Title: Are waiting list prioritisation guidelines being followed in Australia?

Authors: Meliyanni Johar, PhD

Associate Professor

Economics Discipline Group

University of Technology Sydney

Correspondence: Meliyanni Johar, PhD

PO Box 123, Broadway NSW 2007, Australia
Email: Meliyanni.johar@uts.edu.au
Telephone: +612 9514 7742
Fax: +612 9514 7722

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Abstract

Objective When waiting lists are used to ration treatments for non-emergency procedures, a prioritisation rule is required to ensure that urgent patients are admitted first. This study investigates how the introduction of an explicit prioritisation guideline affected the prioritisation behaviour of doctors, who previously had full discretion for assigning patients.

Design The analysis exploits the publication of recommended priority categories in public hospitals. Taking the recommendations as a reference, deviations from the recommended priority assignments by doctors before and after the guideline publication are assessed. Multinomial logit models are used to control for patient and hospital characteristics. Heterogeneity in the impact of the guideline across patient characteristics is explored through interaction terms.

Setting The state of New South Wales, Australia, between July 2004 and December 2010.

Participants Admissions via waiting lists in public hospitals (N=753,010).

Main outcome measure Priority categories assigned by doctors.

Results The guideline increased the likelihood that doctors would actually assign a semi-urgent priority to admissions with a recommended priority of semi-urgent by 11.7 percentage points (p-value<0.000) and would assign a non-urgent priority to admissions with a recommended priority of non-urgent by 13.1 percentage points (p-value<0.000). In contrast, the guideline lowered the likelihood of an urgent priority being assigned to admissions with a recommended priority of urgent by 13.7 percentage points (p-value<0.000). Priority assignments are affected by payment status; specifically, a higher priority is given to paying patients, and this preferential treatment is not diminished by the presence of the guideline.

Conclusion The presence of a simple clinical priority guideline at the procedural level has not produced systematic, clinically based prioritisation behaviours among doctors. The NSW priority guideline has curtailed assignments to the highest priority. This result raises a question concerning the usefulness of such a guideline in improving timely and equitable access to health care.

INTRODUCTION

Only a few countries (New Zealand, Sweden, Spain and several Canadian provinces) have developed formal algorithms to make the prioritisation of waiting lists for non-emergency (elective) procedures more systematic and provide more certainty to patients about the timing of their access to treatment. Generally, prioritisation rules require that patients with the most life-threatening or urgent conditions should be admitted first. For example, Canada and New Zealand have developed explicit, systematic prioritisation rules in the form of scoring tools that include both clinical criteria and social factors perceived to contribute to the urgency of treatment, such as the inability to live independently [1]. In contrast, most other countries where waiting lists are used, including the UK and Australia, do not use an explicit tool for prioritising patients on waiting lists. In the absence of such a prioritisation scoring tool, referring and treating physicians use their judgement to schedule patients on waiting lists, and they have considerable discretion in doing so, such as by assigning patients to a higher clinical priority category to expedite admission [2,3].

As waiting times are determined largely by the clinical priority category, advancement on the waiting list can be advantageous to some less urgent patients, who end up facing shorter waits. However, patients whose admissions were delayed because they were assigned to a lower clinical priority category than clinically indicated may experience prolonged suffering and a reduced quality of life and have worse health outcomes [4,5]. This study exploits a policy change created by the publication of *Advice for Referring & Treating Doctors - Managing Elective Patients/ Waiting Lists* in April 2006 [6,7] in public hospitals in New South Wales (NSW), the most populous state of Australia, to identify changes in prioritisation behaviour among referring or treating doctors following the introduction of prioritisation recommendations. The NSW guideline is only a recommendation for doctors, not a rule, and is not mandatory. The guideline contains recommendations for 170 elective procedures and was released by the NSW Department of Health with the objective of achieving "clinically appropriate, consistent and equitable management of elective patients and waiting lists in public hospitals across NSW" (p.1) [6].

In Australia's tax-funded universal health system, waiting lists are used to ration the demand for elective procedures in public hospitals, which are provided free of charge to Australian residents. Patients have the alternative to go to private hospitals, where there is no waiting list, but treatments in private hospitals would involve payments (as an out-of-pocket expense or through private health insurance). In public hospitals, to ensure that patients are treated in a timely manner, a clinical priority categorisation is used. There are three clinical priority categories: 30 day (urgent), 90 day (semi-urgent)

and 365 day (non-urgent). These priority categories reflect the maximum waiting time beyond which treatment can be considered overdue and possibly carry health risks to patients. Patients assigned to an urgent priority category should have a condition that can deteriorate quickly and may become an emergency. Patients assigned to a semi-urgent priority category should have a lower risk of developing an emergency, whereas patients assigned to a non-urgent priority category should not have any potential to develop an emergency. Assignment to one of these categories has been the responsibility of the referring specialist when booking the patient on a hospital waiting list (i.e., at the beginning of the waiting period). The clinical priority categorisation determines where the patient is placed on the waiting list and hence his/her admission order.

Ideally, the priority assignments should solely be based on the patient's clinical need. However, there has been evidence that waiting list prioritisation is affected not only by the patient's clinical need but also by non-clinical factors. Controlling for health status, socioeconomically advantaged patients have been found to have significantly lower waiting times than their less advantaged counterparts [8, 9]. In Australia, patients can be admitted to public hospitals as 'public' or 'private' patients, where 'public' and 'private' refer to the patient's payment status. Private patients incur hospital and medical charges (as an out-of-pocket expense or through private health insurance) in exchange for the choice of doctor and a better standard of accommodation. There is evidence that private patients are admitted faster than public patients [3]. Private patients are a source of revenue for the hospital in addition to their fixed periodic government funding, so both hospitals and doctors have financial incentives to expedite their admission. Even after controlling for the health profile in the hospital's area, waiting times have also been shown to vary substantially across areas [10]. All of these findings provide challenges to the equity principle of the Australian universal health system that all residents should have the same access to health care irrespective of the ability to pay.

The publication of a guideline might be expected to make priority assignments by doctors more systematic, ensuring that patients with similar conditions are prioritised in a similar manner. This study will first outline the priority assignments by doctors in the absence of guidelines, then use a before and after analysis to measure the impact of the guideline on this prioritisation behaviour. This study will also examine whether the guideline reduces any non-clinical prioritisation behaviour that existed in the pre-guideline period. Given that the guideline has no specific target or criterion, such as achieving a certain level of admissions, the question of interest is more about whether the guideline has changed any of the doctors' behaviour in assigning urgency priority for patients.

METHODS

Data

The data were derived from the waiting list data linked to admission data in NSW public hospitals from July 2004 to December 2010 by the NSW Department of Health, under ethics approval from the NSW Population and Health Services Research Ethics Committee. These data included elective patients of all ages who completed their waiting period and any associated inpatient stay in NSW public hospitals during this period. For each admission, the priority category assigned by the treating doctor was recorded when the patient was booked.

During the entire sample period, there were 1,778,659 ready-for-care admissions from waiting lists in the 114 NSW public hospitals. Overall, 74% of the admissions in the sample population were for procedures that are covered by the guidelines. Non-covered procedures were mostly for injections, blood transfusions, chemotherapy and MRI scans or were broadly defined procedures, such as other surgical, other medical and other general. Twenty-six procedures were excluded because they have multiple priority recommendations (i.e., can be urgent or non-urgent), which creates ambiguity in their pairings with the observed priority assignment. These procedures include cholecystectomy, gastroscopy, colonoscopy and removal of skin lesions. Excluding admissions for these twenty-six procedures reduced the sample by 41.6%. Furthermore, admissions for three new procedure codes were excluded because these procedures did not exist in the pre-guideline period. This exclusion reduces the sample population by a further 2%. The remaining sample consisted of 753,010 observations. Most patients (92.1%) had only one admission in a year. Multiple admissions were typically for different procedures. Overall, the study involves 586,939 unique individuals (78% of the sample population).

Because the data are exclusive to NSW public hospitals, transfers to waiting lists in public hospitals in other Australian states were not observed. However, these transfers should not occur too often because of travel and accommodation costs and the fact that Australian public hospitals are similar in terms of resources. For example, the median waiting time across all elective procedures in NSW public hospitals fluctuates around 30-40 days, and this figure across all Australian hospitals is approximately 35 days [11].

Statistical method

To identify a change in prioritisation behaviour, the empirical approach exploits the introduction of the NSW clinical priority category guideline and conducts a before and after analysis. A dummy variable $After$ is created, using a value of one for the post-guideline period between May 2006 and December 2010 and zero for the pre-guideline

period between July 2004 and April 2006. For each recommended priority category (urgent, semi-urgent and non-urgent), a treating doctor can do one of two things: follow the recommendation and assign a patient to the recommended priority category or not follow the recommendation and assign the patient to one of the other two categories. For example, a procedure recommended as semi-urgent can be assigned to an urgent or non-urgent priority category.

Because prioritisation behaviour may also be influenced by a number of other factors, multinomial logit models control for the confounding effects of these factors from the effect of the guideline. Three multinomial logit models were estimated, one for each recommended clinical category. For each recommended priority category, the log-odds of each response was assumed to follow a linear model:

$$(1)\ \log\left(\frac{\pi_{ij}}{\pi_{ik}}\right) = \alpha_{0j} + \alpha'_{1j}After_i + \alpha'_{2j}X_i + \alpha'_{3j}H_i$$

where π_{ij} denotes the probability of admission i being assigned to category j (j = urgent, semi-urgent or non-urgent) and π_{ik} is the reference probability, which is chosen to be the category that is consistent with the recommendation. For example, for procedures that were recommended as urgent, the reference group is admissions that were also assigned as urgent. Thus, the log-odds represent the tendency of a doctor to assign a patient to a "wrong" priority category. α is the regression coefficient to be estimated, which vary with category j. $After_i$ is the dummy variable for the post-policy period. The effect of $After$ indicates the extent to which prioritisation has become more aligned or consistent with the guideline. X_i denotes a vector of patient characteristics, including age, sex, primary diagnosis, comorbidities (as measured by the number of secondary diagnoses), public/private patient status, socioeconomic characteristics of the patient's residential area (as measured by the Australian Bureau of Statistics' Index of Relative Socioeconomic Advantage and Disadvantage, IRSAD) and remoteness of the patient's residential area (as measured by the Australian Bureau of Statistics' Accessibility/ Remoteness Index of Australia, ARIA). H_i consists of hospital characteristics including the type of hospital (principal referral/specialist, major, district or community hospital) and administrative boundary (Area Health Services, AHS). Although the peer group and AHS should account for most of the variations in the hospital characteristics, there may be some further unobserved hospital characteristics that correlate with urgency assignment. Individual hospital fixed effects can be used to control for this source of omitted variable bias, but I found that in models by the recommended priority category, many hospitals have a small number of inconsistent assignments, creating a convergence problem. An alternative model that pooled all of the recommended priority categories was therefore estimated to ensure the robustness of the policy impact to the inclusion of hospital fixed effects. In this regression, dummy

variables for the recommended category are included as explanatory variables as well as their interactions with patient characteristics. The robustness of the policy impact was confirmed.

Although equation (1) provides the overall impact of the guideline, testing whether the guideline has had varying effects over time and has affected the prioritisation of some patients more than others is also of interest. To achieve the first objective, the guideline impact is estimated for each year of the post-guideline period via 5 dummy variables for the last 8 months of 2006 and the full years of 2007, 2008, 2009 and 2010. Therefore, in equation (1), $After_i$ is now a [1 x 5] vector of these post-year dummy variables, and α_{1j} is its coefficient vector measuring the average change in the log odds ratio in a given post-guideline year relative to the pre-guideline periods. To achieve the second objective, interaction terms between X and $After$ are used. To avoid having too many interaction terms, $After$ is once again defined as binary, capturing pre- vs. post-guideline periods. The primary interest here is to investigate whether the guideline has reduced any non-clinically based prioritisation by doctors that existed prior to its introduction. Equation (1) is augmented by the following:

$$(2)\ \log\left(\frac{\pi_{ij}}{\pi_{ik}}\right) = \beta_{0j} + \beta'_{1j}After_i + \beta'_{2j}X_i + \beta'_{3j}H_i + \beta'_{4j}(X_i \times After_i).$$

The entire analysis is conducted using STATA/MP software. The standard errors of estimates are sandwich standard errors that are corrected for intra-group correlation by procedure.

RESULTS

Table 1 shows how the volume of admissions by priority category varied over time. The first three columns show volumes by recommended priority, which reflect the demand for various procedures across years. These values are largely stable, suggesting that hospitals neither increased nor decreased their admissions after the publication of the guideline. More than 70% of the admissions were for non-urgent procedures, recommended to be admitted within 365 days. The picture was rather different for admissions by the doctors' priority assignments in the last three columns. Prior to the guideline, each of the three priority categories accounted for approximately one-third of the total admissions, but post-guideline, the share of urgent assignments fell 13 percentage points to 21%, whereas the share of non-urgent assignments rose 13 percentage points to 48%.

Table 2 presents the mean of the patient and hospital characteristics by recommended priority category before and after the publication of the guideline. Patients who were

assigned to urgent priority are older, more likely to be male, have more comorbidities and are more likely to be private patients compared with the patients who were assigned to a less urgent priority. Circulatory conditions were by far the most common condition group among urgent procedures, followed by respiratory and kidney conditions. Meanwhile, the semi-urgent procedures largely involved diseases of gender-specific organs and the digestive system. For non-urgent procedures, approximately 60% of admissions were for eye, ear, nose and throat (ENT) and musculoskeletal conditions. Urgent procedures were mostly performed in principal referral hospitals, whereas less urgent procedures were more widely distributed across various hospital types. Post-guideline, there were changes in the patient and hospital characteristics, highlighting the importance of controlling for these characteristics in the estimation. There were less recorded comorbidity data in general, which may reflect structural changes over time due to an aggregation of some diagnosis codes or the adoption of a new system of medical recording. The share of private patients increased for urgent procedures and decreased for non-urgent procedures. The share of circulatory conditions among urgent procedures fell, whereas the shares of admissions for kidney and male organ conditions increased. The distribution of diagnoses for less urgent categories was relatively stable. In the post-guideline period, there was an increasing share of admissions being performed in major hospitals.

Table 3 reports the overall impact of the guideline on priority assignment. The first three columns show the prioritisation behaviour before the introduction of the guideline (baseline). For example, the first row shows how procedures that were recommended as urgent by the guideline were actually assigned in practice by the doctor. Most (83.5%) were consistently assigned as urgent. The remainder were assigned to lower priority or less urgent categories, with most in the semi-urgent category (12.7%). When there was more scope for treatment delay, the consistency between the recommended and actual assignment was much lower. For semi-urgent procedures, only 33.8% were assigned to the semi-urgent category. The majority of the semi-urgent procedures were assigned to urgent. For non-urgent procedures, 45.9% were consistently assigned to non-urgent, with nearly a quarter of the remaining cases assigned to urgent. The Kappa statistic, which is a summary measure of agreement between two or more independent graders evaluating the same item that takes into account the possibility that these graders may agree just by chance, is 0.263 (p-value 0.000), indicating that there is a 'fair agreement' (kappa statistic between 0.2 and 0.4) between the recommended and assigned urgency.

The next three columns of Table 3 report the unconditional change in the prioritisation behaviour after the guideline. These estimates are simply the sample mean differences in each cell before and after the guideline. They indicate that for urgent procedures, the

guideline actually reduced, rather than improved, the agreement between the recommended and actual assignments by 11.9 percentage points (p<0.000). For semi-urgent and non-urgent procedures, the guideline improved the consistency in assignments by 12.5 and 15.7 percentage points, respectively (p<0.000 for both). Table 3 also indicates that the guideline reduced assignments to a higher priority category than recommended, with the number of semi-urgent procedures assigned to the urgent category lowered by 16.1 percentage points and the number of non-urgent procedures assigned to the urgent category being halved.

The last three columns of Table 3 report the conditional impact (on covariates) of the guideline using multinomial logit models of the equation (1). These data represent the impact of the guideline, taking into account differences in the patient and hospital characteristics. The full results are provided in the Appendix. The conditional estimates are not very different from the unconditional estimates. For urgent procedures, the adjustment reduced the likelihood of doctors following the recommendation and assigning urgent priority to admissions with a recommended priority of urgent by 13.7 percentage points (p-value <0.000), whereas for semi-urgent and non-urgent procedures, the guideline increased the likelihood of observing doctors assigning semi-urgent priority to admissions with a recommended priority of semi-urgent by 11.7 (p-value<0.000) and assigning non-urgent priority to admissions with a recommended priority of non-urgent by 13.1 (p-value<0.000) percentage points.

Figure 1 shows the guideline impact on aligning priority assignments by year of the post-guideline period. For urgent procedures, the guideline impact was relatively constant after the first few months of its release. For semi-urgent and non-urgent procedures, the guideline had larger impacts in later years but stabilised in the last two years. This pattern may reflect delays in doctors becoming aware of and adopting the guideline in the first years following its introduction.

Table 4 presents the relative risk ratios (RRRs) from the multinomial logit models with interaction terms (equation (2)). An RRR that is greater than one indicates that the risk of having an assignment inconsistent with the guideline increases as the variable increases or, for a dummy variable, as the variable is switched on. In contrast, an RRR that is less than one indicates that an outcome in which doctors assigned a priority category as recommended is more likely. For urgent procedures (Model 1), older and private patients are more likely to be assigned as urgent rather than semi-urgent. The guideline does not reduce the private patient advantage, as the RRR of the interaction term with private patients is not significant. Relative to the reference diagnosis category, circulatory conditions, conditions of the nervous system, ENT, respiratory system and skin were less likely to be assigned to semi-urgent. ENT and skin became

more likely to be misclassified as semi-urgent after the guideline was introduced. There were fewer significant results for an inconsistent assignment to the non-urgent category being related to non-clinical patient characteristics. A greater number of comorbidities was associated with a lower risk of being assigned as non-urgent. For semi-urgent procedures (Model 2), private patients had much higher odds of being assigned as urgent rather than semi-urgent, as recommended. With the effects of all other variables being held constant, private patients were estimated to be 1.5 times more likely to be advanced to urgent priority than public (non-paying) patients. Again, this advantage was not reduced with the guideline publication, as the RRR of the interaction term $After \times Private$ is not significantly different from 1. In fact, the results also showed that the guideline lowered the chance of private patients being incorrectly assigned as non-urgent. Relative to the reference category, digestive conditions, ENT and respiratory conditions were more likely to be assigned to the two extreme priority categories than semi-urgent, conditions of the nervous system were more likely to be assigned to urgent, and musculoskeletal conditions were more likely to be assigned to non-urgent. Following the guideline, respiratory conditions are now more likely to be correctly assigned as semi-urgent. Finally, for non-urgent procedures (Model 3), patients with a greater number of comorbidities are more likely to be assigned a higher priority category than recommended, and this trend seems to continue despite the guideline. Private patients were 3 times more likely to be assigned as urgent priority and 1.8 times more likely to be assigned as semi-urgent priority for non-urgent procedures than public patients by their doctors. This preferential treatment has not changed with the guideline. With regard to the hospital characteristics, the risk of observing priority assignments that are less urgent than recommended was higher for non-principal referral hospitals, which may reflect the higher capacity of the constraints faced by smaller hospitals.

DISCUSSION

The above results indicate that a simple clinical priority guideline at the procedural level is unlikely to produce a systematic prioritisation process, with continuing preferential treatment given to private patients that is not justified by clinical needs. Despite the presence of the guideline, approximately 30% of the admissions for procedures that are recommended as urgent are not classified as urgent. In fact, this trend is worse compared with the pre-guideline period. For semi-urgent procedures, there is even less alignment, with 55% of the admissions for semi-urgent procedures not being assigned as semi-urgent.

The finding that adherence falls for those who need urgent care is a concern given that one of the objectives of the guideline is to promote timely treatment, which is likely to be most critical for the urgent cases. Policymakers should communicate with doctors and hospitals to find out more about their attitude toward urgent admissions. The guideline may make providers reserve resources whenever they can, in case there is an increase in demand for procedures that the guideline recommends to be of urgent priority that cannot be deferred. NSW indeed has a relatively high proportion of urgent admissions compared with other major Australian states, such as Victoria [11], which may have actually motivated the guideline in the first place although this reasoning was not explicitly stated. There is also anecdotal evidence that given the growing demand for transparency in hospital performance, public reporting of performance indicators creates incentives for providers to manipulate priority assignment to produce more favourable outcome statistics. The proportion of waiting list patients that are admitted within the clinically recommended time is one of the reporting variables in the periodic publications from the Australian Health Institute of Welfare (AIHW). The drop in the share of admissions assigned as urgent and the increase in the share of admissions assigned as non-urgent after the guideline (Table 1) are consistent with the conjecture of gaming behaviour by providers because achieving on-time admissions may be more difficult for the urgent category, which has a relatively short waiting period. However, access to the hospital performance measures by the general public (e.g., through the *myHospitals* website) did not start until 2009. The stable guideline impact on urgent assignments since 2007 seen in Figure 1 suggests that the curtailment of assignments to the highest priority group was not driven by public reporting; otherwise, we would expect to see larger impacts in 2009 and 2010.

To the extent that the guideline has a fairness objective, "consistent and equitable management of elective patients", the guideline is a failure. One may define fairness by urgent patients being treated first, but the results show that the guideline reduces the likelihood that a patient with an urgent procedure is correctly assigned as urgent. The concept of fairness may also overlap with the equity objective that all patients should not be treated based on health insurance status ("Allocation of the Clinical Priority category for patients is based on clinical need, regardless of health insurance status", p.2) [6]. The results show that the guideline has not reduced any of the preferential treatment given to private patients. Giving priority to private patients is likely to come at the cost of the care of public patients in public hospitals, who may face further delays in their admissions. One way to promote greater equity could be to discourage providers from engaging in non-clinical-based priority assignments by making hospitals more transparent to the general public and report waiting times by indicators of patient socioeconomic status, such as payment status.

In addition, although the guideline does not explicitly state an efficiency objective, the fact that hospitals maintained their case load (Table 1) suggests that the guideline has also not allowed hospitals to admit more patients. The re-allocation of patients is effectively a zero sum game. However, the stable volume may reflect the long-term demand for elective procedures.

There are two factors that may have led to the results being an overestimation. First, a limitation in using admission data is that the data contain only patients who have completed the waiting period; data linkage can only be established for completed waits. This fact may create bias if the priority assignments by doctors induce drop-outs from the waiting list. Specifically, if the guideline reveals to patients that they were assigned a lower priority category than what is recommended for their procedures and they exit the waiting lists before admission, then our sample is biased towards admissions that are consistent with the guideline or at a higher priority than recommended. However, the stable number of admissions before and after the policy (Table 1) suggests that this source of bias is small. Furthermore, if there are significant drop-outs from the waiting list, we should observe this effect much more strongly among private patients assigned to the least urgent category because their private health insurance or greater economic resources are likely to provide them more ready access to treatment, without delay, in a private hospital. This pattern is not supported by the data, with steady proportions of private patients who were assigned as non-urgent over time. Second, hospitals selecting patients who give them the highest chance of fast admissions may be reinforced by the introduction of the guideline, creating a positive bias. However, I found no correlation between the change in the individual hospital market share before and after the guideline and the mean waiting time prior to the guideline (p-value of 0.9). Furthermore, as previously mentioned, the policy impact is robust for hospital fixed effects, which also capture the intrinsic patient allocation of a hospital, based on location (catering to patients living nearby) and preference. Third, to ensure a clean empirical analysis, the sample population excluded patients with multiple possible priority categories. This exclusion may create a sample selection bias toward procedures that have less uncertainty regarding the appropriate priority.

The failure of the guideline may be due to its design. Previous studies and commentaries have discussed the challenges of designing an appropriate prioritisation scoring tool [2,12,13], and suggesting an ideal design is beyond the scope of this paper. Nonetheless, the NSW guideline has provided a case study of the practicality of a simple priority guideline by procedure, which does not appear to be effective. There should be more integration between the policymakers and the health providers whose reactions will determine the success of the policy.

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Table 1: Hospital case load by the recommended and assigned priority categories over time

	Recommended			Assigned		
	Urgent	Semi-urgent	Non-urgent	Urgent	Semi-urgent	Non-urgent
Before guideline						
July – Dec 2004	5,874	12,373	41,303	20,898	18,384	20,268
2005	10,854	23,582	84,094	40,158	36,696	41,676
Jan – Apr 2006	2,771	6,800	24,930	10,794	11,143	12,564
Total	19,499	42,755	150,327	71,850	66,223	74,508
(%)	(9.17%)	(20.11%)	(70.72%)	(33.80%)	(31.15%)	(35.05%)
After guideline						
May – Dec 2006	6,357	15,977	60,242	21,779	26,465	34,332
2007	9,086	21,137	82,401	24,892	37,047	50,685
2008	9,645	22,475	85,841	23,733	37,579	56,649
2009	9,433	21,511	78,967	21,417	31,661	56,833
2010	9,322	22,776	85,260	20,931	34,157	62,270
TOTAL	43,843	103,876	392,711	112,752	166,909	260,769
(%)	(8.11%)	(19.22%)	(72.67%)	(20.86%)	(30.88%)	(48.25%)

Note: 'Recommended' refers to priority categorisation according to the NSW clinical priority guideline by procedure, and 'Assigned' refers to the observed priority category given by the treating doctor.

Table 2: Patient and hospital characteristics by recommended priority before and after the guideline

Recommended priority	Urgent			Semi-urgent			Non-urgent		
	Before	After	p-value	Before	After	p-value	Before	After	p-value
Age	60.36	60.49	0.423	45.32	46.6	0.000	48.97	50.31	0.000
Male	0.637	0.645	0.054	0.316	0.317	0.533	0.460	0.464	0.005
Comorbidities	3.895	2.789	0.000	1.824	1.396	0.000	1.630	1.141	0.000
ABS IRSAD	5.773	5.423	0.000	5.754	5.672	0.000	5.363	5.321	0.000
ABS ARIA	0.820	0.964	0.000	0.889	0.889	0.968	1.037	1.048	0.012
Private	0.222	0.241	0.000	0.136	0.131	0.014	0.094	0.085	0.000
Primary Diagnoses									
Nervous system	0.042	0.043	0.589	0.022	0.026	0.000	0.040	0.042	0.000
Eye	0.000	0.000	0.561	0.015	0.016	0.659	0.219	0.233	0.000
ENT	0.012	0.015	0.001	0.041	0.045	0.002	0.163	0.164	0.577
Respiratory	0.193	0.196	0.479	0.001	0.002	0.132	0.007	0.012	0.000
Circulatory	0.595	0.510	0.000	0.003	0.003	0.782	0.020	0.017	0.000
Digestive	0.003	0.003	0.850	0.120	0.108	0.000	0.125	0.126	0.447
Musculoskeletal	0.003	0.004	0.204	0.009	0.009	0.130	0.216	0.228	0.000
Skin	0.012	0.020	0.045	0.034	0.033	0.187	0.015	0.014	0.050
Kidney	0.064	0.094	0.000	0.075	0.062	0.000	0.001	0.001	0.154
Male organ	0.012	0.043	0.000	0.103	0.120	0.000	0.045	0.034	0.000
Female organ	0.000	0.001	0.012	0.447	0.468	0.000	0.133	0.118	0.000
Other	0.064	0.081	0.000	0.129	0.109	0.000	0.017	0.010	0.000
Hospital type									
Principal Referrals	0.850	0.722	0.000	0.454	0.459	0.107	0.400	0.394	0.000
Major	0.103	0.221	0.000	0.297	0.322	0.000	0.286	0.330	0.000
District	0.042	0.051	0.000	0.214	0.192	0.000	0.281	0.247	0.000
Community	0.005	0.006	0.174	0.035	0.027	0.000	0.033	0.029	0.000
Area Health Service (AHS)									
Sydney South West	0.186	0.169	0.000	0.169	0.181	0.000	0.177	0.181	0.000
South East Sydney & Illawarra	0.338	0.244	0.000	0.223	0.200	0.000	0.199	0.191	0.000
Sydney West	0.163	0.143	0.000	0.164	0.163	0.619	0.107	0.105	0.044
North Sydney & Central Coast	0.151	0.130	0.000	0.136	0.141	0.016	0.114	0.112	0.059
Hunter & New England	0.086	0.130	0.000	0.118	0.113	0.009	0.163	0.160	0.006
North Coast	0.025	0.107	0.000	0.081	0.095	0.000	0.102	0.116	0.000
Greater Southern	0.038	0.058	0.000	0.052	0.054	0.108	0.070	0.067	0.000
Greater Western	0.013	0.019	0.000	0.056	0.052	0.000	0.069	0.068	0.152
N	71,850	112,752		66,222	166,909		74,508	260,769	

Note: N refers to the number of admissions. The p-value is based on the classical hypothesis test of two-sample means. Other diagnoses pool diagnoses with rare prevalence in the sample population (<1%) with a general group 'Factors influencing health status and other contacts with health services'.

Table 3: Impact of the publication of a clinical priority guideline on prioritisation behaviour

Assigned priority (column)	Baseline prioritisation			Impact of guideline (without control)			Impact of guideline (with control)		
Recommended priority (row)	30 day	90 day	365 day	30 day	90 day	365 day	30 day	90 day	365 day
30 day (urgent)	0.8348	0.1267	0.0385	-0.1186	0.0769	0.0418	-0.1366	0.0773	0.0593
				(t = -32.22)	(t = 23.35)	(t = 19.43)	(t = -5.74)	(t = 9.31)	(t = 2.40)
90 day (semi-urgent)	0.5515	0.3379	0.1106	-0.1611	0.1246	0.0365	-0.1490	0.1167	0.0322
				(t = -57.15)	(t = 44.15)	(t = 18.52)	(t = -13.92)	(t = 12.02)	(t = 5.01)
365 day (non-urgent)	0.2128	0.3280	0.4592	-0.1089	-0.0480	0.1570	-0.0891	-0.0420	0.1311
				(t = -106.50)	(t = -34.83)	(t = 105.69)	(t = -20.60)	(t = -3.36)	(t = 10.53)

Note: The impact without controls is based on the difference in the sample means before and after the guideline. The impact with controls is the estimated average partial effects of *after* using three multinomial logit models, one for each recommended category, and their t-statistics are based on clustered robust standard errors by procedures. The critical values for (two-tail) t-distribution with a large sample (>200) and $p<0.05$, $p<0.01$ and $p<0.001$ are 1.97, 2.60 and 3.34, respectively.

Table 4: Relative risk ratios for patient variables from the multinomial logit models

Recommended priority	Urgent (Model1)				Semi-urgent (Model 2)				Non-urgent (Model 3)			
Assigned priority	Semi-urgent		Non-urgent		Urgent		Non-urgent		Urgent		Semi-urgent	
After	1.152	(0.861, 1.542)	1.814	(1.163, 2.831)	0.479	(0.362, 0.635)	1.074	(0.798, 1.445)	0.550	(0.357, 0.847)	1.065	(0.855, 1.327)
Age	0.980	(0.974, 0.987)	0.978	(0.954, 1.003)	1.009	(1.000, 1.020)	1.001	(0.995, 1.007)	0.989	(0.985, 0.993)	0.991	(0.986, 0.997)
Male	0.967	(0.885, 1.055)	0.967	(0.758, 1.234)	0.905	(0.536, 1.528)	1.017	(0.880, 1.174)	1.088	(1.010, 1.173)	1.014	(0.951, 1.081)
Comorbidities	1.027	(1.008, 1.045)	0.948	(0.932, 0.965)	1.037	(1.008, 1.066)	1.000	(0.974, 1.027)	1.075	(1.038, 1.114)	1.033	(1.017, 1.050)
ABS IRSAD	0.986	(0.968, 1.005)	0.963	(0.925, 1.002)	1.012	(0.988, 1.037)	0.984	(0.923, 1.05)	1.044	(1.009, 1.080)	1.039	(1.016, 1.063)
ABS ARIA	1.024	(1.001, 1.047)	0.936	(0.873, 1.003)	1.045	(0.952, 1.147)	0.971	(0.912, 1.034)	1.201	(1.131, 1.275)	1.106	(1.066, 1.147)
Private	0.572	(0.507, 0.645)	0.809	(0.557, 1.177)	1.520	(1.381, 1.674)	1.032	(0.769, 1.384)	3.014	(1.787, 5.083)	1.813	(0.954, 3.447)
Diagnosis group												
Nervous system	0.747	(0.658, 0.848)	0.899	(0.599, 1.350)	1.636	(1.370, 1.953)	1.018	(0.924, 1.122)	7.980	(7.672, 8.300)	4.989	(4.625, 5.381)
Eye					0.660	(0.555, 0.784)	1.032	(0.866, 1.231)				
ENT	0.351	(0.239, 0.517)	0.083	(0.018, 0.381)	1.138	(1.038, 1.247)	1.511	(1.387, 1.646)	4.151	(3.422, 5.035)	2.658	(1.996, 3.539)
Respiratory	0.348	(0.327, 0.371)	1.034	(0.903, 1.183)	3.113	(2.404, 4.032)	2.235	(1.933, 2.586)	8.399	(6.795, 10.38)	4.314	(3.088, 6.025)
Circulatory					2.814	(2.565, 3.087)	1.027	(0.942, 1.119)	4.432	(4.196, 4.682)	4.202	(3.768, 4.687)
Digestive	1.071	(0.945, 1.213)	1.272	(0.476, 3.401)					13.613	(12.91, 14.34)	8.355	(7.384, 9.453)
Musculoskeletal	1.027	(0.985, 1.071)	3.833	(2.735, 5.373)	1.041	(0.879, 1.234)	3.811	(3.536, 4.106)	4.293	(4.078, 4.519)	3.177	(2.921, 3.455)
Skin	0.179	(0.165, 0.195)	0.210	(0.171, 0.257)	0.647	(0.498, 0.841)	1.576	(1.381, 1.799)	19.651	(17.43, 22.16)	7.627	(6.220, 9.354)
Kidney	1.294	(1.208, 1.386)	0.921	(0.858, 0.989)	0.864	(0.689, 1.084)	0.814	(0.642, 1.032)				
Male organ	3.164	(2.568, 3.899)	0.732	(0.541, 0.990)	0.597	(0.452, 0.788)	0.951	(0.830, 1.091)	2.717	(2.228, 3.313)	3.345	(2.471, 4.527)
Female organ					0.758	(0.532, 1.078)	0.831	(0.758, 0.912)	10.649	(9.897, 11.46)	6.810	(5.962, 7.779)
Other	0.579	(0.532, 0.631)	1.117	(0.899, 1.386)	4.629	(3.285, 6.523)	1.087	(0.962, 1.228)	14.277	(12.25, 16.65)	4.461	(3.657, 5.440)
Interaction terms												
After x Age	1.006	(1.001, 1.011)	0.998	(0.986, 1.009)	1.000	(0.997, 1.004)	0.993	(0.990, 0.995)	0.997	(0.990, 1.004)	0.999	(0.996, 1.002)
After x Male	1.073	(0.951, 1.209)	0.870	(0.611, 1.237)	0.960	(0.868, 1.062)	1.088	(0.939, 1.259)	1.024	(0.901, 1.164)	1.009	(0.950, 1.071)
After x Comorbidities	0.989	(0.966, 1.012)	1.012	(0.986, 1.039)	0.997	(0.963, 1.032)	0.999	(0.966, 1.033)	1.051	(1.017, 1.086)	1.047	(1.036, 1.057)
After x ABS IRSAD	1.015	(0.984, 1.048)	1.025	(1.000, 1.052)	0.994	(0.970, 1.019)	1.017	(0.984, 1.052)	0.983	(0.961, 1.006)	0.975	(0.958, 0.992)
After x ABS ARIA	1.001	(0.926, 1.084)	1.035	(0.993, 1.078)	1.039	(0.992, 1.089)	0.972	(0.888, 1.063)	0.924	(0.875, 0.975)	0.932	(0.903, 0.963)
After x Private	1.139	(0.889, 1.461)	1.008	(0.627, 1.622)	0.966	(0.914, 1.02)	0.834	(0.719, 0.966)	0.913	(0.652, 1.279)	0.941	(0.677, 1.309)
After x Nervous system	1.135	(0.958, 1.344)	0.603	(0.508, 0.716)	1.267	(1.210, 1.326)	0.674	(0.646, 0.704)	0.640	(0.593, 0.691)	0.691	(0.658, 0.725)
After x Eye					1.419	(1.368, 1.471)	0.830	(0.794, 0.868)				
After x ENT	1.904	(1.538, 2.358)	1.886	(0.914, 3.89)	1.423	(1.377, 1.469)	1.255	(1.184, 1.330)	0.674	(0.492, 0.924)	0.723	(0.612, 0.853)
After x Respiratory	0.714	(0.598, 0.853)	0.380	(0.351, 0.412)	0.391	(0.309, 0.495)	0.500	(0.469, 0.533)	0.429	(0.294, 0.628)	0.783	(0.633, 0.969)

After x Circulatory					0.994	(0.887, 1.114)	0.761	(0.720, 0.805)	0.806	(0.732, 0.888)	0.524	(0.488, 0.563)
After x Digestive	0.958	(0.839, 1.094)	0.260	(0.164, 0.412)					0.754	(0.659, 0.863)	0.688	(0.633, 0.748)
After x Musculoskeletal	0.676	(0.632, 0.722)	0.375	(0.278, 0.505)	1.406	(1.281, 1.543)	1.073	(1.011, 1.138)	0.817	(0.745, 0.896)	0.593	(0.560, 0.627)
After x Skin	2.011	(1.670, 2.422)	0.508	(0.456, 0.566)	1.094	(1.025, 1.168)	1.302	(1.221, 1.389)	0.652	(0.524, 0.811)	0.644	(0.570, 0.728)
After x Kidney	1.656	(1.435, 1.910)	1.108	(0.967, 1.270)	0.834	(0.751, 0.925)	0.623	(0.544, 0.713)				
After x Male organ	1.325	(1.029, 1.707)	1.962	(1.448, 2.661)	0.807	(0.737, 0.883)	1.270	(1.151, 1.401)	0.748	(0.558, 1.003)	0.723	(0.610, 0.857)
After x Female organ					1.029	(0.972, 1.089)	1.262	(1.166, 1.366)	0.841	(0.707, 1.000)	0.656	(0.609, 0.708)
After x Other	1.139	(1.036, 1.254)	0.368	(0.322, 0.420)	1.448	(1.349, 1.553)	1.058	(0.962, 1.163)	1.568	(1.268, 1.939)	0.953	(0.833, 1.090)
Hospital group												
Major	1.448	(0.916, 2.287)	1.722	(1.066, 2.780)	0.921	(0.827, 1.025)	1.334	(1.199, 1.484)	0.573	(0.443, 0.742)	0.748	(0.650, 0.860)
District	0.977	(0.486, 1.966)	1.172	(0.524, 2.622)	0.828	(0.672, 1.021)	1.045	(0.766, 1.425)	0.500	(0.448, 0.558)	0.844	(0.784, 0.909)
Community	3.760	(1.481, 9.549)	5.769	(1.478, 22.52)	0.616	(0.391, 0.972)	0.893	(0.593, 1.345)	0.454	(0.313, 0.658)	0.811	(0.619, 1.062)
N	63342				146631				543038			
Pseudo R2	0.1872				0.0778				0.1019			

Note: All of the models include dummy variables for area health services and dummy variables for missing area information. The 95% CIs are given in parentheses. For recommended urgent procedures, the reference diagnosis category is circulatory, and because eye and female organ conditions have very small shares, they are combined in Other. For recommended semi-urgent procedures, the reference diagnosis category is digestive. For recommended non-urgent procedures, the reference diagnosis category is eye, and there is no kidney case.

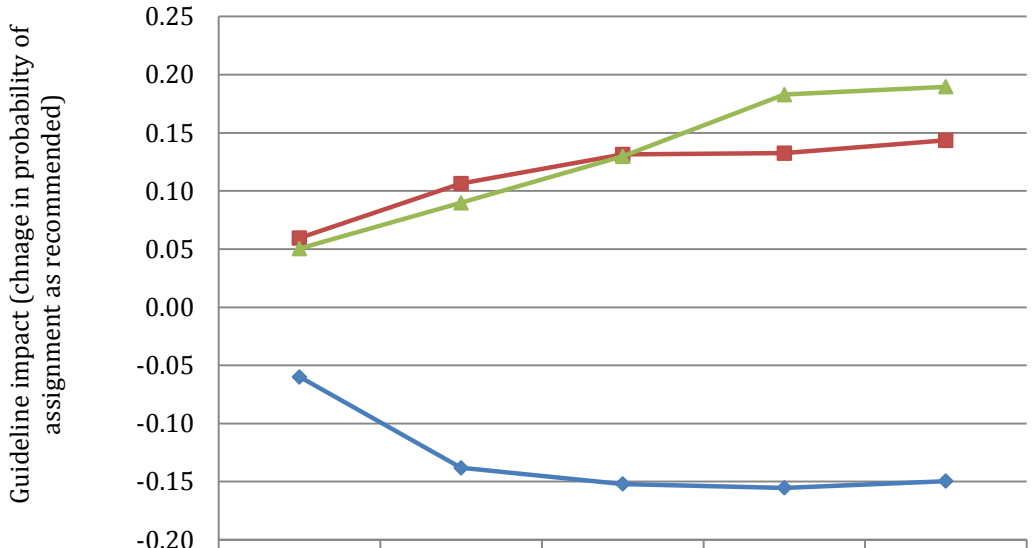
Appendix

Assigned priority	Urgent (Model1)				Semi-urgent (Model 2)				Non-urgent (Model 3)			
Recommended priority	Semi-urgent		Non-urgent		Urgent		Non-urgent		Urgent		Semi-urgent	
After	2.066	(1.777, 2.401)	3.979	(1.221, 12.97)	0.495	(0.445, 0.551)	0.970	(0.861, 1.092)	0.349	(0.317, 0.385)	0.625	(0.546, 0.716)
Age	0.985	(0.979, 0.990)	0.977	(0.960, 0.995)	1.009	(0.999, 1.020)	0.995	(0.990, 1.001)	0.987	(0.980, 0.994)	0.990	(0.986, 0.995)
Male	1.026	(0.876, 1.201)	0.903	(0.821, 0.994)	0.881	(0.490, 1.583)	1.079	(0.924, 1.261)	1.105	(0.952, 1.283)	1.022	(0.982, 1.063)
Comorbidities	1.017	(1.010, 1.024)	0.956	(0.932, 0.981)	1.037	(1.019, 1.055)	1.003	(0.980, 1.027)	1.108	(1.058, 1.160)	1.064	(1.051, 1.077)
ABS IRSAD	0.998	(0.967, 1.031)	0.990	(0.968, 1.013)	1.008	(0.982, 1.035)	0.997	(0.956, 1.041)	1.032	(1.008, 1.056)	1.020	(1.006, 1.035)
ABS ARIA	1.026	(0.959, 1.098)	0.962	(0.923, 1.003)	1.074	(0.997, 1.156)	0.950	(0.920, 0.981)	1.140	(1.103, 1.178)	1.051	(1.025, 1.077)
Private	0.627	(0.574, 0.685)	0.509	(0.405, 0.639)	1.480	(1.353, 1.62)	0.900	(0.738, 1.096)	2.831	(2.118, 3.784)	1.725	(1.157, 2.572)
Diagnosis group												
Nervous system	0.822	(0.757, 0.893)	0.608	(0.474, 0.780)	1.950	(1.675, 2.270)	0.747	(0.684, 0.815)	6.047	(5.793, 6.312)	3.820	(3.569, 4.089)
Eye					0.840	(0.720, 0.980)	0.897	(0.743, 1.083)				
ENT	0.577	(0.370, 0.898)	0.142	(0.045, 0.451)	1.479	(1.340, 1.632)	1.779	(1.658, 1.909)	3.271	(2.332, 4.587)	2.113	(1.616, 2.763)
Respiratory	0.269	(0.246, 0.296)	0.525	(0.417, 0.661)	1.468	(1.322, 1.630)	1.201	(1.054, 1.369)	4.752	(3.218, 7.016)	3.690	(2.625, 5.186)
Circulatory					2.779	(2.399, 3.219)	0.820	(0.731, 0.919)	3.775	(3.411, 4.178)	2.696	(2.419, 3.003)
Digestive	1.054	(0.901, 1.232)	0.546	(0.287, 1.040)					11.341	(10.11, 12.73)	6.399	(5.702, 7.181)
Musculoskeletal	0.770	(0.723, 0.821)	1.882	(1.617, 2.190)	1.314	(1.176, 1.467)	3.957	(3.713, 4.217)	3.730	(3.537, 3.933)	2.198	(2.035, 2.374)
Skin	0.314	(0.263, 0.374)	0.144	(0.113, 0.182)	0.698	(0.538, 0.905)	1.909	(1.705, 2.136)	14.757	(11.65, 18.70)	5.521	(4.548, 6.702)
Kidney	1.920	(1.825, 2.020)	0.945	(0.837, 1.067)	0.765	(0.617, 0.949)	0.582	(0.495, 0.683)				
Male organ	3.977	(3.254, 4.859)	1.187	(0.834, 1.688)	0.518	(0.372, 0.721)	1.134	(0.995, 1.292)	2.271	(1.624, 3.176)	2.652	(2.046, 3.439)
Female organ					0.776	(0.528, 1.142)	0.985	(0.904, 1.072)	9.509	(8.275, 10.93)	5.082	(4.478, 5.767)
Other	0.639	(0.544, 0.750)	0.509	(0.405, 0.639)	6.066	(4.168, 8.83)	1.127	(1.014, 1.251)	19.518	(17.17, 22.18)	4.404	(3.843, 5.046)
Hospital group												
Major	1.437	(0.907, 2.277)	1.560	(1.022, 2.379)	0.920	(0.827, 1.023)	1.330	(1.199, 1.476)	0.573	(0.442, 0.743)	0.747	(0.65, 0.859)
District	0.984	(0.487, 1.985)	1.194	(0.516, 2.763)	0.827	(0.674, 1.015)	1.041	(0.761, 1.425)	0.501	(0.448, 0.561)	0.843	(0.783, 0.908)
Community	3.840	(1.499, 9.838)	6.372	(1.652, 24.58)	0.610	(0.39, 0.954)	0.897	(0.597, 1.349)	0.460	(0.316, 0.671)	0.821	(0.624, 1.08)
Area Health Services												
Sydney South West	1.261	(0.859, 1.851)	1.993	(1.250, 3.179)	1.394	(0.94, 2.068)	1.055	(0.628, 1.772)	0.882	(0.664, 1.171)	0.811	(0.573, 1.148)
Sydney West	1.692	(1.263, 2.267)	3.947	(3.272, 4.760)	1.003	(0.737, 1.365)	1.409	(0.921, 2.153)	0.755	(0.546, 1.045)	0.733	(0.566, 0.951)
North Sydney & Central Coast	0.371	(0.183, 0.753)	0.328	(0.121, 0.886)	0.791	(0.545, 1.147)	0.923	(0.636, 1.341)	0.840	(0.611, 1.154)	1.067	(0.822, 1.386)
Hunter & New England	0.584	(0.200, 1.705)	0.315	(0.087, 1.145)	1.147	(0.734, 1.794)	0.859	(0.618, 1.193)	0.794	(0.601, 1.050)	0.908	(0.693, 1.190)
North Coast	0.215	(0.082, 0.563)	0.045	(0.009, 0.222)	1.579	(0.962, 2.590)	1.494	(1.251, 1.783)	0.884	(0.511, 1.527)	0.730	(0.500, 1.063)
Greater Southern	0.708	(0.234, 2.142)	0.369	(0.106, 1.290)	1.258	(0.819, 1.931)	1.069	(0.605, 1.888)	0.652	(0.467, 0.911)	0.751	(0.594, 0.948)

Greater Western	1.165	(0.497, 2.732)	1.598	(0.769, 3.320)	0.715	(0.444, 1.153)	0.951	(0.727, 1.244)	0.620	(0.379, 1.015)	1.029	(0.813, 1.302)
N	63342				146631				543038			
Pseudo R2	0.1697				0.0763				0.1007			

Note: All of the models include dummy variables for missing area information. The 95% CIs are given in parentheses. For recommended urgent procedures, the reference diagnosis category is circulatory, and because eye and female organ conditions have very small shares, they are combined in Other. For recommended semi-urgent procedures, the reference diagnosis category is digestive. For recommended non-urgent procedures, the reference diagnosis category is eye, and there is no kidney case.

Figure 1: Heterogeneity in the guideline's impact over time



	2006 (7 months)	2007	2008	2009	2010
Urgent	-0.06	-0.13813	-0.15203	-0.1553	-0.14958
Semi-urgent	0.0596	0.1063	0.13144	0.1325	0.14355
Non-urgent	0.0504	0.0898	0.1297	0.1829	0.18957