageing population, are contributing to ever-increasing levels of health care resource consumption at the end-of-life. A recent Australian study reported that people aged 65 years and over who were in their last year of life used an estimated 10.3% of all public hospital days and accounted for 8.9% of total inpatient costs, with 40% of these costs accumulating in the last month of life [23]. To ensure a sustainable health care system into the future, it is therefore critical that scarce resources are allocated to treatments that deliver the greatest patient benefit.

The findings of this study indicate that the incidence and nature of futile treatment in end-of-life admissions may differ significantly between hospitals. The impact of futile treatment is substantial in terms of both the bed days and costs expended. Yet this treatment, by definition, presents only a very

low chance of achieving meaningful benefit for patients. Increased awareness of the extent of futile treatment and its impacts should stimulate the design and evaluation of interventions to reduce frequency. These should be tested for effectiveness, cost-effectiveness and the challenges around their implementation should be documented.

Contributorship Statement. All authors: made substantial contributions to the conception or design of the work; MAP, LB, GS & SW acquired the data. HC, AB & NG analysed the data. BW, LW, LC, CG & MP interpreted the data. HC drafted the manuscript and all authors critically revised it for intellectual content. All authors gave final approval and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests. No, there are no competing interests

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Data Sharing Statement. The full dataset used, which has no identifying information, is available from the corresponding author.

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Appendix 1. Major Australian hospitals

State	Name	Beds	Annual admissions
WA	Fiona Stanley Hospital	783	85,352
NSW	Bankstown Hospital	454	50,772
NSW	Blacktown Hospital	534	36,240
NSW	Concord Repatriation Hospital	750	57,156
NSW	Gosford Hospital	484	57,500
NSW	Wollongong Hospital	500	52,752
NT	Royal Darwin Hospital	363	39,569
QLD	Cairns Hospital	531	58,827
QLD	Mater Adult Hospital	205	22,531
QLD	Nambour General Hospital	350	51,176
QLD	The Prince Charles Hospital	630	47,860
SA	Lyell McEwin Hospital	336	43,127
SA	Queen Elizabeth Hospital	311	38,075
SA	Women's & Children's Hospital	295	31,650
TAS	Launceston General Hospital	316	34,446
VIC	Box Hill Hospital	621	63,214
VIC	Dandenong Hospital	573	67,240
VIC	Frankston Hospital	454	62,864
VIC	Geelong Hospital	370	73,316
VIC	The Northern Hospital	300	56,533
VIC	Western Hospital	290	31,316
WA	Fremantle Hospital	450	49,053
ACT	Canberra Hospital	600	65,404
NSW	John Hunter Hospital	550	79,372
NSW	Liverpool Hospital	855	84,444
NSW	Nepean Hospital	520	61,616
NSW	Prince of Wales Hospital	440	44,648
NSW	Royal North Shore Hospital	740	69,228
NSW	Royal Prince Alfred Hospital	920	80,968
NSW	St George Hospital	600	64,452
NSW	St Vincent's Hospital	880	48,208
NSW	Westmead Hospital	975	107,192
QLD	Gold Coast University Hospital	750	74,436
QLD	Princess Alexandra Hospital	800	88,370
QLD	Royal Brisbane & Women's Hospital	929	95,579
QLD	Townsville Hospital	580	60,329
SA	Flinders Medical Centre	593	65,108
SA	Royal Adelaide Hospital	680	82,435
TAS	Royal Hobart Hospital	490	53,413
VIC	Alfred Hospital	688	81,882
VIC	Austin Hospital	980	78,402
VIC	Monash Medical Centre	640	82,695
VIC	Royal Melbourne Hospital	700	85,465
VIC	St Vincent's Hospital	848	55,516
WA	Royal Perth Hospital	855	93,201
WA	Sir Charles Gairdner Hospital	607	66,167
TOTAL			2,879,099

Appendix 2. Brisbane Futility Audit Tool

Brisbane Futility Audit Tool_5February15

9. Date and time of death

	DD	MM	YYYY	HH	MM	AM/PM
Date	/	/		:		

10. Medical Unit of Death (specialty not ward)

11. Interregional transfer?

- Yes
- No

If yes, please specify referring hospital

12. Previous admissions over past 3 years

Number:

13. Admitted to ICU in final admission

- Yes
- No

14. Start and end times for ICU admissions during final admission

	DD	MM	YYYY	HH	MM	AM/PM
First Admission Start Date and Time:	/	/		:		
End Date and Time:	/	/		:		
Second Admission Start Date and Time:	/	/		:		
End Date and Time:	/	/		:		

Social Premorbid History

15. Activities of Daily Living

- Independant
- Partially dependant
- Dependant
- Unknown

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Brisbane Futili

Patient demog

1. BFAT ID Cod

2. Age:

Age in years

3. Sex:

- Male
- Female

4. Marital Status

- Single
- Married
- De facto
- Widowed
- Divorced
- Unknown

5. Aboriginal or

- Yes
- No
- Unknown

6. NESB

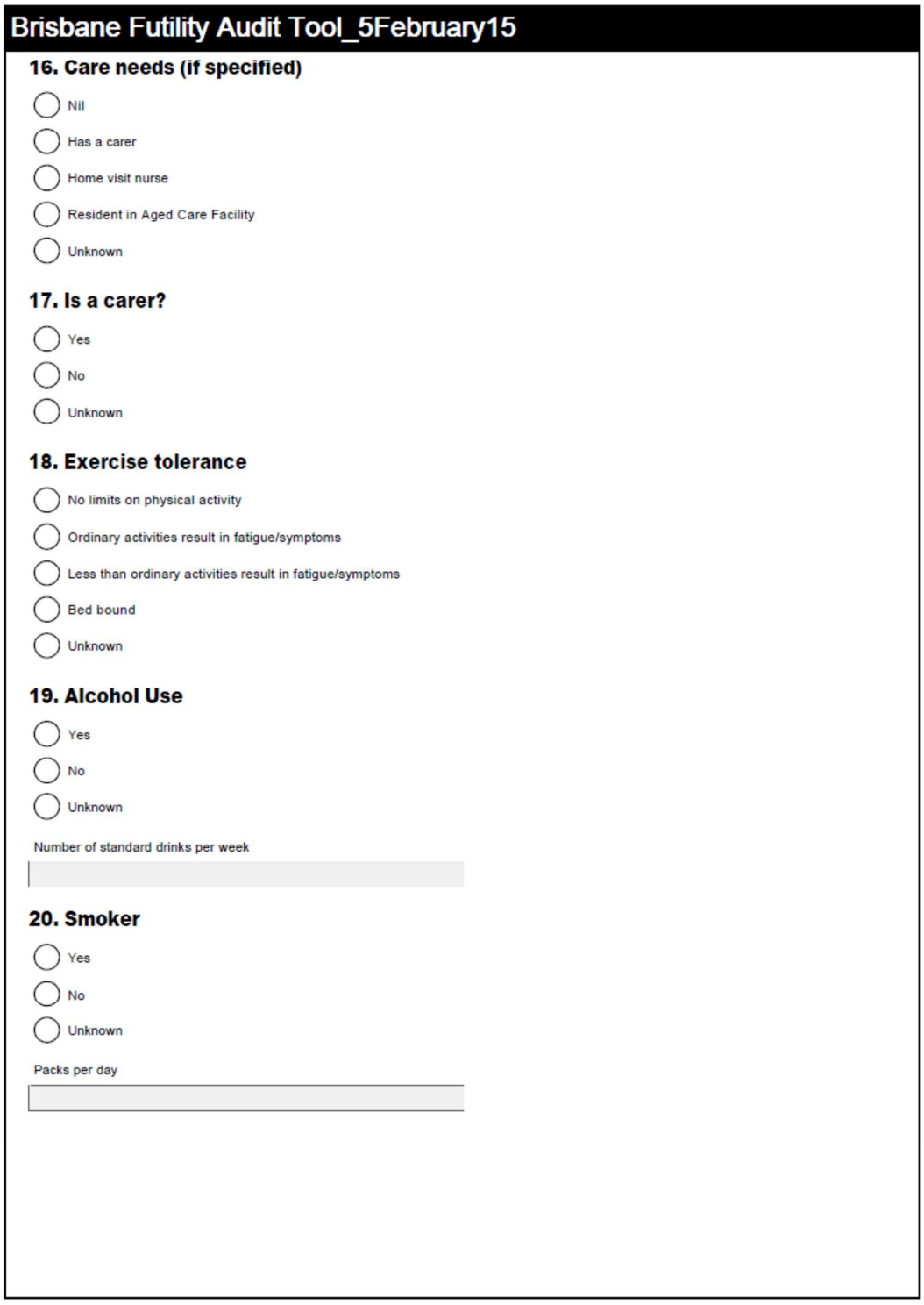
- Yes
- No
- Unknown

7. Date and time

	DD
Date	/

8. Cause of dea

Admissions Hi



Brisbane Futility Audit Tool_5February15

16. Care needs (if specified)

- ◯ Nil
- ◯ Has a carer
- ◯ Home visit nurse
- ◯ Resident in Aged Care Facility
- ◯ Unknown

17. Is a carer?

- ◯ Yes
- ◯ No
- ◯ Unknown

18. Exercise tolerance

- ◯ No limits on physical activity
- ◯ Ordinary activities result in fatigue/symptoms
- ◯ Less than ordinary activities result in fatigue/symptoms
- ◯ Bed bound
- ◯ Unknown

19. Alcohol Use

- ◯ Yes
- ◯ No
- ◯ Unknown

Number of standard drinks per week

20. Smoker

- ◯ Yes
- ◯ No
- ◯ Unknown

Packs per day

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21. Other drug use

- ◯ Yes
- ◯ No
- ◯ Unknown

Give details here

22. Evidence of Advance Care Planning prior to admission

- ◯ Yes
- ◯ No

23. If yes, tick the boxes below

- ☐ Palliative Care Review
- ☐ Refusal of treatment
- ☐ AHD
- ☐ EPA
- ☐ NFR
- ☐ ARP
- ☐ Notes in chart regarding wishes (give details on Summary page)

24. Family, partner and personal support group

- ☐ Spouse or partner
- ☐ Sibling/s
- ☐ Adult children
- ☐ Parent
- ☐ Attorney or Guardian appointed
- ☐ Other (e.g friend, neighbour, nephew, niece)
- ☐ None

25. Conflict in medical team?

- ◯ Yes
- ◯ No

26. Family conflict

- ◯ Yes
- ◯ No

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27. Briefly note the nature of the conflict here

28. Other external review

- [ ] Hospital lawyer
- [ ] Hospital administrator
- [ ] Ethics committee

Brisbane Futility Audit Tool_5February15

33. Documented burden of treatments delivered in the last 2 weeks

34. Use of evidence based protocols in the last 2 weeks

35. Resuscitation Status for final admission

Patient requests:

- [ ] Defibrillation
- [ ] Invasive ventilation
- [ ] Active treatment

36. Outcome of resuscitation at or during admission

- ◯ Improvement
- ◯ No change
- ◯ Deterioration

Other (please specify)

37. Suitable for organ donation

- ◯ Yes
- ◯ No

38. Decision to donate

- ◯ Yes
- ◯ No

Review all sections

39. Date patient or family request withdrawal or limitation of therapy

Date / Time DD / MM / YYYY

40. Date that medical team suggest withdrawal or limitation of therapy

Date / Time DD / MM / YYYY

41. If treatment continues after these dates, record reason here

Brisbane Futility Audit Tool_5February15

42. Was there a documented decision not to treat or to withdraw treatment during this admission?

- ◯ Yes
- ◯ No

43. On what date was treatment withdrawn?

Date / Time DD / MM / YYYY

44. Was there futile treatment for this patient? Use this definition as a guide and tick elements that appear to be relevant for this case.
Futile treatment is treatment that does not bring benefit to the patient, in terms of:

- ☐ Improving the patient's quality of life
- ☐ Significantly prolonging the patient's life of acceptable quality
- ☐ Involving burden that outweighs benefit

45. Was there futile treatment for this patient?

- ◯ YES
- ◯ NO

46. How confident are you in your answer?

◯ 0-10% ◯ 11-20% ◯ 21-30% ◯ 31-40% ◯ 41-50% ◯ 51-60% ◯ 61-70% ◯ 71-80% ◯ 81-90% ◯ 91-100%

47. If YES, on what date did care become futile?
Please do not skip this question, your best response is very important

Date care became futile: DD / MM / YYYY

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Appendix 3. Consensus Score Sheet and instruction

Definition of futile treatment for this audit:

Treatment that brings only a very low chance of meaningful benefit to the patient, in terms of:

- improving the patient's quality of life;
- sufficiently prolonging the patient's life of acceptable quality and/or
- bringing benefits that outweigh burdens of treatment

Did this patient receive futile treatment? (Tick)

☐ YES
☐ NO

If YES, when do you think treatment became futile?

...../...../ 2012

If futile, please tick below to indicate if any of the following factors contributed to the futile treatment being provided (tick as many as apply):

Reason	Tick
Prognostic uncertainty	
Futile transfer	
Doctors kept offering treatment	
Patient's overall state of ill-health not taken into account	
No clear overall treatment goal/plan for this patient	
Patient or family requested continuation of active treatment	
Conflict within family	
Difference of opinion between teams/clinicians	
Communication issues (please specify below):	
Other reason/s (please print):	

Any other comments about the review procedure or process:

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5 to 9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5 to 9*
Bias	9	Describe any efforts to address potential sources of bias	5 to 9
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4 to 9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	4 to 9
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	n/a
		(*d*) If applicable, explain how loss to follow-up was addressed	n/a
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Figure 1
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	No data available
		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
		(c) Summarise follow-up time (eg, average and total amount)	4

Outcome data	15*	Report numbers of outcome events or summary measures over time	4 to 9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	n/a
		(*b*) Report category boundaries when continuous variables were categorized	Table 2
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7
Discussion			
Key results	18	Summarise key results with reference to study objectives	10 to 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15 to 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14 to 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15 to 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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The incidence, duration and cost of futile treatment in end-of-life hospital admissions to three Australian public-sector tertiary hospitals. A retrospective multi-centre cohort study.

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Keywords:	GENERAL MEDICINE (see Internal Medicine), Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Adult intensive & critical care < INTENSIVE & CRITICAL CARE, MEDICAL ETHICS, MEDICAL LAW

The incidence, duration and cost of futile treatment in end-of-life hospital admissions to three Australian public-sector tertiary hospitals. A retrospective multi-centre cohort study.

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Abstract

Objectives. To estimate the incidence, duration and cost of futile treatment for end-of-life hospital admissions.

Design. Retrospective multi-centre cohort study involving a clinical audit of hospital admissions.

Setting. Three Australian public-sector tertiary hospitals.

Participants. Adult patients who died while admitted to one of the study hospitals over a six-month period in 2012.

Main Outcome Measures. Incidences of futile treatment among end-of-life admissions; length of stay in both ward and intensive care settings for the duration that patients received futile treatments; health system costs associated with futile treatments; monetary valuation of bed days associated with futile treatment.

Results. The incidence rate of futile treatment in end-of-life admissions was 12.1% across the three study hospitals (range 6.0% to 19.3%). For admissions involving futile treatment, the mean length of stay following the onset of futile treatment was 15 days, with 5.25 of these days in the intensive care unit. The cost associated with futile bed days was estimated to be $12.1 million for the three study hospitals using health system costs, and $988,000 when using a decision maker's willingness to pay for bed days. This was extrapolated to an annual national health system cost of $153.1 million and a decision maker's willingness to pay of $12.3 million.

Conclusions. The incidence rate and cost of futile treatment in end-of-life admissions varied between hospitals. The overall impact was substantial in terms of both the bed days and cost incurred. An increased awareness of these economic costs may generate support for interventions designed to reduce futile treatments. We did not include emotional hardship or pain and suffering, which represent additional costs.

Strengths & Limitations

- This is the first attempt to estimate the costs associated with futile treatment across a whole of hospital setting.
- Our estimates of the costs associated with futile treatment are highly dependent on the perspective taken.
- We articulated the process for making determinations of futile treatment judgements yet these are inherently value-laden and subjective.
- The retrospective nature of the review process also had the potential to produce bias in clinical judgements.
- Our results only describe futile treatment in end-of-life hospital admissions, rather than a comprehensive estimate of the nature of futile treatment.
- The costs reported are likely to be an upper bound as we have no knowledge of the costs of other treatments that would have happened has futile treatment not occurred.
- Increased awareness of the extent of futile treatment and its impacts should stimulate action to reduce the problem.

Introduction

Advances in medical technology allow clinicians in acute hospitals to save lives and lengthen the time to death. Some interventions have little chance of conferring a meaningful benefit to the patient[1]. While a value-laden and contested term, such treatments are often referred to as 'futile' [2 3] and more recently as 'potentially inappropriate' [4] or 'non-beneficial' [5]. There is evidence, that for various reasons, doctors provide treatments they perceive as futile [6-8]. These can prevent patients from experiencing a good death, cause distress to family members and medical staff and use up scarce resources[9]. Studies limited to paediatric or adult intensive care settings have investigated the relationship between hospital administered futile treatment and resource use [10 11]. Information on the cost of futile treatment that occurs across the broader hospital setting for patients at the end of life is unavailable. Futile treatments in many cases will be an inappropriate use of scarce health care resources and so data about the frequency and magnitude of this problem is valuable for decision makers in both the hospital and broader health care setting. It may stimulate interventions designed to reduce its frequency. The aims of this study are to estimate the incidence and duration of futile treatment in end-of-life hospital admissions and to assign a monetary value to the hospital bed days that were used.

Method

A retrospective cohort study was used to identify cases of futile treatment among 907 consecutive adult admissions to three tertiary referral hospitals in Australia. Every eligible admission that ended in death and occurred during the six months between March and September 2012 was included. At one hospital there was one month where no charts were available for review. No sample size calculation was undertaken, rather we judged this time frame sufficient to access enough information to meet the aims of the analysis.

Admissions were sourced from the medical records of the study hospitals. Patients aged under 18 years were excluded, as were patients declared dead on arrival, even if they were placed on life support to facilitate

organ donation. We excluded information that would identify the hospitals. Multi-centre ethics approval for the study was obtained for all the relevant hospitals and universities. Access to patients' medical records was granted by the state health department.

Identifying futile treatment:

The assessment of futile treatment emerged from four consecutive steps, consisting of an initial nurse-led medical chart audit followed by three rounds of review by senior medical staff. An overview of this process is shown in Figure 1.

Figure 1 here

Two registered nurses were trained for the task and reviewed medical charts from all 907 end-of-life admissions at the three hospitals. This nurse audit was guided by the Brisbane Futility Audit Tool, a 47-item instrument developed using the Supportive and Palliative Care Indicators Tool (SPICT™) criteria[12] and from a review panel of experienced clinicians and researchers in end-of-life care. A copy of the audit tool is included in Appendix 1. Inter- and intra-rater consistency in the application of the tool was ascertained and confirmed after every 200 cases reviewed.

The nurse audit classified each admission as receiving treatment prior to death that was 'potentially futile' or 'not futile'. The nurses' judgements were based on this definition:

"Futile treatment is treatment that does not bring benefit to the patient in terms of: improving the patient's quality of life; significantly prolonging the patient's life of acceptable quality; or involving burden that outweighs benefit."

This definition was synthesised from semi-structured interviews with doctors from the three study hospitals and further detail regarding this component of the study is reported in a previous publication[1]. The research nurses also rated how confident they were about this judgement on a scale of 0% to 100%. Cases where the nurses were more than 70% confident that no futile treatment was provided were screened out at this point; the remainder were classified as 'potentially futile'.

The remaining 159 'potentially futile' cases were classified by consensus. Hospital-based doctors with experience in end-of-life care from the three study hospitals were invited to participate in this process. A total of 55 consultants were involved from a range of specialties including emergency medicine, internal medicine, geriatric medicine, oncology, cardiology, surgery, palliative care, renal medicine, endocrinology, intensive care, neurology, haematology, respiratory medicine and psychiatry.

Round 1 of the consensus process involved reviewing a detailed summary of each 'potentially futile' case. Each case summary was de-identified and given a code number, then conditionally randomised to exclude cases from each consultant's own hospital. Each case was then assigned to five eligible consultants. Cases were assigned so that no two reviewers had more than ten cases in common. Each consultant reviewed up to 25 cases using scoresheets containing instructions and the definition of futile treatment used by the nurse auditors; this is shown in Appendix 2. Consultant reviewers were required to independently classify cases as involving treatment that was 'futile' or 'not futile', and when four out of five (80%) consultants agreed on the judgment regarding futility, it was deemed as resolved. For cases identified as 'futile', reviewers were asked to indicate the date that they believed the futile treatment commenced. This yielded several different nominated dates in many cases. For Round 2, the 74 cases that had failed to achieve an 80% consensus were randomly assigned to a further five consultants repeating the procedure described above. A combined minimum consensus of 60% per case across the first two rounds was required to finalise a judgment on treatment futility. The 30 remaining cases that failed to achieve 60% consensus were referred to Round 3.

This comprised three face-to-face panels of approximately 5 consultants who discussed each case until a final determination was made.

Incidences, length of stay and cost of futile treatment

The incidence rate of futile treatment within each hospital was calculated as the number of admissions involving futile treatment as determined by the review process, as a proportion of the total number of end-of-life admissions for the six months between March and September 2012.

The length of stay after futile treatment commenced was estimated as the number of days in a hospital bed until the date of death in hospital. Due to variation among the start dates specified by the different consultants that reviewed each admission, we assumed that futile treatment began on the mean number of days post-admission for all reported dates. Using the earliest date would lengthen the duration of futile treatment and using the latest date would shorten it. A sensitivity analysis was used to explore the impact of adopting the earliest and latest dates on lengths of stay and cost outcomes. Days spent receiving futile treatment were either in medical wards or the intensive care unit.

A mean cost per bed day was estimated using accounting values, where the annual operating expenditure of Australian public hospitals was divided by the number of annual patient bed days. This figure was then adjusted to reflect the relative cost of bed days occurring in the ward and ICU, with the ICU cost based on the estimate derived by Rechner et al [13]. All costs were then inflated to 2016 Australian prices using a national inflation index specific to medical and hospital services [14]. A resulting cost of $2,351 and $6,141 was found for each ward and ICU bed day, respectively. Cost calculations are summarised in Table 1.

Table 1 Hospital bed day costing items in Australian public hospitals

Item	Estimate	Source	Date
National public hospital expenditure	$44,435,000,000	AIHW[15]	2014
National public hospital patient bed days	18,267,000 days	AIHW [16]	2014
ICU days	392,000 days	AIHW [16]	2014
Ward days	17,875,000 days	AIHW [16]	2014
Average national cost per hospital bed day (ward and ICU combined)	$2,433	Calculation[a]	2014
Cost per ICU bed day in 2002	$2,670	Rechner 2005 [13]	2002
CPI inflator (medical and hospital services)	2.3%	ABS [14]	2002-2016
Cost per ICU bed day in 2016	$6,141	Calculation[b]	2016
Cost per ward day in 2016	$2,351	Calculation[c]	2016

[a] Total public hospital expenditure divided by the total public hospital bed days

[b] Cost per ICU bed day in 2002 multiplied by the inflation factor

[c] Total public hospital expenditure, less expenditure on ICU days (applying the 2016 ICU bed day cost calculated in (b)), divided by annual public hospital ward days

The accounting cost of a bed day reflects historical spending by health services. Hospital decision-makers thinking prospectively may not value bed days in this way. Thus an alternate approach was used, where bed days were valued in terms of a hospital CEO's willingness to pay for them. This method provides an indication of a bed day's value in achieving desired hospital outcomes, often referred to as the economic opportunity cost [17]. The willingness to pay estimates were informed by a 2017 study by Page et al. [18] and $216 was used for a ward day and $436 for an ICU day. We assumed that while the accounting method represented a societal perspective on the costs of futile treatment, the willingness to pay of hospital CEOs represented the perspective of hospital decision-makers who might choose programmes in the future to reduce futile treatments.

To estimate the expected costs associated with futile treatment on a national level, we extrapolated by assuming the average incidence and length of stay associated with futile treatment among the three study hospitals was representative of other major Australian public hospitals. After excluding children's hospitals, we defined major Australian hospitals as those with an ICU accredited for advanced clinician training by the College of Intensive Care Medicine, and a public hospital classified by the National Health Performance Authority as a "Major Hospital". The full list of hospitals is in Appendix 3.

To allow for the uncertainty in the estimates statistical distributions were fitted to the data. We chose a Beta distribution to represent the incidence of futile treatment across the three hospitals, as this distribution is a good fit to the binomial distribution parameters, is restricted to the interval 0 – 1 and is continuous. Gamma distributions were used for lengths of stay, as they are positive and right-skewed. To generate results that show uncertainty, the distributions were randomly sampled 1,000 times using simulation. The parameters for the distributions were derived from the observed data from the three hospitals. Fixed values were applied to the bed day costs assigned to each sample; 95% uncertainty intervals around the means were derived from 1,000 simulations. There was no patient involvement in this research.

Results

At the end of the review process, 110 of the total 907 end-of-life admissions (12.1%) among the three hospitals involved futile treatment. The lowest mean incidence rate of futile treatment was at Hospital A (6%) relative to Hospitals B (12.8%) and C (19.6%). The distribution of the incidences of futile treatment across the hospitals after accounting for uncertainty is shown in Figure 2.

Figure 2 here

Beta distributions are used to reflect the uncertainty around the mean incidence of futile treatment. The X axis is the incidence of futile treatment across the distribution. The Y axis is the number of samples from the Beta distribution that produced each incidence rate. A total of 1,000 samples were generated for each hospital.

For admissions involving futile treatment, the mean length of stay following the onset of futile treatment across all three hospitals was 15.1 days. This consisted of 9.8 days spent in a ward and 5.3 days in the ICU. When examining the relative frequency of days spent receiving futile treatment across the distribution (Figure 3), over 50% of admissions containing futile treatment were associated with 3 or fewer futile bed days. This reflects the nature of hospital admissions data where a relatively small number of admissions with long lengths of stay create an average length of stay that is higher than most patients [19].

Figure 3 here

The Gamma distribution was used to reflect the uncertainty around the mean length of stay. The X axis is the number of days spent receiving futile treatment across the distribution. The Y axis is the number of samples from the Gamma distribution that produced each length of stay. A total of 1,000 samples were generated.

The mean lengths of stay for receiving futile treatment were similar in Hospitals A (12 days) and B (12.7 days), but higher in Hospital C (19.4 days), Figure 4. The number of ICU days as a proportion of the total futile length of stay ranged from 30% in Hospital A to 39% in Hospital C.

Figure 4 here

When results were generalised to a year, a total of 3,313 bed days were associated with futile treatment across the combined study hospitals, with approximately 35% of these occurring in the ICU, Table 2. When accounting costs were attributed to both ward and ICU days, the estimated total health system cost was $12.4 million across the three hospitals. The estimated willingness to pay by hospital CEOs for the bed days used for futile treatment was $988,000.

Table 2 Total bed days and costs associated with futile treatment over 12 months

Item	Hosp A (n=333)	Hosp B (n=324)	Hosp C (n=250)	All (n = 907)
Annual ward days	328	650	1,141	2,160
95% uncertainty interval	297-359	600-703	1,075-1,029	2,029-2,318
Annual ICU days	143	382	716	1,153
95% uncertainty interval	132-155	358-406	677-758	1,074-1,230
Annual cost to the health system ($ thou)	1,671	3,923	7,008	12,350
95% uncertainty interval	1,577-1,762	3,716-4,126	6,709-7,352	11,759-12,954
Annual hospital Willingness to Pay ($ thou)	135	310	554	988
95% uncertainty interval	128-143	293-327	529-580	942-1037

When extrapolated to reflect the national impact of futile treatment in major tertiary hospitals, an estimated 41,222 bed days per year were attributed to futile treatment. This translated to an annual national health system cost of $153.1 million and a hospital willingness to pay of $12.3 million.

A sensitivity analysis to test the date at which futile treatment was estimated to have begun is shown, Figure 5. The earliest and latest dates recorded by all clinicians to have reviewed each futile case were tested. When the earliest date for futile treatment was applied, a total of 4,586 bed days were attributed to futile treatment (2,997 in the ward and 1,529 in the ICU), translating to a total cost of $16.4 million and willingness to pay of $1.3 million. This reduced to 2,035 when the latest dates were applied (1,291 in the Ward and 745 in the ICU) at a cost of $7.6 million and willingness to pay of $604,000.

Figure 5 here

Boxes depict the 25th and 75th percentile values across the bootstrapped means, vertical lines join the minimum and maximum observations.

Discussion

Estimates of the total number of hospital bed days lost to futile treatment in end-of-life admissions across three major tertiary hospitals are reported, and valued in monetary terms that reflect both the societal and hospital decision maker perspectives. Futile treatment was associated with a total of 3,313 bed days per year, translating to a value of $12.1 million to the health system and $988,000 to hospital decision makers.

This is the first attempt to estimate the costs associated with futile treatment across a whole of hospital setting. We found that both the incidence of futile treatment and the length of stay attributable to futile treatment varied between hospitals. Hospital C was associated with the highest incidence of futile treatment, as well as the longest average length of stay following the onset of futile treatment. Hospital A was found to have both the lowest levels of futile treatment and the shortest associated length of stay. The reasons for these differences are not known. While all three hospitals were similar in their geographic location and accredited training status, there nonetheless may be differences in the admitted patient cohorts and clinician preferences that drive treatment decisions. A 2016 study in an earlier phase of this project identified a number of hospital-specific factors that may contribute to the provision of futile treatment, including the degree of specialisation, the availability of routine tests and interventions, and organisational barriers to diverting a patient from a curative to a palliative pathway[20]. It would be useful to recruit more hospitals and repeat this work to see if rates were higher or lower than those seen in Hospital A (6%) and C (19.6%) respectively.

Our estimates of the costs associated with futile treatment are dependent on the perspective taken. When a societal perspective was adopted, in which the cost per hospital bed day was derived as a hospital's total

operating expenses per patient bed day, total costs were more than twelve times higher than what hospital CEOs would be willing to pay to free up that day. This may reflect hospital funding arrangements in Australia, where hospitals receive funding allocations up to a specified level of activity. It also may reflect the 'fixed' nature of many hospital cost items, such as permanent staffing and building overheads, that are fixed regardless of hospital activity. We suggest that the societal perspective provides a more accurate picture of the total costs of futile treatments to the health care system as well as an incentive to drive system-wide change. Nonetheless, a CEO's willingness to pay is likely to be an important consideration in decision making processes regarding changes to hospital-specific policies or practices.

Our research method has limitations. Although we articulated the process for making determinations of futile treatment, judgements such as these are inherently value-laden and subjective. Deciding when treatment becomes futile, in many instances, requires the perspectives of patients and family members as well as multiple clinicians. The retrospective nature of the review process also had the potential to produce bias in clinical judgements. For example, the knowledge that a particular medical intervention was unsuccessful may have influenced an assessment that the intervention was futile, when such an assessment may not have been reasonably apparent in real time. A prospective randomised study of some intervention to reduce futile treatment might assemble evidence of futile treatment in real time and then be used for an audit and feedback process. The outcomes for comparison might be number of referrals to palliative care and length of stay in an acute bed. Our focus on hospital admissions ending in death ignored the potential for hospital-administered futile treatment to occur in cases where patients were discharged and later died in a hospice, residential care or home setting. In addition, while futile treatment may also occur in a non-hospital setting, this was beyond the scope of the study. As such, our results describe futile treatment in end-of-life hospital admissions, rather than a comprehensive estimate of the nature of futile treatment. There are further limitations regarding the costs assigned to futile treatment. It is naïve to believe that patients would have died immediately following the onset of futile treatment, had that treatment not been provided. Instead it is likely the intensity of treatment would reduce and a transfer to a sub-acute or palliative care services would

have arisen. These services would still incur positive costs. Thus, the costs reported here represent an upper bound on costs. This is an important caveat for those who cite the findings of this paper to argue for an investment of scarce resources for programmes that reduce futile treatment.

The nature of death has changed dramatically over the past century. Advances in the prevention of disease, as well as ongoing investment with effective health care interventions have improved life expectancy across the globe. Causes of death have shifted from infectious diseases towards chronic and progressive illnesses, and Australians much more commonly die in old age[21]. Death has become an increasingly medicalised experience and more than half of Australian deaths now occur in hospital, with 26% occurring in residential care and just 20% in the home [22].

These factors, combined with an ageing population, are contributing to ever-increasing levels of health care resource consumption at the end-of-life. A recent Australian study reported that people aged 65 years and over who were in their last year of life used an estimated 10.3% of all public hospital days and accounted for 8.9% of total inpatient costs, with 40% of these costs accumulating in the last month of life [23]. To ensure a sustainable health care system it is important that scarce resources are allocated to treatments that deliver the large patient benefit.

The findings of this study indicate that the incidence and nature of futile treatment in end-of-life admissions may differ significantly between hospitals. The impact of futile treatment is substantial in terms of both the bed days and costs expended. Yet this treatment, by definition, presents only a very low chance of achieving meaningful benefit for patients. Increased awareness of the extent of futile treatment and its impacts should stimulate the design and evaluation of interventions to reduce frequency. These should be tested for effectiveness, cost-effectiveness and the challenges around their implementation should be documented.

Figure 1: Processes used to judge whether futile treatment occurred during the final admission of 907 patients. Only those admissions judged as 'potentially futile' were carried forward to additional review rounds.

Figure 2 Incidence of futile treatment in end of life admissions for the three hospitals.

Figure 3. Length of stay while receiving futile treatment across the three study hospitals combined.

Figure 4. Mean length of stay while receiving futile treatment, by hospital

Figure 5. Annual bed days spent receiving futile treatment when applying the earliest and latest dates of futile treatment onset.

Appendix 1. Brisbane Futility Audit Tool

Appendix 2. Consensus Score Sheet and instruction

Appendix 3. Major Australian hospitals

Contributor ship statement. All authors: made substantial contributions to the conception or design of the work; MAP, LB, GS & SW acquired the data. HC, AB & NG analysed the data. BW, LW, LC, CG & MP interpreted the data. HC and NG drafted the manuscript and all authors critically revised it for intellectual content. All authors gave final approval and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests. None

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Data sharing statement. The full dataset used, which has no identifying information, is available from the corresponding author.

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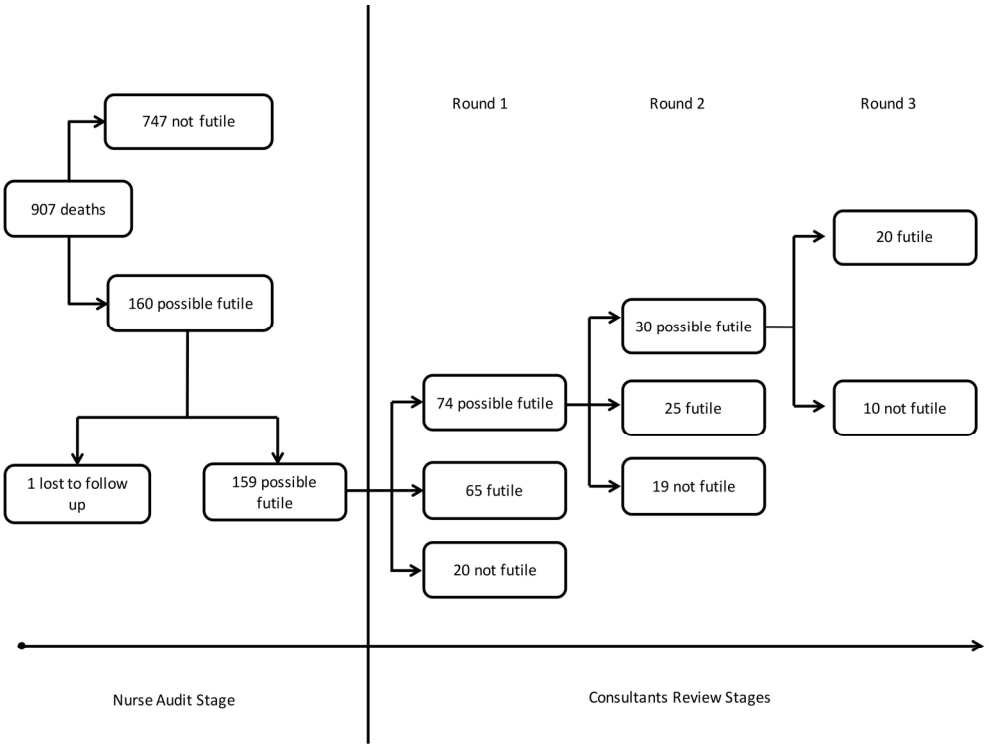
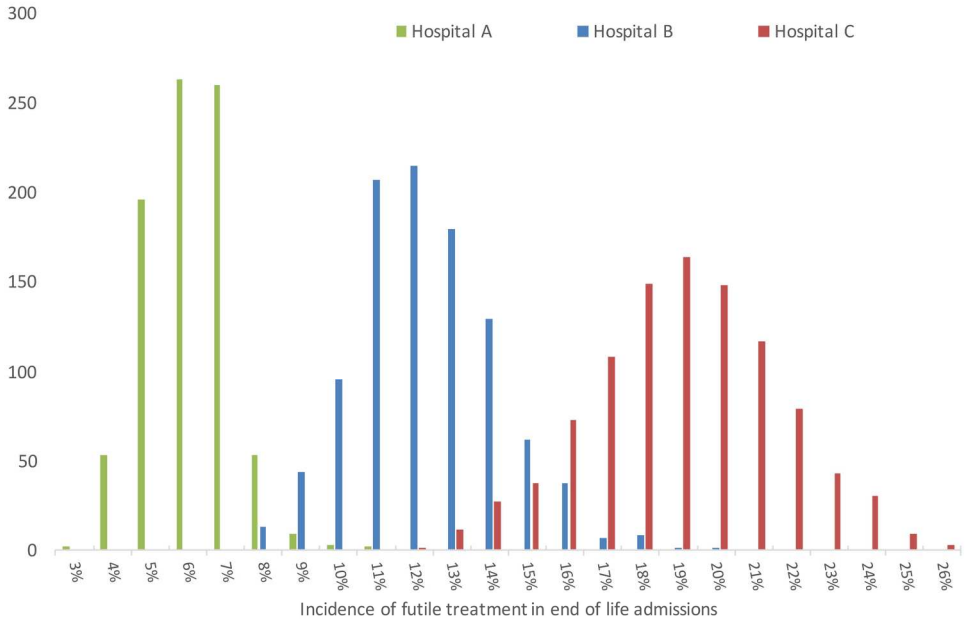


Processes used to judge whether futile treatment occurred during the final admission of 907 patients. Only those admissions judged as 'potentially futile' were carried forward to additional review rounds

190x142mm (300 x 300 DPI)



Incidence of futile treatment in end of life admissions for the three hospitals

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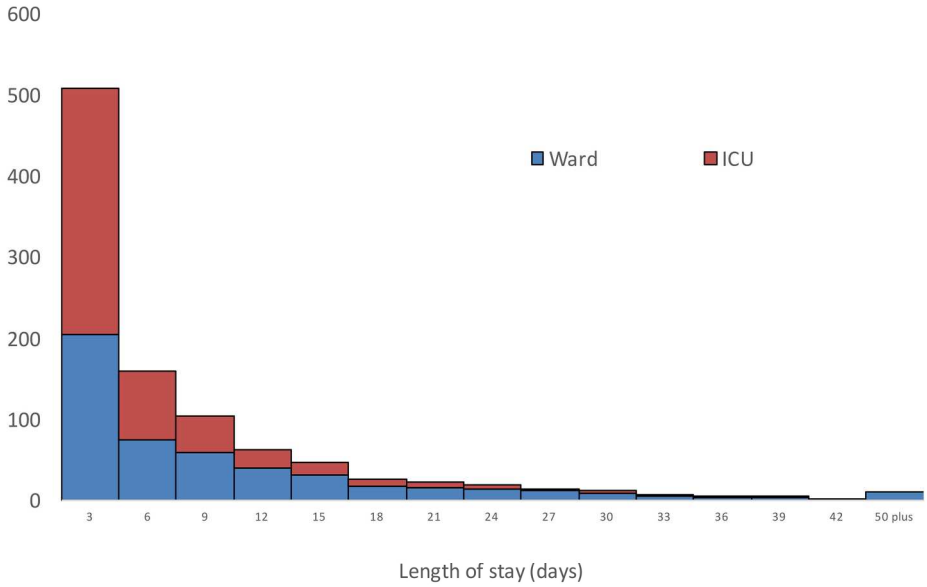
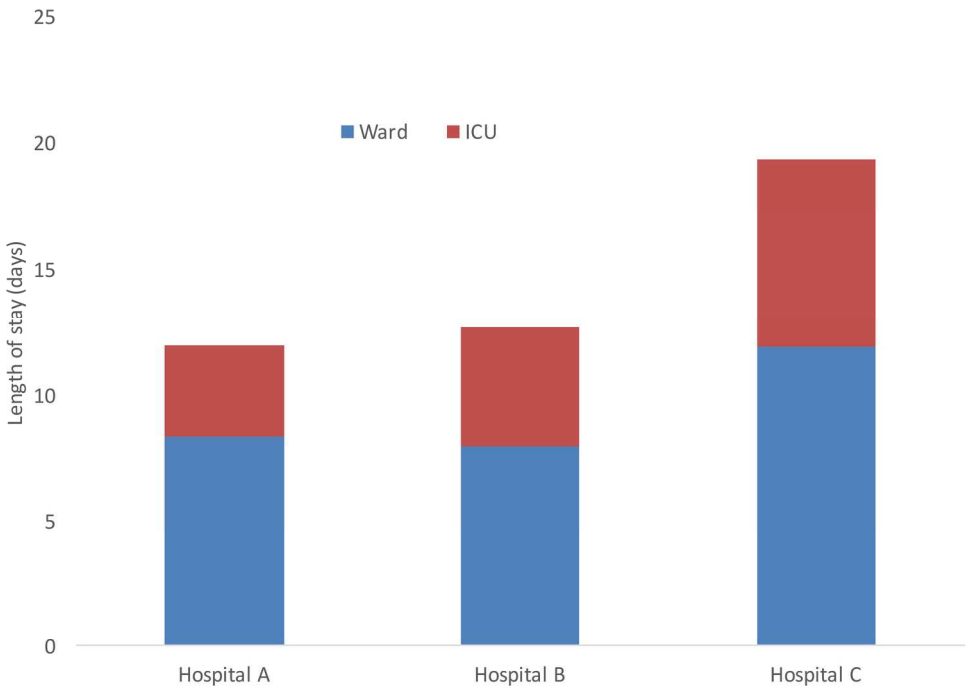


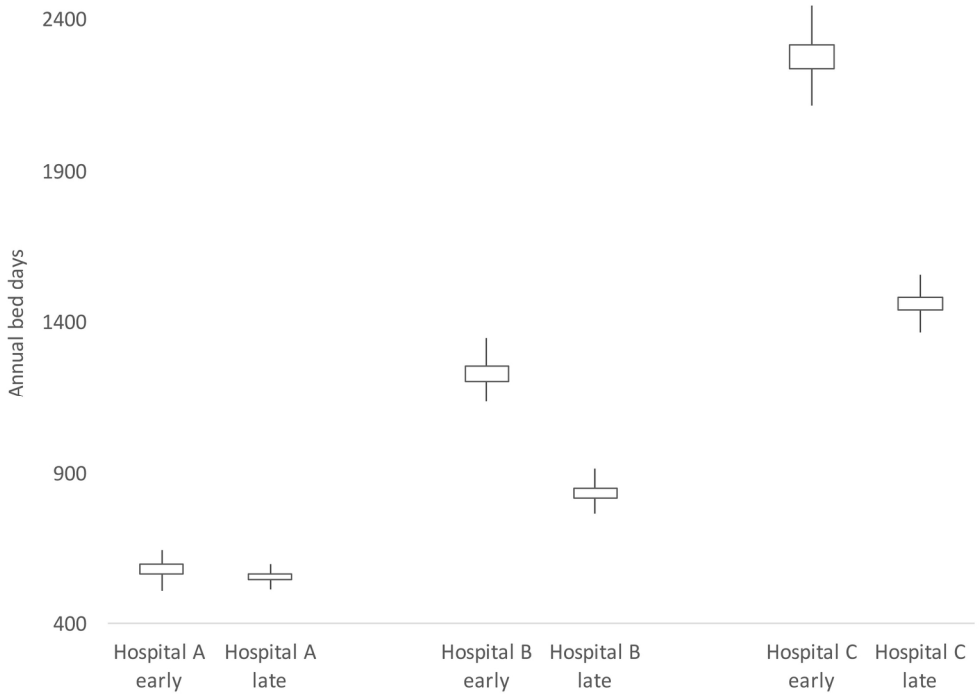
Length of stay while receiving futile treatment across the three study hospitals combined

190x142mm (300 x 300 DPI)



Mean length of stay while receiving futile treatment, by hospital

190x142mm (300 x 300 DPI)



Annual bed days spent receiving futile treatment when applying the earliest and latest dates of futile treatment onset

190x142mm (300 x 300 DPI)

Brisbane Futility Audit Tool_5February15

Patient demographics

1. BFAT ID Code (e.g HOSP_0001)

2. Age:

Age in years

3. Sex:

- ◯ Male
- ◯ Female

4. Marital Status

- ◯ Single
- ◯ Married
- ◯ De facto
- ◯ Widowed
- ◯ Divorced
- ◯ Unknown

5. Aboriginal or Torres Strait Islander

- ◯ Yes
- ◯ No
- ◯ Unknown

6. NESB

- ◯ Yes
- ◯ No
- ◯ Unknown

7. Date and time of final admission

	DD	MM	YYYY	HH	MM	AM/PM
Date	/	/		:		

8. Cause of death/diagnosis at death

Admissions History

Brisbane Futility Audit Tool_5February15

9. Date and time of death

	DD	MM	YYYY	HH	MM	AM/PM
Date	/	/		:		

10. Medical Unit of Death (specialty not ward)

11. Interregional transfer?

- ◯ Yes
- ◯ No

If yes, please specify referring hospital

12. Previous admissions over past 3 years

Number:

13. Admitted to ICU in final admission

- ◯ Yes
- ◯ No

14. Start and end times for ICU admissions during final admission

	DD	MM	YYYY	HH	MM	AM/PM
First Admission Start Date and Time:	/	/		:		
End Date and Time:	/	/		:		
Second Admission Start Date and Time:	/	/		:		
End Date and Time:	/	/		:		

Social Premorbid History

15. Activities of Daily Living

- ◯ Independant
- ◯ Partially dependant
- ◯ Dependant
- ◯ Unknown

Brisbane Futility Audit Tool_5February15

16. Care needs (if specified)

- ◯ Nil
- ◯ Has a carer
- ◯ Home visit nurse
- ◯ Resident in Aged Care Facility
- ◯ Unknown

17. Is a carer?

- ◯ Yes
- ◯ No
- ◯ Unknown

18. Exercise tolerance

- ◯ No limits on physical activity
- ◯ Ordinary activities result in fatigue/symptoms
- ◯ Less than ordinary activities result in fatigue/symptoms
- ◯ Bed bound
- ◯ Unknown

19. Alcohol Use

- ◯ Yes
- ◯ No
- ◯ Unknown

Number of standard drinks per week

20. Smoker

- ◯ Yes
- ◯ No
- ◯ Unknown

Packs per day

Brisbane Futility Audit Tool_5February15

21. Other drug use

- ◯ Yes
- ◯ No
- ◯ Unknown

Give details here

22. Evidence of Advance Care Planning prior to admission

- ◯ Yes
- ◯ No

23. If yes, tick the boxes below

- ☐ Palliative Care Review
- ☐ Refusal of treatment
- ☐ AHD
- ☐ EPA
- ☐ NFR
- ☐ ARP
- ☐ Notes in chart regarding wishes (give details on Summary page)

AHD – Advance Health Directive

EPA – Enduring Power of Attorney

NFR – Not For Resuscitation

ARP – Acute Resuscitation Plan

24. Family, partner and personal support group

- ☐ Spouse or partner
- ☐ Sibling/s
- ☐ Adult children
- ☐ Parent
- ☐ Attorney or Guardian appointed
- ☐ Other (e.g friend, neighbour, nephew, niece)
- ☐ None

25. Conflict in medical team?

- ◯ Yes
- ◯ No

26. Family conflict

- ◯ Yes
- ◯ No

Brisbane Futility Audit Tool_5February15

27. Briefly note the nature of the conflict here

28. Other external review

- [ ] Hospital lawyer
- [ ] Hospital administrator
- [ ] Ethics committee
- [ ] Adult Guardian
- [ ] Court or Tribunal
- [ ] Coronial review

Other (please specify)

Clinical Premorbid History incorporating SPICT criteria

29. Identify any of the following indicators of deteriorating health

- [ ] Needs help with personal care, in bed or chair for 50% or more per day
- [ ] Two or more unplanned hospital admissions in the past 6 months
- [ ] Weight loss (5-10%) over the past 3-6 months and/or body mass index <20
- [ ] Persistent, troublesome symptoms despite optimal treatment of any underlying condition(s).
- [ ] At risk of dying from a sudden, acute deterioration.
- [ ] Patient requests supportive and palliative care, or treatment withdrawal.
- [ ] Would be surprised if this patient is alive in 12 months?
- [ ] Have clinicians indicated this is futile?

30. Consult attached SPICT Criteria code and tick the symptoms that apply

Number of critieria ticked:

Insert codes here:

31. Major procedures in the last 12 months (including CPR)
(e.g surgery, GA, initiate dialysis, chemotherapy or radiotherapy)

32. Documented benefit of treatment in the last 2 weeks

Brisbane Futility Audit Tool_5February15

33. Documented burden of treatments delivered in the last 2 weeks

34. Use of evidence based protocols in the last 2 weeks

35. Resuscitation Status for final admission

Patient requests:

- ☐ Defibrillation
- ☐ Invasive ventilation
- ☐ Active treatment

Active treatment is defined as a therapeutic substance or course intended to ameliorate the basic disease problem, as opposed to supportive or palliative treatment

36. Outcome of resuscitation at or during admission

- ◯ Improvement
- ◯ No change
- ◯ Deterioration

Other (please specify)

37. Suitable for organ donation

- ◯ Yes
- ◯ No

38. Decision to donate

- ◯ Yes
- ◯ No

Review all sections

39. Date patient or family request withdrawal or limitation of therapy

Date / Time DD / MM / YYYY

40. Date that medical team suggest withdrawal or limitation of therapy

Date / Time DD / MM / YYYY

41. If treatment continues after these dates, record reason here

Page 6

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42. Was there a documented decision not to treat or to withdraw treatment during this admission?

- ◯ Yes
- ◯ No

43. On what date was treatment withdrawn?

Date / Time DD / MM / YYYY

44. Was there futile treatment for this patient? Use this definition as a guide and tick elements that appear to be relevant for this case.
Futile treatment is treatment that does not bring benefit to the patient, in terms of:

- ☐ Improving the patient's quality of life
- ☐ Significantly prolonging the patient's life of acceptable quality
- ☐ Involving burden that outweighs benefit

45. Was there futile treatment for this patient?

- ◯ YES
- ◯ NO

46. How confident are you in your answer?

◯ 0-10% ◯ 11-20% ◯ 21-30% ◯ 31-40% ◯ 41-50% ◯ 51-60% ◯ 61-70% ◯ 71-80% ◯ 81-90% ◯ 91-100%

47. If YES, on what date did care become futile?
Please do not skip this question, your best response is very important

Date care became futile: DD / MM / YYYY

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Brisbane Futility Chart Audit

Case ID: **Reviewer ID:**

Definition of futile treatment for this audit:

Treatment that brings only a very low chance of meaningful benefit to the patient, in terms of:

- improving the patient's quality of life;
- sufficiently prolonging the patient's life of acceptable quality and/or
- bringing benefits that outweigh burdens of treatment

Did this patient receive futile care? (Tick one)

☐ **YES**

☐ **NO**

If YES, when do you think treatment became futile?

..... / ..... / **2012**

If futile, please tick below to indicate if any of the following factors contributed to the futile treatment being provided (tick as many as apply):

Reason	***Tick***
Prognostic uncertainty	
Futile transfer	
Doctors kept offering treatment	
Patient's overall state of ill-health not taken into account	
No clear overall treatment goal/plan for this patient	
Patient or family requested continuation of active treatment	
Conflict within family	
Difference of opinion between teams/clinicians	
Communication issues (please specify below):	
Other reason/s (please print):	

Any other comments about the review procedure or process:

.....

.....

State	Name	Beds	Annual admissions
WA	Fiona Stanley Hospital	783	85,352
NSW	Bankstown Hospital	454	50,772
NSW	Blacktown Hospital	534	36,240
NSW	Concord Repatriation Hospital	750	57,156
NSW	Gosford Hospital	484	57,500
NSW	Wollongong Hospital	500	52,752
NT	Royal Darwin Hospital	363	39,569
QLD	Cairns Hospital	531	58,827
QLD	Mater Adult Hospital	205	22,531
QLD	Nambour General Hospital	350	51,176
QLD	The Prince Charles Hospital	630	47,860
SA	Lyell McEwin Hospital	336	43,127
SA	Queen Elizabeth Hospital	311	38,075
SA	Women's & Children's Hospital	295	31,650
TAS	Launceston General Hospital	316	34,446
VIC	Box Hill Hospital	621	63,214
VIC	Dandenong Hospital	573	67,240
VIC	Frankston Hospital	454	62,864
VIC	Geelong Hospital	370	73,316
VIC	The Northern Hospital	300	56,533
VIC	Western Hospital	290	31,316
WA	Fremantle Hospital	450	49,053
ACT	Canberra Hospital	600	65,404
NSW	John Hunter Hospital	550	79,372
NSW	Liverpool Hospital	855	84,444
NSW	Nepean Hospital	520	61,616
NSW	Prince of Wales Hospital	440	44,648
NSW	Royal North Shore Hospital	740	69,228
NSW	Royal Prince Alfred Hospital	920	80,968
NSW	St George Hospital	600	64,452
NSW	St Vincent's Hospital	880	48,208
NSW	Westmead Hospital	975	107,192
QLD	Gold Coast University Hospital	750	74,436
QLD	Princess Alexandra Hospital	800	88,370
QLD	Royal Brisbane & Women's Hospital	929	95,579
QLD	Townsville Hospital	580	60,329
SA	Flinders Medical Centre	593	65,108
SA	Royal Adelaide Hospital	680	82,435
TAS	Royal Hobart Hospital	490	53,413
VIC	Alfred Hospital	688	81,882
VIC	Austin Hospital	980	78,402
VIC	Monash Medical Centre	640	82,695
VIC	Royal Melbourne Hospital	700	85,465
VIC	St Vincent's Hospital	848	55,516
WA	Royal Perth Hospital	855	93,201
WA	Sir Charles Gairdner Hospital	607	66,167
TOTAL			2,879,099

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5 to 9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5 to 9*
Bias	9	Describe any efforts to address potential sources of bias	5 to 9
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4 to 9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	4 to 9
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	n/a
		(*d*) If applicable, explain how loss to follow-up was addressed	n/a
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Figure 1
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	No data available
		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
		(c) Summarise follow-up time (eg, average and total amount)	4

Outcome data	15*	Report numbers of outcome events or summary measures over time	4 to 9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	n/a
		(*b*) Report category boundaries when continuous variables were categorized	Table 2
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7
Discussion			
Key results	18	Summarise key results with reference to study objectives	10 to 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15 to 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14 to 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15 to 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.