Cause of death in intensive care patients within 2 years of discharge from hospital

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ABSTRACT

Objective: To identify intensive care patients dying within 2 years of discharge from hospital and assess whether the cause of death was related to the diagnosis at hospital discharge.

Design, setting and participants: A retrospective cohort study of all patients admitted to the intensive care unit at Wellington Hospital, New Zealand, between 1 July 2001 and 30 June 2003, using data from the ICU database. Mortality data were obtained from the New Zealand National Death Registry.

Main outcome measures: Death within 2 years of hospital discharge; cause of death and its relation to the hospital discharge diagnosis.

Results: Of 1984 patients discharged home, 193 died within 2 years. One-year and 2-year survival rates were 93.8% and 90.3%, respectively. Two-year mortality rates were 4.6% in elective cardiac surgical patients, 19.7% in elective non-cardiac surgical patients, 16.9% in acute patients admitted from the operating room, and 10.2% in other acute patients. Among the 193 patients who died after discharge, 124 deaths (64.2%) were related to the diagnosis at hospital discharge. The mortality rate in this group was highest at 3 months (90.5%) and lower at 6 months (75.0%), then averaged 51.4% after 6 months. Cause of death was related to discharge diagnosis in 46.2% of elective cardiac surgical patients, 66.6% of elective non-cardiac surgical patients, 60.5% of acute patients admitted from the operating room, and 75.4% of other acute patients. Cancer was the cause of death in 34.2% of elective cardiac surgical patients, 66.7% of elective non-cardiac surgical patients, 48.8% of acute patients admitted from the operating room, and 29.0% of other acute patients.

Conclusion: Survival rates of ICU patients after discharge from hospital are high. Deaths are closely related to the discharge diagnosis only in the first 6 months after discharge. Cancer is a common cause of death. Elective non-cardiac surgical patients have the worst outcomes.

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Understanding of intensive care outcomes has moved from focusing on intensive care unit outcomes to hospital outcomes and now to longer-term outcomes. The rates of survival after discharge from hospital are well reported[1-6] and vary with country and time. Two recently published Australian studies found survival rates of 93%–95% at 1 year and 90% at 3 years.[2,6] What a patient dies from after discharge has been less well reported. Two European studies published in 1990[3] and 1992[4] reported the causes of death after discharge in general intensive care populations. Only one[4] examined whether the cause of death was related to the intensive care or hospital diagnosis. The aim of our study was to identify intensive care patients dying within 2 years of discharge from hospital and assess whether the cause of death was related to the diagnosis at hospital discharge.

Methods

We conducted a retrospective cohort study of all patients admitted to the ICU at Wellington Hospital, New Zealand, between 1 July 2001 and 30 June 2003, using data from the ICU database. Wellington Hospital ICU is a 14-bed closed tertiary unit with a broad casemix of patients, including cardiothoracic, neurosurgical, surgical, medical and some paediatric patients.

A 2-year follow up period after discharge was planned. In 2006, the National Health Index number for each patient in the study was sent to the national death registry to match it against death records. Where a death was identified, the registry returned the date of death and a primary cause of death expressed as an International classification of diseases (ICD-10) code.

Deaths within 2 years of hospital discharge were included in the outcome assessment. Any deaths occurring after this time were excluded from the assessment. No censoring of data was required.

For each patient, the Wellington Hospital discharge diagnosis (ICD-10 code) was obtained from the hospital patient information system. Where patients had several hospital admissions with ICU admissions within the study period, the last hospital admission was used. If a patient was transferred from Wellington Hospital to another hospital, the hospital outcome at the other hospital was followed up to determine whether the patient died or was discharged. For transferred patients, the discharge diagnosis from Wellington Hospital was used as it related to the intensive care admission.

For patients who died after discharge from hospital, the relationship between the hospital discharge diagnosis and death registry cause of death was graded as “related” or “not related”. If the registry’s ICD-10 cause of death code was exactly the same as the hospital discharge diagnosis code, the relationship was classed as "related". For patients whose codes did not match exactly, the registry cause of death and hospital discharge diagnosis were manually compared to assess the relationship. The ICU admission and discharge reports were reviewed to provide additional clinical information and some context to the hospital diagnosis. The two diagnoses were defined as related when they were the same or were part of the same single disease process.

The ICU used the APACHE II (Acute Physiology and Chronic Health Evaluation II) diagnostic codes in the patient database but did not collect APACHE II severity-of-illness scores during the study period. All ICU admission diagnoses were compared with hospital discharge diagnoses to ensure they were related.

For analysis, ICU admissions where divided in four categories: elective cardiac surgery, elective non-cardiac surgery, acute admissions from the operating room and other acute admissions. Post-discharge deaths were compared between groups.

Age- and sex-specific annual death rates for 2000–2002 were obtained from Statistics New Zealand[7] and were used to calculate the predicted number of deaths among hospital survivors.

Ethics approval

Our study was approved by the Wellington Regional Ethics Committee. Requirement for patient consent was waived.

Results

The study group comprised 2376 patients who had 2446 admissions to Wellington Hospital and 2574 admissions to the ICU. Of these patients, 1506 (63.4%) were male and 870 (36.6%) were female. Of the index ICU admissions, 45.9% of patients were elective and 78.1% required ventilation. The median length of stay for all intensive care admissions was 24 hours (interquartile range, 19–50 hours), with 168 patients (6.5%) staying longer than 7 days.

Table 2. Two-year outcomes of patients discharged from hospital

	Number of patients	%
Admissions and deaths		
Intensive care admissions	2574	
Hospital admissions	2446	
Patients	2376	
Intensive care deaths	259	10.9%
Wellington Hospital deaths	88	3.7%
Other hospital deaths	45	1.9%
Total hospital deaths	392	16.5%
Hospital survivors	1984	
Deaths at 0–6 months	72	3.6%
Deaths at 7–12 months	51	2.7%
Deaths at 13–18 months	35	1.9%
Deaths at 19–24 months	35	1.9%
Total deaths within 2 years	193	9.7%

Table 1. Age distribution of deaths after hospital discharge

Decade	Hospital survivors	Deaths at 2 years	Predicted deaths at 2 years*
	n	*n* (%)	*n* (%)
0	86	3 (3.5%)	0.17 (0.2%)
10	85	2 (2.4%)	0.09 (0.1%)
20	123	2 (1.6%)	0.22 (0.2%)
30	142	1 (0.7%)	0.27 (0.2%)
40	201	11 (5.5%)	0.81 (0.4%)
50	322	32 (9.9%)	3.41 (1.1%)
60	474	55 (11.6%)	13.04 (2.9%)
70	460	61 (13.1%)	36.54 (7.4%)
80	82	26 (31.7%)	15.45 (18.0%)
90	3	0	1.28 (42.8%)
Totals	*1984*	*193 (9.7%)*	*71.29 (3.6%)*

* In the general New Zealand population.

Table 3. Deaths in hospital and within 2 years after hospital discharge, by admission type

	Elective surgery		Acute admissions		
	Cardiac	Non-cardiac	From OR	Other	Total
Number of patients	863	228	329	956	2376
Hospital deaths (%)	24 (2.8%)	15 (6.6%)	75 (22.8%)	278 (29.1%)	392 (16.5%)
Hospital survivors	839	213	254	678	1984
Died within 2 years (%)	39 (4.6%)	42 (19.7%)	43 (16.9%)	69 (10.2%)	193 (9.7%)
Related* (%)	18 (46.2%)	28 (66.7%)	26 (60.5%)	52 (75.4%)	124 (64.2%)
Not related* (%)	21 (53.8%)	14 (33.3%)	17 (39.5%)	17 (24.6%)	69 (35.8%)

OR = operating room. * Whether cause of death was related or not related to diagnosis at hospital discharge.

Table 4. Proportion of deaths related to cancer, by admission type

Admission type	Relationship*	No. of deaths	Cancer (%)
Elective cardiac surgery	Related	18	0
	Not related	21	13 (61.9%)
	Subtotal	39	13 (34.2%)
Elective non-cardiac surgery	Related	28	24 (85.7%)
	Not related	14	4 (28.6%)
	Subtotal	42	28 (66.7%)
Acute admission from OR	Related	26	20 (76.9%)
	Not related	17	1 (5.9%)
	Subtotal	43	21 (48.8%)
Other acute admission	Related	52	14 (26.9%)
	Not related	17	6 (35.3%)
	Subtotal	69	20 (29.0%)
Total	Related	124	58 (46.8%)
	Not related	69	24 (34.8%)
Total overall	*All*	*193*	*82 (42.5%)*

OR = operating room. * Whether cause of death was related or not related to diagnosis at hospital discharge.

The age distribution of patients, by decade, is shown in Table 1. Outcomes are shown in Table 2. Of 1984 patients surviving hospital, 193 (9.7% [95% CI, 8.3%–11.0%]) died within 2 years of discharge. This was compared with the predicted proportion of deaths from New Zealand life-expectancy data (3.6%). Of 128 patients aged 80 years and over admitted to the ICU, 69 (53.9%) died within 2 years.

Two years after discharge, 124 patient deaths (64.2% [95% CI, 57.5%–70.0%]) were related to the patient's diagnosis on hospital admission. The proportion of related deaths was 90.5% in the first 3 months, 75.0% in the second 3 months, and 50.0%, 48.5% and 54.2%, respectively, for each subsequent 6-month period after discharge.

Of the 124 related deaths, 42 patients (33.9%) were matched by ICD-10 diagnosis codes and 82 patients were matched manually. ICD-10 disease codes have a letter and 3 or 4 digits (eg, C18.7: malignant neoplasm of sigmoid colon). Using the letter and one digit in the matching process improved the positive matching to 56.5%, with no false positives. Using the letter only produced 10 false positives (sensitivity, 71.0%; specificity, 85.5%). All the false positives were cerebrovascular diagnoses (I60–I69) matched to cardiac diagnoses (I01–I52).

Patients' deaths were further analysed by ICU admission category (Table 3). Elective cardiac surgical patients had the lowest post-discharge mortality at 2 years (4.6%), with patients in the other categories having mortality rates ranging from 10.2% to 19.7%. The proportion of deaths related to hospital diagnosis ranged from 46.2% to 75.4%.

It became evident that cancer was a prominent cause of death. All deaths were manually reviewed to see which ones had a death registry cancer diagnosis (Table 4). Overall, 46.8% of related deaths and 34.8% of non-related deaths had cancer as the principal diagnosis. Elective non-cardiac surgical patients had the highest cancer rates, reflecting the underlying reason for their ICU admission. A surprising finding was the high proportion of cancer deaths among cardiac surgical patients.

Four patients committed suicide after discharge from hospital. Their ICU admissions had been the result of cancer surgery, non-cancer laparotomy and carotid injury from a suicide attempt. Fourteen patients were not resident in New Zealand when admitted to intensive care and two of them died in hospital. Treatment was withdrawn in 169 patients in intensive care and 167 died in hospital, with the remaining 2 patients dying at 101 and 301 days, respectively, after discharge. Another 65 patients had treatment limitations in place in the ICU without withdrawal of treatment: 54 died in hospital, five died within 80 days of discharge, and the remaining six were alive at 2 years.

Discussion

This is the first study in Australia or New Zealand to evaluate the cause of death after hospital discharge of a general intensive care population of patients. The logistics of our study were straightforward because of the national unique health identifier and the contained population. We do not know whether any of the study patients emigrated overseas during the follow-up period. It is likely the 12 non-resident patients who were discharged from hospital will have returned overseas, representing a loss of 0.6% of the study population. In 2000, 58 700 people left New Zealand as permanent or long-term migrants.[8] This was 3.8% of the New Zealand population (although predominantly in the 20–40-year age group).

In attempting to match hospital discharge codes with causes of death, we found an exact match in only a third of cases. Using the ICD-10 code letter only increased the match rate to 71.0% but produced 10 false positives. This is disappointing, as there remains a need to manually review at least 50% of deaths and this has logistic implications for researchers wishing to review much larger populations.

The ICU mortality rate, hospital mortality rate, and 1-year and 2-year survival rates were similar to those reported in other recent studies,[1,2,6] but lower than those of two earlier studies.[3,4] The hospital mortality rates were casemix-dependent: our elective cardiac surgical patients had a much lower hospital mortality rate (2.8%) than the nonelective patients (22.8% and 29.1%). As the earlier studies did not have cardiac surgical patients in their units, the hospital survival rates are not comparable.

The purpose of our study was to examine the cause of death and see how it related to the hospital discharge diagnosis. Overall, 64.3% of deaths were related to hospital diagnosis. This compares to 64% found in a 1990 Scottish study.[4] In our study, the proportion of related deaths was highest in the first 6 months and declined for the remaining 6-month periods up to 2 years. This would fit with our intuitive understanding that patients are more likely to die from the condition diagnosed at hospital discharge during the immediate period after discharge. However, our presumption was that the proportion of related deaths would remain higher than 50% for longer than 6 months. The proportion of related deaths after 6 months appears to be relatively consistent, but could reflect changing ratios in differing diagnostic subgroups. The number of deaths in each subgroup were too small to allow further comparative analysis.

Patients having elective cardiac surgery had the lowest mortality rate, but half their deaths were not related to heart disease. There was a surprisingly high proportion of cancer deaths within these patients, and further review is needed to examine whether the cancers were known of at the time of ICU admission. Non-cardiac elective surgical patients had a low hospital mortality rate (6.6%) but a high 2-year mortality rate after discharge (19.7%), which probably reflects the reasons for ICU admission. The operations were mostly for vascular surgery or general surgery in patients with cancer, who had significant comorbidities. Comorbidities are not quantifiable within our ICU database. They may contribute to admission to ICU without being the admission diagnosis. Overall, 66.7% of post-discharge deaths in non-cardiac elective surgical patients were cancer-related. This suggests the deaths were more related to the underlying disease than the comorbidities, but there was no control group to compare with. Elective non-cardiac surgical patients were the group with the highest post-discharge mortality in our study. Compared with acute admission patients, they had a lower hospital mortality rate and a shorter length of ICU stay, and were less likely to be ventilated. Although this suggested that they might do better in the longer term, this was not the case.

Acute surgical patients also had a high 2-year mortality rate (16.9%), and 60.5% of deaths were related to the hospital diagnosis. As with elective surgical patients, cancer was the predominant cause of related deaths.

Acute non-surgical (medical) patients had a lower mortality rate (10.2%) than surgical patients, but mortality was highly related to the hospital diagnosis (75.3%) and possibly reflected the progression of chronic medical illnesses. The median time to death was shorter in this group than in the other groups, with most deaths occurring in the first 6 months. Cancer was a less common cause of death in this group.

Our results have implications for how we assess long-term outcomes, the possible effect of ICU treatments on those outcomes, and the advice we give to patients and families. If the cause of death is not related to the diagnosis on hospital discharge or ICU admission, how will the intensive care treatment we provide have any effect on long-term survival once a patient is discharged? Other studies have shown that the severity of illness on admission to intensive care has an effect that lasts for several years after discharge.[2,5] Unfortunately, in our study we did not have access to severity-of-illness data to compare with the relative cause of death. The fact that half the deaths after 6 months in our study population were not related to hospital discharge diagnosis suggests that any effect the severity of illness has may not be specific to the admission disease. Alternatively, it may be that the effect the severity of illness has is strong enough to not be masked by the 50% of deaths that are not related.

The outcome measure for clinical trials has moved from mortality in hospital to mortality at 28 days and now 90 days after enrolment. In our study, 90.5% of deaths within 3 months of discharge were related to the hospital diagnosis. Pushing a study outcome to a period longer than 6 months may introduce some error, as half of the late deaths may not be related to the ICU or hospital diagnosis. The prominence of cancer as a cause of death in our study suggests that study and control groups in clinical trials may need to be matched for the incidence of cancer at enrolment.

Cancer is a prominent cause of death in the general population (28%[9]) and was the cause of death in 42.5% of our study patients after discharge. This compares with 31% and 40%, respectively, in earlier studies.[3,4] As we were unable to identify which patients had cancer at the time of admission to intensive care or when the cancer was identified, our interpretation was limited. We could not ascertain how many cancers were first discovered after hospital discharge and were thus probably unrelated to the ICU admission and severity of illness. Further review of these patients is needed to investigate these relationships.

Conclusion

The 2-year survival rate among ICU patients after hospital discharge is high (90.3%). Most deaths within the first 3 months after discharge were related to the hospital discharge diagnosis (90.5%), but this fell to 51.4% after 1 year. In 42.5% of all patients who died, cancer was the cause of death. Non-cardiac elective surgical patients had the highest 2-year mortality rate after discharge (19.7%) due to cancer, despite having a low hospital mortality rate (6.6%).

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References

1 Williams TA, Dobb GJ, Finn JC, Webb SA. Long-term survival from intensive care: a review. *Intensive Care Med* 2005; 31: 1306-15.
2 Williams TA, Dobb GJ, Finn JC, et al. Data linkage enables evaluation of long term survival after intensive care. *Anaesth Intens Care* 2006: 34: 307-15.
3 Dragsted L, Qvist J. Outcome from intensive care. V. A 5 year study of 1308 patients: underlying causes of death. *Eur J Anaesthesiol* 1990; 7: 159-68.
4 Ridley S, Purdie J. Cause of death after critical illness. *Anaesthesia* 1992; 47: 116-9.
5 Wright JC, Plenderleith L, Ridley SA. Long-term survival following intensive care: subgroup analysis and comparison with the general population. *Anaesthesia* 2003; 58: 637-42.
6 Mullany DV, Foot CL, Smith SE, et al. Methods and preliminary results for a data linkage project to determine long term survival after intensive care unit admission. *Crit Care Resusc* 2009; 11: 191-7.
7 Statistics New Zealand. Period life tables. http://www.stats.govt.nz/methods_and_services/access-data/tables/period-life-tables.aspx (accessed Nov 2009).
8 Statistics New Zealand. Tourism and migration 2003. http://www.stats.govt.nz/methods_and_services/access-data/tables/tourism-migration-2003.aspx (accessed Nov 2009).
9 New Zealand Ministry of Health. Mortality and demographic data 2002 and 2003. Wellington: New Zealand Health Information Service, 2006. http://www.moh.govt.nz/moh.nsf/Files/mortdemo/$file/mortality02-03.pdf (accessed Dec 2009) ❑