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Indigeneity and the quality of hospital care: indicative results from preventable adverse events among Maori patients in New Zealand

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Summary

Background: New Zealand has a substantial indigenous minority – the Maori – that exhibits considerably worse health status than the majority population. The objective of this paper is to assess possible disparities in the quality of hospital care for Maori using data on preventable adverse events as an indicator of sub-optimal treatment.

Methods: A nationally representative survey of admissions to general public hospitals with over 100 beds providing acute care. A sample of 6,579 patients admitted in 1998 to 13 hospitals was selected by stratified systematic list sample. A two-stage retrospective assessment of records was conducted using structured implicit review. Outcome measures were the occurrence, impact and preventability of adverse events.

Findings: Maori patients accounted for just over 15 per cent of admissions and were on average much younger – with half under 25 – were overwhelmingly from deprived areas, had a different case mix (more birth-related and respiratory diagnoses, less circulatory), and were in hospital for a shorter stay. Overall, after age standardisation, 14% of admissions for Maori were associated with an adverse event compared to 11% for non-Maori/non-Pacific. For preventable, in-hospital events, this disparity persisted after controlling for age, other socio-demographic factors, and case mix. An analysis of potential causal factors revealed no markedly or consistently different pattern. For example, system factors were involved in just under a half of events for both groups.

Interpretation: A predominantly publicly-funded hospital system has not shielded indigenous Maori from care that, at least on one indicator of sub-optimal treatment, is marginally poorer in quality than that received by New Zealand citizens of non-Maori/non-Pacific origin. Although no aetiology specific to Maori is evident from these results, there is a range of policy and system issues that can usefully be addressed.

Key Words: quality of care; adverse events; indigenous health

Introduction

There is considerable evidence of differences between ethnic groups in the quality of care (defined as the degree to which health services increase desired health outcomes and are consistent with professional knowledge[1]). However, what is not clear is the extent to which these differences are due to variations in access, clinical need, appropriateness, and patient preference, or whether they are disparities in quality - that is, attributable to the potentially discriminatory effects of the delivery system and those who staff it.[1] It is also not evident whether these differences affect indigenous groups since indigeneity has tended not to be identified as a separate factor, but rather absorbed into ethnic affiliation in such analyses.

New Zealand has a substantial indigenous minority – the Maori – that exhibits considerable health status disadvantages when compared with the majority population that is principally of British migrant stock.[2,3,4] There are also significant Asian and Pacific minorities, the latter largely being descendants of migrants indigenous to the immediate region of the South Pacific. While the government has committed to a strategy of enhancing access to primary care and improvements in quality for Maori, little information is available on disparities in the quality of treatment by indigeneity.[5,6,7]

New Zealand has a health care system that is predominantly tax-funded with family doctors acting as gate-keepers to specialist and hospital care. Hospital care is available free of charge and is generally distributed in a relatively uniform and co-ordinated fashion across the country, with 90% of the population within an hour's drive of a district hospital.[8]

One difficulty in assessing the extent of such disparities is the tendency for most existing measures of the quality of care to be confounded with the quantity of care that is available and accessed. Thus, while, for example, research may identify lower use of certain procedures among ethnic minority groups, it is still possible that higher levels for the majority group are due to overuse rather than clinical necessity.[1]

Preventable adverse events are measures of quality that are less susceptible to this methodological problem since they reflect outcomes of care - i.e. patient harm - which may be caused by acts of both omission and commission in the treatment process.[9] Such events also meet the definition of quality, albeit on a narrow interpretation: they are undesirable health outcomes produced by health service interventions and, because of their preventability, also reflect potentially remediable deficiencies in professional knowledge and practice. Although narrowly prescribed, they provide powerful evidence of sub-optimal treatment and may be indicative of broader quality issues. This investigation assesses whether preventable adverse events are higher among Maori patients in New Zealand public hospitals.

Methods

Detailed information on the sample design and data collection has been reported elsewhere. [10,11]

Sampling strategy

Medical records were drawn from a representative sample of 13 general public hospitals selected from 20 institutions with 100 or more beds. Sampling followed stratification by hospital type and geographical listing of institutions from north to south across New Zealand. The national sample comprised: all six large tertiary service facilities; a probability proportional to size (PPS) sample of four smaller secondary service facilities with more than 300 beds and a PPS sample of three secondary service facilities with less than 300 beds (where PPS involved selection proportional to the number of beds in the institution to ensure that every admission had an equal chance of being selected).

The survey population was defined as all patient admissions for calendar year 1998 (excluding day, psychiatric and rehabilitation-only cases). The sampling frame for each hospital was a list of all eligible admissions in that hospital. A systematic list sample of 575 admissions was selected from each of these hospitals for the year 1998, with cases ordered by admission date. A total sample of 6,579 admissions was available for analysis. The full medical record associated with each sampled admission was analysed for the occurrence, either in a public hospital or other setting, of an adverse event. To be included in the analysis an adverse event had to be associated with the sampled admission.

Record review

The core data collection procedure of the study was a two-stage retrospective review of a representative sample of medical records from each selected hospital, using review forms closely modelled on the comparable instruments in the American and Australian studies.[12,13]

The first stage was the screen undertaken by trained registered nurses to ascertain if the hospitalisation in question - the sampled admission - met any of 18 screening criteria selected as potentially indicative of an adverse event. The second stage undertaken by specifically trained and highly experienced physicians used an instrument relying on structured implicit review. This was a protocol in which reviewers were guided to an informed professional judgement – for example, whether or not a case was an adverse event, or, if an adverse event, whether it was preventable - by following series of questions designed to assist them to interrogate the patient record in a systematic and structured way. The objective was to determine whether an adverse event was associated with the sampled admission and, if so, to characterise its causation, preventability, and impact on length of stay and patient morbidity.
The physician reviewers were unblinded to the indigeneity of patients though they were not aware of this paper's hypothesis of consequent disparities in outcome.

Definition of variables

To qualify as an adverse event for this analysis, an incident had to be related to, or have occurred during the sampled admission. An adverse event that occurred during the sampled admission was defined to be "in-hospital". For this, and all other, variables derived from the study protocol rather than administrative sources, judgement on definition and classification were made by study physician reviewers.

An adverse event was defined as an unintended injury resulting in disability, and caused by health care management rather than the underlying disease process.

Adverse events were categorised according to broad clinical classifications, and whether they were related to systems failure. Systems failure was defined as: defective equipment or supplies; equipment or supplies not available; inadequate reporting or communication; inadequate training or supervision of doctors/other personnel; delay in provision or scheduling of services; inadequate staffing; inadequate functioning of hospital services; no protocol / failure to implement protocol or plan. Adverse events were also classified by specialty (surgery, medicine, other) and according to whether they occurred inside or outside a public hospital.

Severe impact of an adverse event was defined as resulting in permanent disability (lasting more than one year) or death. Attributable bed days were defined as extra bed days associated with an adverse event that were spent in the study hospital during one or more admissions.

Preventability of an adverse event was assessed as an error in health care management due to failure to follow accepted practice at an individual or system level. Areas where effort could be directed to prevent adverse event recurrence were identified and categorised (system, consultation, education, resources, quality assurance, other).

Patient factors that might be associated with adverse event occurrence were identified from the hospital records: indigeneity (Maori, non-Maori/non-Pacific); age (0-24, 25-44, 45+); gender (female, male); area deprivation score (NZDep96 deciles 1-5 [low] or 6-10 [high], an area-based index of social deprivation,[14] derived from patient domicile code); Major Diagnostic Categories (derived from Australian AN-DRG 3.1).[15]

Ethnic affiliation refers to a sense of distinct peoplehood within a nation state. Individuals of Maori ethnicity are classified as indigenous, being the first settlers of New Zealand. Individuals of Pacific origin are excluded because they represent groups that are indigenous to the immediate region. The remaining ethnic affiliations are aggregated into a single comparator group, non-Maori/non-Pacific. In 1998 patients were permitted up to three choices on ethnic identification, and these were prioritised - Maori, Pacific, other - to a single affiliation where necessary. There has been significant under-counting of Maori in official statistics.[2]

Statistical analysis

Percentages, means, odds ratios and variance estimates have been adjusted to account for the stratified cluster sample design.[16] Each hospital was assigned a weight inversely proportional to its selection probability. Variances were estimated using a Taylor expansion approximation. SAS 9.1 survey procedures were employed for these analyses.

Where indicated, percentages and means have also been directly age-standardised to Segi's world population, using the weights 0.48, 0.26, 0.26 for the age groups 0-24, 25-44, and 45+ respectively.[17] Age standardisation was felt to be necessary because of the marked contrast in age distribution between the two comparator groups.

Adjusted odds ratios were estimated using multiple logistic regression with adverse event occurrence as the binary outcome. Predictors were patient factors and are itemised in the relevant table, together with reference categories in each case. The adjusted odds ratios show the effect of each patient factor controlling for the effects of the other patient factors in the model.

Differences described in the text are not statistically significant, unless so stated.

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Results

In Table 1 information is presented, by indigeneity, on key socio-demographic and clinical characteristics of the patients in the study sample. Maori patients made up just over 15 per cent of the sample, were younger – half being under 24 – tended to reside in more deprived areas – over 80 per cent in the more deprived half of the distribution – and showed corresponding age-related differences in case mix (more in the diagnostic categories of pregnancy and respiratory, fewer in circulatory).

TABLE ONE ABOUT HERE

Table 2 outlines data, broken down by indigeneity, on the clinical and incident characteristics of identified adverse events in the study sample, with the latter characteristics adjusted for age. There was a statistically significantly lower proportion of adverse events among Maori in surgery, but a slightly higher proportion of adverse events among Maori were in-hospital and system-related, while marginally fewer were preventable, or severe.

TABLE TWO ABOUT HERE

Rates of occurrence of adverse events are displayed in Table 3. The age-adjusted occurrence rates for all adverse events and for those of in-hospital origin were significantly different, showing a disadvantage for Maori.

TABLE THREE ABOUT HERE

The results of an adjusted analysis of preventable, in-hospital adverse events are displayed in Table 4. Higher rates of such events were recorded for Maori, and for older patients and for those in particular diagnostic categories (musculoskeletal, digestive). Deprivation of area of residence was not associated.

TABLE FOUR ABOUT HERE

An analysis by indigeneity of “areas of effort” for in-hospital preventable events is presented in Table 5. For both groups system factors were important for nearly half of all events.

TABLE FIVE ABOUT HERE

Discussion

Maori patients were younger – half being under 25 – predominantly from more deprived areas (over 80%), and with a shorter length of stay and contrasting case mix (more in diagnostic categories that were pregnancy-related and respiratory, fewer in circulatory). After age-adjustment, adverse events among Maori patients were more likely to be in-hospital in origin and significantly more likely to be non-surgical in nature. The age-adjusted occurrence rate for adverse events overall was significantly higher among Maori, and significantly higher for events that were in-hospital in origin. This disparity persisted for preventable, in-hospital events in an adjusted analysis. Older patients and patients with certain diagnoses were also at greater risk, while deprivation of area of residence was not associated with this outcome. There was no notable difference by indigeneity for “areas of effort” for prevention; for both Maori and non-Maori/non-Pacific, system-related factors were important for about half of all in-hospital, preventable events.

The strength of the current study is that it has applied a standardised, audit-style review of medical records to a representative cross-section of admissions to New Zealand public hospitals for calendar year 1998. Furthermore, as a measure of quality, preventable adverse events have certain advantages; they are less likely to be confounded by differences between groups in patterns of usage and treatment, and they focus attention by identifying only those areas of poor-quality practice that both harm patients and are potentially remediable.

However, these strengths of the study are also its weaknesses. Thus, a cross-section of hospital admissions means that Maori are not represented in sufficient numbers to pursue the analysis of disparities more fruitfully - quite aside from the likely under-counting of Maori in administrative statistics. Different strategies need to be mounted to address these problems.[2] In addition, as an outcome-based measure, preventable adverse events fail to tap broader dimensions of quality, although they may be indicative in this respect. A fuller picture would need a range of measures to supplement this rather narrow focus.[1]

Questions have also been raised about the reliability and validity of retrospective record review as an instrument for gauging errors and events of clinical practice.[18] The measurement properties of the instrument are moderate at best.[19] Nevertheless, these are shortcomings that afflict most instruments in this area,[20] and it has to be noted that these data represent judgements of experienced hospital physicians based on the systematic interrogation of a representative sample of medical records.

A wide range of studies has documented disparities in the quality of care between ethnic/racial groups, mostly in the United States. A subset of these concerns the outcomes of care. Thus, the Harvard Medical Practice Study showed that more black and poor patients suffered medical injuries due to negligence, although this result was not statistically significant after controlling for other factors.[21] In the case of mortality, findings are not consistent, with both higher[22] and lower[23] rates identified among black patients after suitable statistical controls have been applied. There are few reviews of quality for indigenous people.[24]

While age is the patient attribute most strongly associated with preventable harm in hospital, the adjusted analysis in this study shows that Maori patients in 1998 experienced a higher risk of preventable adverse events of hospital origin. What is less clear are the practical implications since in the current study there are few clues as to any distinct pattern of hospital quality issues for Maori (for example, “areas of effort” for prevention was similar across both groups).

A range of remedies or reforms can be considered, and successes can be achieved.[25] If we accept that evidence of disparities in preventable inpatient harm may be indicative of broader quality issues, and if we are willing to apply the template of ethnic disparities to the case of indigenous peoples, then we can work with the framework proposed by the Institute of Medicine – “Unequal Treatment” – which suggests four broad categories of interest: legal, regulatory and policy matters (avoiding fragmentation along socio-economic lines, increasing recruitment of providers from affected groups); health system issues (guidelines, payment systems, provider mix); patient empowerment; and cross-cultural training.[1]

Considering first the broader matters of a legal, regulatory and policy character, it would appear that New Zealand is reasonably well-placed to address these issues since the hospital system largely avoids the fragmentation along socio-economic lines that has been identified as one potential source of disparities in the quality of care,[8] and there have been initiatives, albeit tentative, in Maori provider recruitment and development.[2] In the case of health system issues, the picture is mixed. While there does not seem to be any evidence in the hospital sector of the obstacles to receiving needed treatment that have been identified for Maori in primary care, [26] research suggests that more active and sensitive guideline development may be needed in cardiac care, [27, 28] to take just one example of great importance to Maori health.

For issues of patient empowerment and cross-cultural training, there are again promising initiatives. Thus, the establishment of the Health and Disability Commissioner has advanced patient rights substantially, including attention to the needs of Maori, [29] and there is evidence that New Zealand's no-fault malpractice environment may encourage the discussion of medical error. [30] The matter of enhanced Maori participation in the health system is also on the agenda.[31] Finally, it should be said that significant advances have been made in New Zealand in the matter of cross-cultural training and cultural competence in the delivery of care.[32]

The research results reported here are indicative rather than definitive. Aside from the initiatives in public policy, a number of avenues for further work are also feasible. Firstly, data on quality should be collected routinely and more systematically, and when it is presented it should be stratified by indigeneity (or ethnicity). [33] Secondly, a range of data collection techniques are available, aside from retrospective review, that may prove much more cost-effective both for purposes of reporting on quality and for investigating further the results of this study.[9]

Conclusions

Maori patients in New Zealand public hospitals experience more in-hospital, preventable adverse events. These reflect the outcomes of sub-optimal treatment and may be indicative of broader disparities in quality. However, no aetiology specific to Maori were readily identifiable from these results. For the longer term, further research is required to identify the factors involved and to broaden the quality scope. In the immediate future issues of policy, health system organisation, enhanced participation for Maori, and cross-cultural competence, could usefully be explored and developed.

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References

1. Institute of Medicine. *Unequal treatment: confronting racial and ethnic disparities in health care*. Smedley BD, Stith AY, Nelson AR, eds. Washington, DC: National Academy Press, 2003.

2. Blakely T, Tobias M, Robson B, Ajwani S, Bonne M, Woodward A. Widening ethnic mortality disparities in New Zealand 1981-99, *Soc Sci Med* 2005; 61:2233-2251..

3. Bramley D, Herbert P, Tuzzio L, Chassin M. Disparities in indigenous health: a cross-country comparison between New Zealand and the United States. *Am J Pub Hlth* 2005; 95(5):844-850.

4. Sporle A, Pearce N, Davis P. Social class mortality differences in Maori and non-Maori men aged 15-64 during the last two decades. *NZ Med J* 2002; 115(1150):127-131.

5. Ministry of Health. 2002a. *He Korowai Oranga: Maori Health Strategy.* Wellington: Ministry of Health, 2002a.

6. Ministry of Health. 2002b. *Whakatataka Maori Health Action Plan 2002-2005.* Wellington, Ministry of Health, 2002b.

7. Mitchell EA. Racial inequalities in childhood asthma. *Soc Sci Med* 1991;32(7):831-6.

8. French S, Old A, Healy J. *Health care systems in transition. New Zealand*. Copenhagen: European Observatory on Health Care Systems, 2001.

9. Thomas EJ, Petersen LA. Measuring errors and adverse events in health care. *J Gen Intern Med* 2003;8:61-67.

10. Davis P, Lay-Yee R, Briant R, Schug S, Scott A, Johnson S, Bingley W. *Adverse events in New Zealand public hospitals: Principal findings from a national survey*. Occasional Paper No 3. Wellington: Ministry of Health, 2001. (Available at http://www.moh.govt.nz/moh.nsf/)

11. Davis P, Lay-Yee R, Briant R, Ali W, Scott A, Schug S. Adverse events in New Zealand public hospitals I: occurrence and impact. *NZ Med J*, 2002; 115(1167): 271-9.

12. Brennan TA, Leape LL, Laird NM, Hebert L, Localio AR, Lawthers AG et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. *New Eng J Med* 1991;324(6):370-6.

13. Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The Quality in Australian Health Care Study. *Med J Aust* 1995;163(9):458-71.

14. Crampton P, Salmond C, Sutton F. *NZDep96: Index of Deprivation*. Report No 8. Wellington: Health Services Research Centre;1997.

15. New Zealand Health Information Service. *Data Dictionary National Minimum Dataset*. Wellington: Ministry of Health; 1998.

16. Korn EL, Graubard BI. *Analysis of health surveys*. New York: John Wiley & Sons, 1999.

17. Ahmad OB, Boschi-Pinto C, Lopez A, Murray CJL, Lozano R, Inoue M. *Age standardization of rates: a new WHO standard*. GPE Discussion Paper Series No 31. Geneva: WHO, 2002.

18. Neale G, Woloshynowych M. Retrospective case record review: a blunt instrument that needs sharpening. *Qual Saf Health Care* 2003;12:2-3.

19. Thomas EJ, Studdert DM, Brennan TA. The reliability of medical record review for estimating adverse event rates. *Ann Internal Med* 2002;136:812-816.

20. Goldman RL. The reliability of assessment of peer assessments of quality of care. *JAMA* 1992;267(7):958-950.

21. Burstin HR, Lipsitz SR, Brennan TA. Socioeconomic status and risk for substandard medical care. *JAMA* 1992;268:2383-2387.

22. Gornick ME, Egers PW, Reilly TW, Mentnech RM et al. Effects of race and income on mortality and use of services among Medicare beneficiaries. *N Engl J Med* 1996;335(11):791-799.

23. Jha AK, Shiplak MG, Hosmer W, Frances CD, Browner WS. Racial differences in mortality among men hospitalized in the Veterans Affairs health care system. *JAMA* 2001; 285(3):297-303.

24. Joe JJ. The rationing of healthcare and health disparity for the American Indians/Alaska Natives. In Institute of Medicine, *Unequal treatment: confronting racial and ethnic disparities in health care*. Smedley BD, Stith AY, Nelson AR, eds. Washington, DC: National Academy Press, pp. 528-551, 2003.

25. Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Trends in the quality of care and racial disparities in Medicare managed care. *New Eng J Med* 2005; 353(7):692-700.

26. Schoen C, Blendon R, DesRoches C, Osborn R, Doty M, Downey D. *New Zealand adults' health care system views and experiences, 2001: Findings from the Commonwealth Fund 2001. International Health Policy Survey.* New York: The Commonwealth Fund, 2002.

27. Tukuitonga C, Bindman A. Ethnic and gender differences in the use of coronary artery revascularisation procedures in New Zealand. *NZ Med J* 115; 2002:179-182.

28. Westbrooke I, Baxter J, Hogan H. Are Maori under-served for cardiac interventions? *NZ Med J* 114; 2000:484-487.

29. Paterson RJ. The patients’ complaints system in New Zealand. *Hlth Affairs* 21(3); 2002:70-79.

30. Schoen C, Osborn R, Huynh PT, Doty M, Sapert K, Peugh J, Davis K. Taking the pulse of health care systems: Experiences of patients with health problems in six countries. *Hlth Affairs - Web Exclusive W5;* 2005:509-525.
URL: content .healthaffairs.org/cgi/content/abstract/hlthaff.w5.509

31. Cunningham C, Durie M. Te Rerenga Hauora. In *Health and Society in Aotearoa New Zealand* (K. Dew and P. Davis, eds.). Second Edition. Melbourne: Oxford University Press, pp. 211-232, 2005.

32. Wepa D (ed). *Cultural Safety in Aotearoa New Zealand.* Auckland: Pearson Education, 2005.

33. Fiscella K, Franks P, Gold MR, Clancy CM. Inequality in quality: addressing socioeconomic, racial, and ethnic disparities in health care. *JAMA* 2000;283:2579-2584.

Table 1. Socio-demographic and clinical characteristics of patients, by indigeneity.

	Maori	**Non-Maori/Non-Pacific**	**Total ***
	n (%)	n (%)	n (%)
Admissions:	1,013 (15.5) †	5,326 (80.1)	6,579 (100.0)
Socio-demographic characteristics			
0-24 years	503 (49.2)	1,413 (26.5)	2,013 (30.5)
25-44	260 (25.5)	1,081 (20.4)	1,417 (21.6)
45+	250 (25.3)	2,832 (53.1)	3,149 (47.9)
Total	100.0%	100.0%	100.0%
Female	568 (55.8)	2,914 (54.8)	3,611 (54.9)
Deprived ‡	838 (82.1)	3,035 (57.4)	4,083 (62.4)
Clinical attributes			
Acute	657 (65.3)	3,494 (66.0)	4,310 (66.0)
Hospital stay in days for sampled admission, mean (sd)	4.3 (7.6)	5.3 (8.4)	5.1 (8.3)
Major diagnostic category §			
Pregnancy	165 (16.2)	528 (10.0)	736 (11.2)
Respiratory	122 (12.1)	416 (7.8)	563 (8.5)
Musculoskeletal	108 (10.7)	614 (11.3)	741 (11.1)
Neonatal	104 (10.0)	356 (6.7)	487 (7.4)
Digestive	86 (8.3)	559 (10.6)	667 (10.2)
Circulatory	65 (6.6)	795 (14.9)	881 (13.4)
Other	363 (36.1)	2,058 (38.7)	2,504 (38.2)
Total	100.0%	100.0%	100.0%

* Includes Maori, Pacific, and non-Maori/non-Pacific patients.

† Crude numbers are cited. Percentages and means have been weighted to account for the stratified cluster sample design.

‡ Deciles 6 to 10 of NZDep96; 5 Maori and 71 non-Maori/non-Pacific cases could not be coded.

§ Ordered according to percentage of Maori admissions. ‘Other’ comprises the remaining 19 categories each containing under 5% of admissions including notably: nervous system; kidney and urinary tract; skin, tissue and breast; and injury, poisonings and drugs.

Table 2. Clinical and incident characteristics of adverse events by indigeneity.

		Maori	**Non-Maori/ Non-Pacific**	**Difference (standard error)**	**t, p values**
		n (%)	n (%)		
Adverse events† : n=850 (100.0%)‡		135 (15.5) §	683 (80.4)	-	-
Clinical attributes					
	Acute	94 (68.8)	449 (65.4)	3.4 (5.6)	0.61, 0.5527
	Hospital stay in days for sampled admission, mean (sd)	7.6 (13.9)	10.0 (15.0)	-2.4 (1.4)	1.72, 0.1170
Incident characteristics (age-standardised) ‖					
	In-hospital ¶	121 (89.8)	535 (82.1)	7.7 (3.6)	2.16, 0.0556
	Preventable **	80 (58.2)	428 (59.3)	-1.1 (5.9)	0.18, 0.8611
	Severe ††	14 (10.4)	107 (12.4)	-2.0 (2.0)	0.95, 0.3649
	Surgery §§	66 (48.7)	400 (63.4)	-14.7 (4.8)	3.04, 0.0125*
	Systems failure	42 (30.4)	197 (28.4)	2.0 (5.3)	0.38, 0.7090
	Attributable days stay, mean (sd) ¶¶	8.7 (14.8)	8.5 (19.6)	0.23 (1.5)	0.15, 0.8860

* $p<0.05$

† Any evidence of health care management causation.

‡ Includes Maori, Pacific, and non-Maori/non-Pacific patients.

§ Crude numbers are cited. Percentages, means and standard errors have been adjusted to account for the stratified cluster sample design.

‖ Age-standardised to Segi's world population.

¶ Adverse event occurred inside hospital.

** Any evidence of preventability.

†† Permanent disability or death.

§§ Includes all surgical specialties plus anaesthesiology and obstetrics.

¶¶ 4 Maori and 6 non-Maori/non-Pacific cases had missing data.

Table 3. Occurrence rates of adverse events by indigeneity.

		Maori (n=1013)	**Non-Maori/ Non-Pacific** (n=5326)	**Difference (standard error)**	**t, p values**
All adverse events †		n (%)	n (%)		
	Crude	135 (13.9) ‡	683 (13.0)	0.84 (0.95)	0.89, 0.3952
	Age-standardised §	135 (14.0)	683 (11.0)	3.0 (0.98)	3.10, 0.0113*
In-hospital adverse events only (age-standardised) §					
	All ‖	121 (12.5)	535 (9.0)	3.5 (0.83)	4.33, 0.0015*
	Preventable ¶	69 (7.1)	324 (5.1)	2.0 (0.61)	3.21, 0.0094*
	Preventable and severe **	4 (0.40)	51 (0.64)	-0.24 (0.08)	3.03, 0.0126*

* p<0.05

† Any evidence of health care management causation.

‡ Crude numbers are cited. Rates and standard errors have been adjusted to account for the stratified cluster sample design.

§ Age-standardised to Segi's world population.

‖ Adverse event occurred inside hospital.

¶ Any evidence of preventability.

** Any evidence of preventability, and permanent disability or death.

Table 4. Adjusted odds ratios of patient factors for association with a preventable in-hospital adverse event. †

Patient factors	**All** (388 AEs vs 5452 non-AEs)	
	Adjusted odds ratio ‖	**2-way chi-square, p ¶**
Indigeneity		3.7997, p=0.0513
Reference is Non-Maori/Non-Pacific	1.00	
Maori	1.47	
Age		41.1108, p<0.0001 *
Reference is 0-24 years	1.00	
25-44 years	1.61	
45+ years	2.26	
Gender		1.1076, p=0.2926
Reference is Female	1.00	
Male	0.84	
Area deprivation ‡		0.2140, p=0.6436
Reference is Low (deciles 1-5)	1.00	
High (deciles 6-10)	1.02	
Major Diagnostic Category §		39.2951, p=0.0001 *
Reference is Other	1.00	
Pregnancy	0.52	
Respiratory	0.80	
Musculoskeletal	1.61	
Neonatal	0.65	
Digestive	1.49	
Circulatory	0.77	

AE=adverse event.

* p<0.05

† Any evidence of health care management causation; and AE occurred inside hospital; and any evidence of preventability.

‡ 5 Maori and 71 non-Maori/non-Pacific cases could not be coded and have been excluded from analysis; their profile on other patient factors was similar to the included cases.

§ Ordered by percentage of Maori AEs. ‘Other’ comprises the remaining 19 categories each containing under 5% of admissions including notably: nervous system; kidney and urinary tract; skin, tissue and breast; and injury, poisonings and drugs.

‖ Odds ratios were estimated using multiple logistic regression, weighted to account for the sample design, with all patient factors in the model. Each odds ratio is adjusted for the effect of the other patient factors.

¶ Rao-Scott chi-square test (accounts for the stratified cluster sample design).

Table 5. Age-standardised distribution of preventable in-hospital adverse events* by indigeneity, and areas of effort for prevention.

		Maori	**Non-Maori/Non-Pacific**
		% of 69 AEs	% of 324 AEs
Area of effort †		number of AEs (%)	number of AEs (%)
	System ‖	43 (47.5) ‡	206 (47.8)
	Consultation ¶	29 (37.5)	146 (35.0)
	Education	29 (36.6)	116 (22.9)
	Resources **	8 (10.8)	71 (15.5)
	Quality Assurance	7 (9.3)	50 (14.6)
	Other ††	17 (23.8)	88 (21.4)

AE = adverse event.

* Any evidence of health care management causation; and AE occurred inside hospital; and any evidence of preventability.

† The percentage for each area is the percentage of all preventable in-hospital AEs; more than one area could be identified so the percentages do not add to 100%; ordered according to the percentage of Maori AEs.

‡ Percentages have been weighted to account for the sample design, and age-standardised to Segi's world population.

‖ Policies/protocols, access to or transfer of information, communication, discharge procedures/protocols, organisation management/culture, and record-keeping.

¶ Consultation with specialists or peers.

** Personnel, equipment/other physical resources.

†† Includes credentialling and retraining.