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Relative needs index study, South Australia and New South Wales

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Abbreviations

DAS	Dental Anxiety Scale
NSW	New South Wales
OHIP	Oral Health Impact Profile
RNI	Relative Needs Index
ROC	Receiver Operating Characteristic
SA	South Australia

Symbols

*	statistically significant
n.s.	not statistically significant
..	not applicable

Summary

The Relative Needs Index (RNI) Study applied indicators of patient-perceived treatment needs (i.e. symptom-based measures of disease, and social and psychological consequences of oral diseases and disorders) and compared them to a clinical judgment of urgency of care. The RNI study sought to determine the relative need of patients attending for emergency and general dental care by assessing both patient-perceived need and a clinical determination of need stratified into a hierarchy of urgency of care.

At present there are no criteria or protocols in place that can be used to check or assess the reasonableness of a patient's presentation for emergency dental care or even the relative need or priority of patients on the waiting list for general dental care.

Currently, waiting lists for general dental care are based on a chronological queuing of patients, meaning that general dental care is offered on a 'first come, first served' basis to potential patients in the order they entered the waiting list. However, is this the most egalitarian approach to rationing dental care?

It may seem equitable to take the approach of 'those who make the first claim to wanting to receive dental care by joining a waiting list should also be the first to receive the care'. However, there are clear disadvantages involved in the use of this system. It does not take into consideration a patient's need for care or the urgency with which the care is required.

One way of circumventing the problems associated with allocating dental care to patients on the basis of waiting time is to ration the care on the basis of their overall experience of oral diseases and disorders. Patients would be given priority on the waiting list depending on their reported symptoms and/or the psychosocial impact of their oral problem. Systems that give priority to patients with the greatest need first are deemed to be equitable, and should facilitate better access to adult dental care in both South Australia (SA) and New South Wales (NSW).

The data in the report derives from individual client experience of the problem presented to clinic, and is cross-matched with data provided by the assessing dentists. If client perception and dentist perception are assumed to express the pragmatic experience of access to care, the results suggest that some triaging of emergency and general patients using questions similar to the ones asked in the questionnaire may not be seen as unreasonable by both clients and service providers.

A total of 839 (91.2% of the anticipated sample) and 740 (82.2% of the anticipated sample) eligible patients requesting emergency dental care and general dental care were recruited across South Australia (SA) and New South Wales (NSW) respectively.

Subjective oral health status indicators (i.e. experience of pain or other oral symptoms) and the psychosocial impact of oral disorders were examined as potential predictors of urgency of care.

Psychosocial impact was assessed by asking patients if, during the last week for emergency patients or the last four weeks for general patients, they had experienced specific events because of problems with their teeth, mouth or dentures. The study

included social impact questions on toothache and other oral and facial pain, being concerned/worried about one's dental health or appearance, avoidance of going out, ability to carry out daily activities and dental anxiety.

For the emergency sample, just over 71% of patients reported having a toothache in the last week, almost 70% indicated that they were worried about the appearance of their teeth or mouth, approximately 31% stayed home more than usual and 26.5% reported avoiding their usual leisure activities because of problems with their teeth, mouth or dentures. Variables having a statistically significant association with urgency of care included age, education, experience of toothache, pain in teeth with hot or cold food/fluids, pain in jaw while opening mouth wide, sore gums, bleeding gums, pain at night, difficulty sleeping, staying home more than usual, avoiding usual leisure activities and worry/concern about the health of one's teeth or mouth.

For those patients seeking general dental care, almost 45% reported having a toothache in the last four weeks, 41% of the sample indicated that they were prevented from eating foods they would like to eat, just over 49% felt uncomfortable eating any foods, almost 70% indicated that they were worried about the appearance of their teeth or mouth, approximately 44% reported being embarrassed by the appearance/health of their teeth or mouth and just over 27% felt that life in general was less satisfying. Variables having a statistically significant association with urgency of care included age, usual/previous occupation, experience of toothache and various other oral and facial pain symptoms, being prevented from eating certain foods, decreased enjoyment of food and being worried/concerned or embarrassed about the appearance and health of one's teeth or mouth.

Logistic regression was used to further examine the significant bivariate associations for each sample, and models were developed to aid in the prediction of urgency of care. Since the experience of symptoms reported by patients in each sample is somewhat different, the perceived treatment needs of emergency and general patients will also be different. These differences are accounted for by using separate models to predict urgency of care for each sample.

Emergency dental care

Three statistical models were developed to predict the treatment urgency of patients attending for emergency dental care.

The first regression modelled 'urgency' as needing to be seen within 48 hours compared to more than 48 hours. Difficulty sleeping, pain in the jaw when opening mouth wide, having a broken filling, having a loose tooth and concern about the health of one's teeth or mouth had a significant positive association with needing to be seen within 48 hours. In addition, bleeding gums were negatively associated with needing to be seen within 48 hours.

The second model determined which factors were associated with needing to be seen in the period 2-7 days compared with more than 7 days. Factors significantly associated with needing to be seen in the period 2-7 days included experience of toothache, pain in teeth with hot food or fluids, bleeding gums, having a broken filling, difficulty sleeping all the time, and concern about the appearance of teeth or mouth.

The third model determined the associations with needing to be seen within one week compared with 8 or more days. Those factors with a significant positive association with needing to be seen within a week were presence of toothache, having a broken filling, having a loose tooth, difficulty sleeping all the time and very often being concerned about appearance of teeth and mouth.

General dental care

Two statistical models were developed to predict the treatment urgency of patients requesting general dental care.

The first regression modelled 'urgency' as needing to be seen within 6 months compared to 7 or more months. Factors significantly associated with needing to be seen within 6 months included oral and facial pain symptoms scale, oral health impact profile (OHIP) scale, usual reason for dental visit, time since last visit and smoking.

The second model determined which factors were associated with needing to be seen within 3 months compared with 4 or more months. Factors significantly associated with needing to be seen within 3 months included the oral and facial pain symptoms scale, oral health impact profile (OHIP) scale, usual reason for dental visit, place of last dental visit, usual/previous occupation, a lost filling, a loose tooth and being a smoker.

Predictive ability of the models

Sensitivity, specificity, positive predictive values and negative predictive values were calculated for each model to determine how well the models were able to predict urgency of care. Sensitivity and specificity are dependent on the cut-off values selected for the test, i.e. the value above which the test is interpreted as urgent. The relationship between the cut-off value and sensitivity/specificity were examined for each model using receiver operating characteristic (ROC) curves. As the cut-off was modified (i.e. as the point that separated non-urgent patients from urgent patients was changed), the sensitivity and specificity of the test also changed; sensitivity was enhanced at the expense of specificity and vice versa. A sensitive test will have few false negative test results while a specific test will have few false positive test results. The decision to maximise either sensitivity or specificity depends on the relative cost of a false positive or false negative test result.

This study has indicated that there are tests that may prove useful in giving priority to patients seeking emergency and general dental thus making the RNI a potentially useful tool for allocating priority to patients. The application of RNI requires management decisions on the desirable clinical/political outcomes. The selected approach then needs to be demonstrated and the effects monitored.

1 Introduction

1.1 Background

The reduction in funding for adult public dental services as a result of the cessation of the Commonwealth Dental Health Program (CDHP) in 1997 has led to a substantial fall in the capacity of public dental services to provide dental care for eligible persons.

Public dental services are experiencing strong demand for 'emergency' care and eligible persons seeking 'general' care are placed on waiting lists for care which have a waiting period of up to 4 years.

At present there are no tested criteria by which:

- the reasonableness of the presentation for emergency dental care can be checked; or
- the relative need or priority of eligible persons on the waiting list for general dental care can be assessed.

The New South Wales Oral Health Branch and the South Australian Dental Service sought the development and testing of protocols that might be used by non-dental staff in determining the relative need of eligible persons presenting for either emergency or general dental care.

The conceptual framework for this project starts with a definition of health as 'an individual's subjective experience of his/her functional, social and psychological well-being' (Locker 1997). There has been increasing interest in the development of psychosocial measures of oral health and oral quality of life. A number of measures have been developed but these have not frequently been related to normative measures of oral health.

The Relative Needs Index (RNI) Study applied indicators of patient-perceived treatment needs (i.e. symptom-based measures of disease and social and psychological consequences of oral diseases and disorders) and compared them to clinical judgment of urgency of care in an endeavor to develop a foundation for an alternative strategy of client prioritisation.

Prioritisation of patients in a more timely and equitable manner was hypothesised to facilitate better access to adult dental care in South Australia (SA) and New South Wales (NSW). The RNI study attempted to determine the relative need of patients attending for emergency and general dental care by assessing both patient perceived need and a clinical determination of need stratified into a hierarchy of urgency of care.

1.2 Purpose

Due to the increasing demands placed on public dental services, the primary objectives of the RNI study were to develop and test criteria for the provision of emergency and general dental care within the public dental system.

The specific aims were to develop and test:

- the usefulness of a series of criteria for eligibility for emergency dental care; and
- a subjective index of relative dental need for general dental care within public-funded dental programs.

The study was a prospective study examining associations between subjective indicators and clinical judgment of urgency.

1.3 Methodology

Sample selection

A random sample of eligible adults presenting to public dental clinics in NSW and SA for emergency and general dental care was used. Participants were informed of the study at the time they contacted the clinic for dental care. The criteria used to select emergency and general dental care patients for the study are shown in Table 1.

Table 1: Sample selection

Selection criteria	Emergency sample	General sample
Aged 18 years or more	✓	✓
Dentate with 6 or more teeth	✓	✓
Holder of a current government concession card	✓	✓
New to waiting list	–	✓
Have not visited a dentist (private or public) for routine dental care in the last 12 months ^(a)	–	✓

(a) Patients who received emergency dental care in the last 12 months were included provided they were not already on the waiting list for routine dental care.

Emergency care patients were asked to participate prior to their attendance at the clinic. General dental care patients were asked to participate at the time that they were placed on the waiting list. A benefit of participating for general dental care patients was a shorter waiting time, e.g. 1 month. In each instance verbal consent to participate in the study was initially obtained. Written consent was sought when the patient attended the clinic for their appointment.

Participants completed a structured interview on subjective indicators and were then tracked through examination, diagnosis and treatment planning, and the provision of treatment within public dental clinics in NSW and SA. The positive consent form signed by participants gave authorisation to the researchers to access the data captured as part of their clinical care and link it to the information collected from the structured interview. Associations between self-reported indicators and oral health status, normative needs and clinical judgment of risk could therefore be assessed.

Sample sizes

The sample sizes required from selected public dental clinics across SA and NSW for both the emergency and general samples are shown in Table 2.

Table 2: Sample size required from selected dental clinics in SA and NSW

Sample	State	Public dental clinic	N	
Emergency	SA	Adelaide Dental Hospital – GDU	125	
		Lyell McEwin	125	
		Noarlunga	125	
		Port Adelaide	125	
			SA emergency sample total	500
	NSW	United Dental Hospital	80	
		Western Sydney Area Health Service – Mt Druitt	70	
		Illawarra Area Health Service – Bulli	70	
		South Western Sydney Area Health Service – Narellan	50	
		Mid North Coast Area Health Service – Coffs Harbour	150	
			NSW Emergency sample total	420
	General	SA	East Marden	80
			Gawler	60
			Gilles Plains	130
Kadina			30	
Parks			90	
Somerton Park			100	
Victor Harbour			60	
			SA general sample total	550
NSW		United Dental Hospital	120	
		Western Sydney Area Health Service – Mt Druitt	70	
		Illawarra Area Health Service – Bulli	70	
		South Western Sydney Area Health Service – Narellan	90	
			NSW general sample total	350

Data collection

Participants were informed of the study at the time they contacted the clinic for either emergency or general dental care.

Emergency care patients were asked to participate prior to their attendance at the clinic. General dental care patients were asked to participate at the time that they were placed on the waiting list. A benefit of participating for general dental care patients was shorter waiting time, e.g. 1 month. In each instance verbal consent to participate in the study was initially obtained when the patient telephoned the clinic to make an appointment. Written consent was sought when the patient attended the clinic for their appointment.

A questionnaire containing subjective oral health status indicators was administered to consenting patients by non-dentist clinic staff. Following the questionnaire, the patient underwent an oral health assessment performed by one of the clinic dentists. Information relating to the patient's oral health status was recorded in order to obtain epidemiological data for the study. The assessing dentist also completed a proposed treatment plan for the patient. A second dentist then provided the patient with appropriate treatment (treatment needs were assessed independently of the assessing dentist) and assessed the patient's risk of future disease. The treatment provided and the future oral risk status of the patient were recorded. In addition, each dentist was asked to judge and record the urgency of the patient's oral health needs.

The positive consent form signed by participants gave authorisation to the researchers to access the data captured as part of their clinical care and link it to the information collected from the structured interview. Associations between self-reported indicators and oral health status, normative needs and clinical judgment of risk and urgency of care could therefore be assessed.

Data items

1. The information collected from the administered questionnaire related to:
 - sociodemographic characteristics
e.g. patient's sex, age, country of birth, indigenous status, language mainly spoken at home, ethnicity, level of education, concession card status
 - subjective oral health indicators
e.g. oral and facial pain symptoms, social and psychological impact of oral disorders
 - dental visiting factors
e.g. usual reason for visiting the dentist, time since last visit, site of last visit, frequency of visiting the dentist
2. Information collected at the oral health assessment related to:
 - oral health status
e.g. teeth present, coronal and root caries experience, periodontal disease status, the presence and condition of prostheses, oral mucosal conditions
 - diagnoses and proposed treatment needs including urgency
 - clinical judgments on the risk of further oral disease
3. Information collected at the treatment phase related to:
 - treatment and service provided
 - urgency of care
 - clinical judgment on the oral health outcome at the completion of a course of care in terms of the risk of further oral disease, likelihood of compliance with preventive advice, and expectations for future maintenance course of care.

2 Emergency dental care

2.1 Participants

Of the 920 participants required for the emergency component of the RNI Study, 839 patients requesting emergency care were recruited across SA and NSW. Overall, 91.2% of the anticipated sample was collected. A breakdown of the sample collected at each clinic in each state is given in Table 3.

In SA 429 eligible patients requesting emergency care were randomly recruited for the study. Overall, 85.4% of the required sample for SA was collected. In NSW 412 patients were selected for inclusion in the study, making up 98.1% of the required sample for that state.

Table 3: Sample size collected from selected dental clinics in SA and NSW

State	Community Dental Service Clinic	Anticipated sample size	Sample size achieved	
SA	Adelaide Dental Hospital – GDU	125	76	
	Lyell McEwin	125	85	
	Noarlunga	125	134	
	Port Adelaide	125	132	
	SA total	500	427	(85.4%)
NSW	United Dental Hospital	80	79	
	Western Sydney Area Health Service – Mt Druitt	70	71	
	Illawarra Area Health Service – Bulli	70	70	
	South Western Sydney Area Health Service – Narellan	50	42	
	Mid North Coast Area Health Service – Coffs Harbour	150	150	
	NSW total	420	412	(98.1%)
Total sample		920	839	(91.2%)

2.2 Population characteristics

Sociodemographic characteristics of respondents

The percentages of respondents in each of several sociodemographic groupings for both SA and NSW, as well as in the overall sample are shown in Table 4.

There is an over-representation of females in the sample, which is possibly due to higher reputed usage of dental services by women.

By age, the largest proportion of patients were in the 24–44 years age group (almost 40%), while the smallest proportion of patients (8.5%) were in the youngest age group category (18–24 years), which spanned only 7 years.

Almost two-thirds of the respondents were born in Australia. There were very few Aboriginals or Torres Strait Islanders in the emergency component of the RNI study.

The majority of respondents had completed some or all of their secondary school education (62.3%); 42.9% had some secondary school education while a further 19.4% had completed secondary school.

Just over 60% of patients presenting for emergency dental care held a full-entitlement pensioner concession card and over one-third of the respondents had a health care card.

Table 4: Distribution of sample sociodemographic characteristics by state

	SA (n = 427) %	NSW (n = 412) %	Total (n = 839) %
Sex of patient	n = 427	n = 412	n = 839
Male	43.3	42.7	43.0
Female	56.7	57.3	57.0
Age group	n = 425	n = 410	n = 835
18–24 years	7.1	10.0	8.5
25–44 years	37.4	42.2	39.8
45–64 years	32.5	25.1	28.9
65+ years	23.1	22.7	22.9
Born in Australia	n = 426	n = 412	n = 838
Yes	65.0	64.3	64.7
No	35.0	35.7	35.3
Language mainly spoken at home	n = 426	n = 412	n = 838
English	93.4	85.9	89.7
Other	6.6	14.1	10.3
Indigenous status	n = 426	n = 412	n = 838
No	98.1	97.8	98.0
Yes, Aboriginal	1.6	1.9	1.8
Yes, Torres Strait Islander	0.2	0.2	0.2
Highest level of education	n = 426	n = 409	n = 835
Primary school	8.2	10.8	9.5
Some secondary school	46.9	38.6	42.9
Completed secondary school	16.4	22.5	19.4
Some university or higher education	4.9	4.4	4.7
Completed university or higher education	5.2	3.4	4.3
Some TAFE, CAE or vocational course	5.4	4.4	4.9
Completed TAFE, CAE or vocational course	10.6	15.9	13.2
Other	2.3	–	1.2
Health care card status	n = 427	n = 412	n = 839
Pensioner Concession Card (full) only	62.3	60.4	61.4
Pensioner Concession Card (part) only	1.9	3.2	2.5
Health Care Card only	34.4	35.0	34.7
Veterans Affairs Card only	0.7	0.5	0.6
Commonwealth Seniors Card only	–	0.2	0.1
Other eligible combinations	0.7	0.7	0.7

Access to dental services

Dental visiting patterns of respondents in both SA and NSW, and in the overall samples, are shown in Table 5.

Almost 50% of respondents had visited a dentist in the last 12 months and just over 85% of all respondents reported that a dental problem or pain was their usual reason for a dental visit. The majority of respondents (73.3%) had received their last course of care at a public hospital or clinic. Almost 30% of respondents indicated that they would usually go to the dentist once every 2 years.

Table 5: Dental visiting factors by state

	SA (n = 427) %	NSW (n = 412) %	Total (n = 839) %
Private dental insurance	n = 427	n = 412	n = 839
Yes	4.0	1.0	2.5
No	96.0	99.0	97.5
Usual reason for visit	n = 427	n = 410	n = 837
Check-up	17.1	9.8	13.5
Problem/pain	81.3	89.3	85.2
Check-up/problem/pain	1.6	1.0	1.3
Time since last visit	n = 427	n = 412	n = 839
<12 months	50.1	44.9	47.6
12–<2 years	18.7	20.6	19.7
2–<3 years	10.1	13.8	11.9
3–<5 years	9.1	8.3	8.7
5+ years	11.9	11.7	11.8
Never	–	0.7	0.4
Place of last visit	n = 426	n = 410	n = 836
Private practice	21.1	23.2	22.1
Public hospital/clinic	73.0	73.7	73.3
School Dental Service	4.0	1.7	2.9
Other	1.9	1.5	1.7
Frequency of dental visits	n = 426	n = 405	n = 831
More than 2 times a year	8.2	8.1	8.2
2 times a year	8.0	7.2	7.6
Once a year	24.6	23.0	23.8
Once every 2 years	30.0	26.7	28.4
Once every 5 years	11.7	13.3	12.5
Less often than that	17.4	21.7	19.5

2.3 Data variables

Dependent variable

The aim of this study was to determine levels of priority of those people seeking emergency dental care. Urgency of care, based on the assessing dentist's clinical judgment, was therefore used as the dependent variable. This variable consists of the following four categories into which a patient's urgency for dental treatment may be classified by the assessing dentist: 48 hours, 2-7 days, 8-13 days, 14+ days.

Independent variables

Questionnaire variables were developed from the literature to reflect potential predictors of urgency of care. These variables are described in Table 6.

Table 6: Potential predictors of urgency of dental care

Sociodemographic variables	<ul style="list-style-type: none"> • age group • sex of patient • born in Australia • language mainly spoken at home • maximum education
Oral and facial pain symptoms^(a)	<p>In the last week have you had the following problems?</p> <ul style="list-style-type: none"> • toothache • pain in teeth with hot food or fluids • pain in teeth with cold food or fluids • pain in teeth with sweet food • pain in jaw while chewing • pain in jaw when opening mouth wide • pain in front of ear • burning sensation in tongue or other parts of mouth • shooting pain in face or cheeks • pain or discomfort from denture <p><i>Response format: yes/no</i></p>
Other oral symptoms^(a)	<p>In the last week have you had the following problems?</p> <ul style="list-style-type: none"> • mouth ulcers • cold sores • sore gums • bleeding gums • bad breath • dryness of mouth • unpleasant taste • changes in ability to taste • clicking/grating noise in jaw joint • difficulty opening mouth wide <p><i>Response format: yes/no</i></p>

(a) The variables described in 'Oral and facial pain symptoms', 'Other oral symptoms', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997). Only these four sets of subjective indicators have been used for the emergency component of the RNI Study. (continued)

(b) The Dental Anxiety Scale (Corah, 1969).

Table 6: Potential predictors of urgency of dental care (continued)

Activities of daily living impact scale^(a)	<p>During the last week how often have pain discomfort or other problems with your teeth, mouth or dentures caused you to ...</p> <ul style="list-style-type: none"> • have difficulty sleeping? • stay home more than usual? • stay in bed more than usual? • take time off work? • be unable to do household chores? • avoid usual leisure activities? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Worry/concern impact scale^(a)	<p>During the last week how often have you worried about ...</p> <ul style="list-style-type: none"> • the appearance of your teeth or mouth? • the health of your teeth or mouth? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Other symptoms	<p>In the last week have you had the following problems?</p> <ul style="list-style-type: none"> • pain which is worse in the middle of the day • pain at night • swelling on gums • swelling of your face or neck • a lost filling • a lost crown • a broken filling • a broken crown • a loose tooth • a cracked tooth • high temperature <p><i>Response format: yes/no</i></p>
Other questions	<ul style="list-style-type: none"> • Do you take any regular medication? • Have you experienced pain as a result of problems with your teeth, mouth or dentures? <p><i>Response format: yes/no</i></p>
Dental anxiety^(b)	<ul style="list-style-type: none"> • Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? • Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel? • Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel? • Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel? <p><i>Response format: responses scored from 1 to 5</i></p>

(a) The variables described in 'Oral and facial pain symptoms', 'Other oral symptoms', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997). Only these four sets of subjective indicators have been used for the emergency component of the RNI Study.

(b) The Dental Anxiety Scale (Corah, 1969).

Distribution of responses to dependent and independent variables

Dependent variable distribution – urgency of care

The percentage of respondents falling into each category of urgency of care, as determined by the assessing dentist, by state and total sample is shown in Table 7.

Table 7: Percentage of respondents placed in categories of urgency of care

	SA	NSW	Total
Urgency of care	(n = 395)	(n = 396)	(n = 791)
<48 hours	36.7	34.8	35.8
2–7 days	26.8	42.7	34.8
8–13 days	10.4	9.8	10.1
14+ days	26.1	12.6	19.3

According to the assessing dentist, almost 36% of respondents required emergency care within 48 hours and a further 35% needed to be seen between 2 and 7 days.

Frequency of responses to independent variables

The percentage of respondents reporting ‘yes’ to various symptoms by state and overall sample is shown in Table 8. Patients were questioned about various problems they may have experienced in the last week.

Table 8: Frequency of responses

	SA	NSW	Total	Sig.
	Per cent within state	Per cent within state	Per cent within state	
Oral and facial pain symptoms				
Toothache	61.9	80.9	71.2	*
Pain in teeth with cold food or fluids	56.7	67.5	62.0	*
Pain in teeth with hot food or fluids	43.2	55.7	49.3	*
Pain in jaw while chewing	32.8	42.8	37.7	*
Pain in teeth with sweet food	28.9	41.3	35.0	*
Pain in front of ear	20.6	34.8	27.5	*
Shooting pain in face or cheeks	20.3	30.2	25.1	*
Pain in jaw when opening mouth wide	18.4	23.2	20.7	n.s.
Burning sensation in tongue or other parts of mouth	8.5	8.9	8.7	n.s.
Pain or discomfort from denture	5.6	7.8	6.7	*
Other oral symptoms				
Dryness of mouth	31.1	41.1	36.0	*
Sore gums	27.5	38.1	32.7	*
Unpleasant taste	25.9	44.3	34.9	*
Bleeding gums	25.4	31.1	28.2	*
Bad breath	24.7	39.3	31.9	*
Difficulty opening mouth wide	18.4	23.2	20.7	n.s.
Clicking/grating noise in jaw joint	11.8	18.9	15.3	*
Changes in ability to taste	10.4	18.3	14.3	*
Mouth ulcers	9.4	9.5	9.5	n.s.
Cold sores	7.1	5.1	6.1	n.s.

* Statistically significant chi-square, $P < 0.05$
n.s. Not statistically significant

(continued)

Table 8: Frequency of responses (continued)

	SA	NSW	Total	Sig.
	Per cent within state	Per cent within state	Per cent within state	
Activities of daily living impact scale				
Have difficulty sleeping	44.7	65.3	54.8	*
Stay home more than usual	23.4	38.6	30.9	*
Avoid usual leisure activities	21.1	32.0	26.5	*
Be unable to do household chores	12.6	25.5	19.0	*
Stay in bed more than usual	10.3	25.0	17.5	*
Take time off work	2.4	3.2	2.8	n.s.
Worry/concern impact scale				
Worry about health of teeth or mouth	84.5	88.7	86.6	*
Worry about appearance of teeth or mouth	64.6	75.2	69.8	*
Other symptoms				
Pain at night	35.4	53.3	44.1	*
A lost filling	28.6	32.4	30.4	n.s.
A cracked tooth	24.2	30.5	27.3	*
A broken filling	24.1	22.1	23.2	n.s.
Swelling on gums	19.5	27.7	23.6	*
A loose tooth	11.7	14.6	13.2	n.s.
Swelling of your face or neck	11.3	17.3	14.3	*
Pain which is worse in the middle of the day	8.5	20.2	14.2	*
High temperature	7.5	13.9	10.7	*
A broken crown	2.8	5.8	4.3	*
A lost crown	2.1	2.4	2.3	n.s.
Other questions				
Experienced pain	70.7	84.2	77.4	*
Taking any regular medication	51.1	49.5	50.3	n.s.
Dental Anxiety Scale (DAS) score				
DAS score ≥ 13	17.6	25.5	21.5	*
DAS score < 13	82.4	74.5	78.5	

* Statistically significant chi-square, $P < 0.05$
n.s. Not statistically significant

As can be seen from Table 8, 77.4% of patients requesting emergency dental care across both states experienced pain in the last week.

Overall, 71.2% said 'yes' to experiencing a toothache, 62.0% said they experienced pain in their teeth with cold food or fluids, and almost 50% said they experienced pain with hot food or fluids. Other problems occurring with high frequency included pain at night (44.1%), pain in jaw while chewing (37.7%), dryness of mouth (36.0%) and pain in teeth with sweet food (35%).

Over 50% of the sample reported difficulty sleeping and almost 31% stayed home more than usual because of problems with their teeth, mouth or dentures. Almost 27% of the sample reported avoiding their usual leisure activities because of pain or discomfort associated with a dental problem.

The Dental Anxiety Scale (DAS) consists of four items. The respondent is asked to indicate on a 5-point scale how the statement makes them feel. The scale is scored by summing the responses to obtain a score between 4 and 20. A minimum score of 4 indicates no dental anxiety and a maximum score of 20 indicates that the patient is dentally phobic. The majority of patients (78.5%) had DAS scores of less than 13, indicating they were not anxious about visiting the dentist or receiving dental treatment.

2.4 Analyses

Bivariate analyses

An initial analysis of the data was carried out to determine if any of the potential predictor variables (see section 2.3) should be considered for use in a multivariate model. Bivariate associations between the potential predictor variables and urgency of care were therefore examined. The results are displayed in Table 9.

Table 9: Bivariate associations between independent variables and urgency of care

Symptom	Response	Urgency of care (Per cent within urgency of care)				Total	Sig.
		<48 hours	2-7 days	8-13 days	14+ days		
Oral and facial pain symptoms							
Toothache	Yes	79.9	82.1	61.5	45.7	72.3	0.000 *
Pain in teeth with hot food or fluids	Yes	51.2	58.3	47.4	30.0	49.2	0.000 *
Pain in teeth with cold food or fluids	Yes	61.9	70.2	62.8	49.3	62.5	0.000 *
Pain in teeth with sweet food	Yes	38.6	38.5	29.5	20.7	34.2	0.001 *
Pain in jaw while chewing	Yes	49.5	41.1	16.9	23.8	38.4	0.000 *
Pain in jaw when opening mouth wide	Yes	32.5	17.0	10.3	10.6	20.7	0.000 *
Pain in front of ear	Yes	37.2	26.7	23.4	15.2	27.9	0.000 *
Burning sensation in tongue/mouth	Yes	10.2	8.9	5.2	6.7	8.6	0.414 n.s.
Shooting pain in face or cheeks	Yes	35.1	26.7	18.2	9.3	25.5	0.000 *
Pain or discomfort from denture	Yes	6.0	6.9	7.5	6.6	6.6	0.383 n.s.
Other oral symptoms							
Mouth ulcers	Yes	9.9	10.6	11.4	7.3	9.8	0.678 n.s.
Cold sores	Yes	7.8	4.8	7.6	5.3	6.2	0.445 n.s.
Sore gums	Yes	37.9	32.6	19.0	31.6	33.0	0.016 *
Bleeding gums	Yes	27.3	34.5	18.8	24.5	28.4	0.018 *
Bad breath	Yes	34.4	37.1	23.8	21.3	31.8	0.002 *
Dryness of mouth	Yes	37.2	37.8	31.3	31.8	35.8	0.472 n.s.
Unpleasant taste	Yes	41.5	38.5	22.5	23.8	35.2	0.000 *
Changes in ability to taste	Yes	18.9	15.3	8.8	7.9	14.5	0.008 *
Difficulty opening mouth wide	Yes	32.5	17.0	10.3	10.6	20.7	0.000 *
Clicking/grating noise in jaw joint	Yes	17.7	14.5	10.0	14.6	15.2	0.360 n.s.

* Statistically significant chi-square, $P < 0.05$

n.s. Not statistically significant

(continued)

Table 9: Bivariate associations between independent variables and urgency of care (continued)

Symptom	Response	Urgency of care (Per cent within urgency of care)				Total	Sig.
		<48 hours	2-7 days	8-13 days	14+ days		
Activities of daily living impact scale							
Have difficulty sleeping	All the time	29.0	15.3	7.5	4.6	17.3	0.000 *
	Very often	12.4	9.1	5.0	2.0	8.5	
	Often	6.0	13.8	6.3	5.2	8.6	
	Sometimes	22.6	21.1	26.3	16.3	21.2	
	Never	30.0	40.7	55.0	71.9	44.4	
Stay home more than usual	All the time	12.4	8.7	3.8	0.7	8.0	0.000 *
	Very often	7.8	6.5	3.8	1.3	5.7	
	Often	8.1	5.8	3.8	4.6	6.2	
	Sometimes	12.7	12.0	11.3	6.5	11.1	
	Never	59.0	66.9	77.5	86.9	69.0	
Stay in bed more than usual	All the time	3.9	2.5	1.3	0.7	2.5	0.001 *
	Very often	5.7	5.1	5.0	–	4.3	
	Often	5.3	2.2	2.5	2.0	3.3	
	Sometimes	11.0	8.4	7.5	2.0	8.0	
	Never	74.2	81.8	83.8	95.4	81.9	
Take time off work ^(a)	All the time	2.1	0.4	–	–	0.9	0.071 **
	Very often	0.4	1.5	–	–	0.6	
	Often	–	–	–	–	–	
	Sometimes	1.1	1.9	3.8	–	1.4	
	Never	96.4	96.3	96.3	100.0	97.1	
Be unable to do household chores	All the time	5.3	2.5	1.3	0.7	3.0	0.000 *
	Very often	6.7	2.5	1.3	0.7	3.5	
	Often	2.8	4.0	1.3	–	2.5	
	Sometimes	11.3	10.9	7.5	5.2	9.6	
	Never	73.9	80.0	88.8	93.5	81.3	
Avoid usual leisure activities	All the time	11.7	7.3	2.5	2.6	7.5	0.000 *
	Very often	4.9	3.6	2.5	0.7	3.4	
	Often	6.0	5.5	2.5	1.3	4.6	
	Sometimes	12.0	13.1	17.5	2.0	11.0	
	Never	65.4	70.5	75.0	93.5	73.6	
Worry/concern impact scale^(a)							
Worry about appearance of teeth or mouth ^(a)	All the time	31.4	34.3	32.5	24.2	31.1	0.047 *
	Very often	9.9	8.4	18.8	9.8	10.3	
	Often	9.9	10.6	8.8	6.5	9.4	
	Sometimes	21.6	16.1	18.8	20.3	19.1	
	Never	27.2	30.7	21.3	39.2	30.1	
Worry about health of teeth or mouth	All the time	35.1	43.6	33.8	28.8	36.7	0.010 *
	Very often	20.8	12.1	18.8	15.0	16.4	
	Often	12.5	16.5	10.0	13.1	13.8	
	Sometimes	19.4	17.2	23.8	22.2	19.6	
	Never	12.2	10.6	13.8	20.9	13.5	

* Statistically significant chi-square, P<0.05

** Statistically significant Spearman's rho (ordinal-ordinal variables)

n.s. Not statistically significant

(a) In the initial selection, a critical P-value of 0.25 was used to avoid rejecting potentially significant variables at this stage.

(continued)

Table 9: Bivariate associations between independent variables and urgency of care (continued)

Symptom	Response	Urgency of care (Per cent within urgency of care)				Total		Sig
		<48 hours	2-7 days	8-13 days	14+ days			
Other symptoms								
Pain worse in the middle of the day	Yes	19.4	16.6	9.1	4.6	14.6	0.000	*
Pain at night	Yes	57.6	49.1	35.1	20.5	45.3	0.000	*
Swelling on gums	Yes	32.6	23.3	7.5	16.6	23.7	0.000	*
Swelling of face or neck	Yes	24.5	12.8	6.3	5.3	14.9	0.000	n.s.
A lost filling ^(a)	Yes	26.6	32.7	38.8	28.1	30.3	0.130	*
A lost crown	Yes	3.2	0.7	1.3	4.0	2.3	0.096	*
A broken filling ^(a)	Yes	25.5	24.7	18.8	15.7	22.7	0.074	*
A broken crown	Yes	6.0	4.4	1.3	3.9	4.6	0.312	n.s.
A loose tooth	Yes	19.9	12.4	11.3	5.3	13.6	0.000	*
A cracked tooth ^(a)	Yes	30.5	28.1	22.5	19.7	26.8	0.078	*
High temperature	Yes	14.9	11.7	7.5	3.3	10.8	0.002	*
Other questions								
Experienced pain	Yes	85.5	84.0	78.8	53.6	78.1	0.000	*
Taking any regular medication ^(a)	Yes	47.0	48.5	57.5	55.9	50.3	0.161	*
Sociodemographic variables								
Age group	18-24 years	10.0	7.7	7.5	9.2	8.8	0.001	*
	25-44 years	45.2	43.8	32.5	25.7	39.6		
	45-64 years	26.7	25.5	40.0	33.6	29.0		
	65+ years	18.1	23.0	20.0	31.6	22.6		
Maximum education	Primary	8.5	9.5	15.0	6.6	9.1	0.049	*
	Some secondary	48.8	42.9	28.8	41.4	43.3		
	Completed secondary	19.2	18.9	21.3	17.8	19.0		
	Some university	3.6	4.4	8.8	4.6	4.6		
	Completed university	6.0	2.2	6.3	4.6	4.4		
	Some TAFE	4.3	4.7	6.3	5.9	4.9		
	Completed TAFE	7.8	16.4	13.8	17.8	13.3		
Sex of patient ^(a)	Female	53.0	56.7	66.3	60.1	57.0	0.154	*
	Male	47.0	43.3	33.8	39.9	43.0		
Language mainly spoken at home	English	89.7	91.3	86.3	90.2	90.0	0.620	n.s.
	Other	10.3	8.7	13.8	9.8	10.0		
Country of birth	Australia	61.1	68.4	63.3	66.0	64.8	0.337	n.s.
	Other	38.9	31.6	36.7	34.0	35.2		
Dental anxiety								
DAS score	DAS score							*
	<13	73.5	80.0	73.8	87.6	78.5	0.004	
	≥13	26.5	20.0	26.3	12.4	21.5		

* Statistically significant chi-square, P<0.05

** Statistically significant Spearman's rho (ordinal-ordinal variables)

n.s. Not statistically significant

(a) In the initial selection, a critical P-value of 0.25 was used to avoid rejecting potentially significant variables at this stage.

Bivariate associations between the four subjective oral health scales and urgency of care was also examined. The results are presented in Table 10.

The 'Oral and facial pain symptoms' and 'Other oral symptoms' scales are a 10-item scale with 'yes' and 'no' response options whereby 'yes' is represented by 1 and 'no' by 0. Adding the responses to each item yields a total score ranging from 0 to 10. Zero represents no oral and facial pain symptoms or any other oral symptoms, while 10 represents high experience of oral and facial pain symptoms and other oral symptoms. The mean number of oral symptoms for each urgency of care category is presented in Table 10.

The 'Activities of daily living scale' and 'Worry/concern impact scale' consisted of five and two items respectively. Responses to each item were made on a Likert-type scale whereby respondents were asked to indicate their level of experience with each of the items in question. The response format was a 5-point scale (scored from 1 to 5) ranging from 'all the time' to 'never'. The mean score for each item by category of urgency of care is presented in Table 10.

Table 10: Bivariate associations between subjective oral health scales and urgency of care

Scale	Urgency of care (Per cent within urgency of care)				Total	Sig.
	<48 hours	2-7 days	8-13 days	14+ days		
Oral and facial pain symptoms						
Valid n	255	256	68	106	685	0.000 ***
Mean	4.45	3.99	3.24	3.09	3.95	
Std Dev.	2.23	1.94	1.52	1.75	2.05	
Other oral symptoms						
Valid n	228	221	55	110	614	0.000 ***
Mean	3.28	3.01	2.36	2.45	2.95	
Std Dev.	1.85	1.97	1.70	1.41	1.84	
Activities of daily living impact scale						
Valid n	283	275	80	153	791	0.000 ***
Mean	4.17	4.40	4.63	4.82	4.42	
Std Dev.	0.90	0.78	0.60	0.40	0.79	
Worry/concern impact scale						
Valid n	279	273	80	153	785	0.009 ***
Mean	2.78	2.70	2.71	3.16	2.82	
Std Dev.	1.40	1.41	1.40	1.44	1.42	

*** Statistically significant ANOVA, P<0.05

A number of variables had a significant association with urgency of care and are marked by asterisks. Significant variables from the bivariate analyses will be further examined by means of logistic regression so as to develop a prediction model for urgency of care.

Logistic regression

To further examine factors associated with the urgency of care, logistic regression analysis was performed using a range of predictor variables. Each predictor variable with a significant bivariate association with urgency of care (see section 2.4) was entered in a binary logistic regression in order to determine the strengths of the independent association of these variables. The variables included patient characteristics (age, education) and subjective oral health status indicators (experience of pain or other oral symptoms, ability to perform activities of daily living, social and psychological impact of oral disorders).

For the purpose of this analysis, urgency of care has been dichotomised (since the outcome variable in a logistic regression is binary or dichotomous). Three models will be fitted, one for each of the new urgency of care variables:

Urgency of care	New urgency of care			
1 = <48 hours 2 = 2–7 days 3 = 8–13 days 4 = 14+ days	}	Model 1	Model 2	Model 3
		1 = <48 hours 0 = 2+ days	1 = 2–7 days 0 = 8+ days	1 = ≤ 7 days 0 = 8+ days

The logistic regression equation – overview

Logistic regression is a generalised linear modelling technique which allows both prediction of the dependent variable and assessment of the importance of individual groups of independent (or predictor) variables.

The goal of logistic regression is to find the best fitting model to describe the relationship between the dependent variable (in this case urgency of care, comprising two categories– ‘urgent’ and ‘not urgent’) and a set of independent variables. Logistic regression generates the coefficients (and standard errors and significance levels) of a linear function and the probability of being ‘urgent’ using a linear function (see Equation 1).

$$\text{Probability of being urgent} = P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_kx_k)}}$$

Equation 1: The logistic regression equation for the probability of being urgent

e=natural logarithm base, b_k= regression coefficients, x_k= value of the independent variable

Logistic regression analysis will be used to classify persons into various treatment urgency categories using the probabilities generated from Equation 1. To do this, rules to determine whether or not a patient falls into a certain category (i.e. ‘urgent’ or ‘not urgent’) must be developed. For instance:

1. If $P(\text{'urgent'}) \geq \text{cut-off value}$, then the patient is classified as ‘urgent’;
2. If $P(\text{'urgent'}) < \text{cut-off value}$, then the patient is classified as ‘not urgent’.

The results of logistic regression analysis are presented in terms of the probability of being urgent. Therefore, the cut-off value chosen for assignment to a category is critical in evaluating the success of the model since the cut-off value is used to determine how a patient is classified. Different cut-off values give different prediction results in terms of urgency of care. The chosen cut-off value is an arbitrary decision. Generally, the criteria used to select cut-off points are based on ones that conform to the observed prevalence of the gold standard, i.e. the distribution of persons according to the dentist's clinical assessment of urgency.

In order to judge the usefulness of the logistic regression model to predict urgency of care, diagnostic test indicators such as sensitivity, specificity, and positive and negative predictive values (PV+ and PV-) can be calculated for different cut-off values. This will be discussed further in the sections to follow.

Predicting urgency of care

Before proceeding, it should be noted that acute emergencies are not included in the development of the models. Acute emergencies should have a separate battery of questions that stream patients out immediately. These questions should cover haemorrhage, trauma and facial swelling and should be stringent enough to not miss these particular patients.

Model 1: New urgency of care = <48 hours or 2+ days

Of the variables with a statistically significant bivariate association with urgency of care, seven were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 11.

The odds ratio indicated that persons who experienced pain in their jaw when opening their mouth wide had 2.4 times the odds of requiring treatment within 48 hours compared to those who did not have this symptom.

Persons who reported bleeding gums had 1.5 times the odds of requiring emergency care within 48 hours than those who did not report bleeding gums.

Patients reporting a broken filling had 1.7 times the odds of requiring dental care within 48 hours than persons who did not report a broken filling.

Patients reporting a loose tooth had 2.4 times the odds of requiring dental care within 48 hours than persons who did not report a loose tooth.

The largest statistically significant effect was observed for persons who reported difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures. These people had 4.8 times the odds of requiring emergency care within 48 hours compared to those who reported no difficulty sleeping.

Those with a DAS score of 13 or more were 1.5 times more likely to need treatment within 48 hours compared to those with a lower score.

Table 11: Logistic regression coefficients for model 1

Variable	B	S.E.	P-value	OR	Lower	Upper	Sig.
Pain in teeth with cold food/fluids							
Yes	-0.352	0.187	0.060	0.704	0.488	1.015	n.s.
No	REF.						
Pain in jaw when opening mouth wide							
Yes	0.882	0.219	0.000	2.415	1.572	3.712	*
No	REF.						
Shooting pain in face or cheeks							
Yes	0.399	0.210	0.058	1.490	0.987	2.249	n.s.
No	REF.						
Bleeding gums							
Yes	-0.411	0.197	0.037	0.663	0.451	0.975	*
No	REF.						
A broken filling							
Yes	0.501	0.200	0.012	1.650	1.115	2.441	*
No	REF.						
A loose tooth							
Yes	0.855	0.240	0.000	2.352	1.470	3.763	*
No	REF.						
Difficulty sleeping							
			0.000				*
All the time	1.575	0.259	0.000	4.829	2.960	8.024	*
Very often	1.057	0.323	0.001	2.877	1.528	5.417	*
Often	0.143	0.334	0.670	1.153	0.599	2.220	*
Sometimes	0.659	0.226	0.003	1.933	1.242	3.007	
Never	REF.						
Worried about health of teeth or mouth							
			0.003				*
All the time	-0.454	0.294	0.123	0.635	0.357	1.131	
Very often	0.507	0.314	0.107	1.661	0.897	3.076	
Often	0.137	0.331	0.679	1.147	0.599	2.193	
Sometimes	0.186	0.305	0.543	1.204	0.662	2.191	
Never	REF.						
Dental anxiety							
DAS score ≥13	0.418	0.204	0.040	1.518	1.018	2.264	*
DAS score <13	REF.						
Model constant	-1.436	0.266	0.000	0.238			

Analysis used n = 750 cases with complete data on all variables
REF. = Reference category for odds ratio

* Statistically significant
n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 11 can be represented as follows:

$$P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9)}}$$

(see Table 12 for interpretation of values in this equation.)

Table 12: Independent predictor variables for Model 1: response values, logistic regression beta coefficients and standard errors

i	Independent variable	Response value (x _i)	Beta coefficient (b _i)	SE
0	Model constant	..	-1.436	0.266
1	Pain in teeth with cold food/fluids	1 = Yes 0 = No [†]	-0.352	0.187
2	Pain in jaw opening mouth wide	1=Yes 0=No [†]	0.882	0.219
3	Shooting pain in face or cheeks	1 = Yes 0 = No [†]	0.399	0.210
4	Bleeding gums	1 = Yes 0 = No [†]	-0.411	0.197
5	A broken filling	1=Yes 0=No [†]	0.501	0.200
6	A loose tooth	1 = Yes 0 = No [†]	0.855	0.240
7	Difficulty sleeping	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	1.575 1.057 0.143 0.659	0.259 0.323 0.334 0.226
8	Worried about the health of teeth or mouth	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	-0.454 0.507 0.137 0.186	0.294 0.314 0.331 0.305
9	Dental anxiety	1 = DAS score \geq 13 0 = DAS score $<$ 13 [†]	0.418	0.204

[†] Reference category

N.B. Because the equation is solved for the outcome 'urgency: <48 hours', the derived probabilities are also for urgency of <48 hours.

Model 2: New urgency of care = 2-7 days or 8+ days

Of the variables with a statistically significant bivariate association with urgency of care, six were significant in the binary logistic regression. Once again, the logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 13.

As can be seen from Table 13, those reporting to have had a toothache in the last week are 2.6 times more likely to require emergency treatment within 2-7 days compared to those who did not have a toothache.

Those persons reporting pain in their teeth with hot food or fluids, bleeding gums and/or a broken tooth had 2.0 times the odds of needing emergency treatment within 2-7 days compared to those persons not reporting these symptoms.

Those who experienced difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures had 2.9 times the odds of requiring emergency dental treatment within 2–7 days than those who had no difficulty sleeping.

Persons who reported worrying about the appearance of their teeth or mouth very often had 3.3 times the odds of requiring emergency care within 2–7 days than those who didn't report the same concern.

Table 13: Logistic regression coefficients for model 2

Variable	B	S.E.	P-value	OR	Lower	Upper	Sig.
Toothache							
Yes	0.967	0.253	0.000	2.629	1.600	4.319	*
No	REF.						
Pain in teeth with hot food or fluids							
Yes	0.651	0.219	0.003	1.917	1.248	2.945	*
No	REF.						
Pain worse in the middle of the day							
Yes	0.633	0.352	0.072	1.883	0.945	3.752	n.s.
No	REF.						
Bleeding gums							
Yes	0.698	0.235	0.003	2.009	1.268	3.184	*
No	REF.						
A broken filling							
Yes	0.732	0.265	0.006	2.080	1.238	3.495	*
No	REF.						
Difficulty sleeping							
All the time	1.079	0.393	0.006	2.941	1.361	6.355	*
Very often	1.072	0.499	0.032	2.920	1.098	7.761	*
Often	0.981	0.398	0.014	2.668	1.224	5.817	*
Sometimes	0.156	0.272	0.566	1.169	0.686	1.992	
Never	REF.						
Worried about appearance of teeth/mouth							
All the time	-0.407	0.276	0.141	0.665	0.387	1.144	*
Very often	-1.189	0.394	0.003	0.305	0.141	0.659	*
Often	0.270	0.400	0.500	1.309	0.598	2.866	
Sometimes	-0.586	0.306	0.055	0.556	0.305	1.014	
Never	REF.						
Model constant	-1.213	0.248	0.000	0.297			

Analysis used n = 476 cases with complete data on all variables
REF. = Reference category for odds ratio

* Statistically significant
n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 13 can be represented as follows:

$$P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7)}}$$

(see Table 14 for interpretation of values in this equation.)

Table 14: Independent predictor variables for Model 2: response values, logistic regression beta coefficients and standard errors

i	Independent variable	Response value (x _i)	Beta coefficient (b _i)	SE
0	Model constant	..	-1.213	0.248
1	Toothache	1 = Yes 0 = No [†]	0.967	0.253
2	Pain in teeth with hot food/fluids	1 = Yes 0 = No [†]	0.651	0.219
3	Pain worse in the middle of the day	1 = Yes 0 = No [†]	0.633	0.352
4	Bleeding gums	1 = Yes 0 = No [†]	0.698	0.235
5	Broken filling	1 = Yes 0 = No [†]	0.732	0.265
6	Difficulty sleeping	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	1.079 1.072 0.981 0.156	0.393 0.499 0.398 0.272
7	Worried about appearance of teeth or mouth	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	-0.407 -1.189 0.270 -0.586	0.276 0.394 0.400 0.306

† Reference category

N.B. Since the equation is solved for the outcome 'urgency: 2–7 days', the derived probabilities are also for urgency of 2–7 days.

Model 3: New urgency of care = ≤ 7 days or 8+ days

Logistic regression coefficients and odds ratios for model 3 are presented in Table 15.

Persons reporting a toothache had 2.2 times the odds as person not reporting a toothache to require emergency dental care within 7 days.

Those who reported a broken filling had 2.3 times the odds of needing emergency care within the week than those not reporting a broken filling.

Those who reported a loose tooth had 1.9 times the odds of requiring care within 7 days compared to those not reporting any loose teeth.

Those who experienced difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures had 5.3 the odds of requiring emergency dental treatment within 7 days than those who had no difficulty sleeping. Similarly, those who had difficulty sleeping very often had 4.3 times the odds of requiring dental care within the week compared to those who did not report difficulty sleeping.

Persons who reported worrying about the appearance of their teeth or mouth very often were 2.0 times less likely to require emergency dental care with 7 days compared to those who did not worry about the appearance of their teeth or mouth.

Table 15: Logistic regression coefficients for model 3

Variable	B	S.E.	P-value	OR	Lower	Upper	Sig.
Toothache							
Yes	0.775	0.207	0.000	2.171	1.448	3.254	*
No	REF.						
Pain worse in the middle of the day							
Yes	0.618	0.328	0.059	1.855	0.976	3.526	n.s.
No	REF.						
Shooting pain in face or cheeks							
Yes	0.453	0.262	0.083	1.573	0.942	2.628	n.s.
No	REF.						
Sore gums							
Yes	-0.322	0.214	0.132	0.725	0.476	1.102	n.s.
No	REF.						
Bleeding gums							
Yes	0.360	0.213	0.091	1.433	0.944	2.176	n.s.
No	REF.						
Changes in ability to taste							
Yes	0.534	0.307	0.082	1.706	0.934	3.116	n.s.
No	REF.						
A broken filling							
Yes	0.815	0.228	0.000	2.258	1.445	3.529	*
No	REF.						
A loose tooth							
Yes	0.666	0.313	0.033	1.945	1.054	3.591	*
No	REF.						
Difficulty sleeping							
			0.000				*
All the time	1.669	0.359	0.000	5.309	2.627	10.279	*
Very often	1.455	0.459	0.002	4.286	1.745	10.528	*
Often	0.952	0.368	0.010	2.590	1.260	5.327	*
Sometimes	0.469	0.231	0.043	1.599	1.016	2.516	*
Never	REF.						
Worried about appearance of teeth/mouth							
			0.050				*
All the time	-0.336	0.239	0.160	0.715	0.447	1.142	
Very often	-0.674	0.319	0.035	0.510	0.273	0.953	*
Often	0.477	0.348	0.170	1.611	0.815	3.185	
Sometimes	-0.137	0.254	0.590	0.872	0.529	1.435	
Never	REF.						
Model constant							
	-0.442	0.200	0.027	0.642			

Analysis used n = 750 cases with complete data on all variables
 REF. = Reference category for odds ratio

* Statistically significant
 n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 15 can be represented as follows:

$$P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10})}}$$

(see Table 16 for interpretation of values in this equation.)

Table 16: Independent predictor variables for Model 3: response values, logistic regression beta coefficients and standard errors

i	Independent variable	Response value (x _i)	Beta coefficient (b _i)	SE
0	Model constant	..	-0.442	0.200
1	Toothache	1 = Yes 0 = No [†]	0.775	0.207
2	Pain worse in the middle of the day	1 = Yes 0 = No [†]	0.618	0.328
3	Shooting pain in face or cheeks	1 = Yes 0 = No [†]	0.453	0.262
4	Sore gums	1 = Yes 0 = No [†]	-0.322	0.214
5	Bleeding gums	1 = Yes 0 = No [†]	0.360	0.213
6	Changes in ability to taste	1 = Yes 0 = No [†]	0.534	0.307
7	Broken filling	1 = Yes 0 = No [†]	0.815	0.228
8	Loose tooth	1 = Yes 0 = No [†]	0.666	0.313
9	Difficulty sleeping	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	1.669 1.455 0.952 0.469	0.359 0.459 0.368 0.231
10	Worried about appearance of teeth or mouth	1 = All the time 2 = Very Often 3 = Often 4 = Sometimes 5 = Never [†]	-0.336 -0.674 0.477 -0.137	0.239 0.319 0.348 0.254

† Reference category

N.B. Since the equation is solved for the outcome 'urgency: ≤7 days', the derived probabilities are also for urgency of ≤7 days.

Diagnostic test indicators

The fundamental question to be answered is 'Is a patient 'urgent' or 'not urgent'?'. The logistic regression models are used to discriminate between 'urgent' and 'not urgent' patients. To determine just how accurately this question can be answered using the models, various measures of test performance can be examined.

Sensitivity, specificity and predictive values

Clinicians use measures of test performance such as sensitivity, specificity, positive predictive value (PV+) and negative predictive value (PV-) to assess each model's ability to predict urgency of dental treatment.

Sensitivity and specificity describe the accuracy of the model. Sensitivity measures how accurately the model identifies urgent patients, i.e. the true positive rate, while the specificity measures how accurately the model identifies non-urgent patients i.e. the true negative rate. A sensitive test identifies most of the patients who are urgent and perhaps a few who are not. A specific test identifies most of the patients who are not urgent and maybe a few who are.

The predictive value of a positive test is the probability that a patient with a positive test result is urgent, while the predictive value of a negative test is the probability that a patient with a negative test result is not urgent.

A simple way of looking at the relationships between a test's results and the clinician assessment of urgency is shown in Table 17. The test is considered to be either positive or negative and the clinician's assessment of urgency as either 'urgent' or 'not urgent'. There are four possible interpretations of test results, two of which are correct (true positive and true negative) and two wrong (false positive and false negative). The test has given the correct answer when it is positive when a patient is urgent (true +ve) or negative when a patient is not urgent (true -ve). On the other hand, the test has been misleading if it is positive when a patient is not urgent (false +ve) and negative when a patient is urgent (false -ve).

The relationships between the test result and clinician urgency are summarised in Table 17 in terms of sensitivity, specificity, PV+ and PV-.

Table 17: Relationship between a diagnostic test result and clinician assessment of urgency

		Clinician urgency (clinical assessment of urgency)		Total
		Urgent +ve	Not urgent -ve	
Test result (based on predictor variables)	Urgent +ve	a (TP)	b (FP)	a + b
	Not urgent -ve	c (FN)	d (TN)	c + d
Total		a + c	b + d	N

Notes

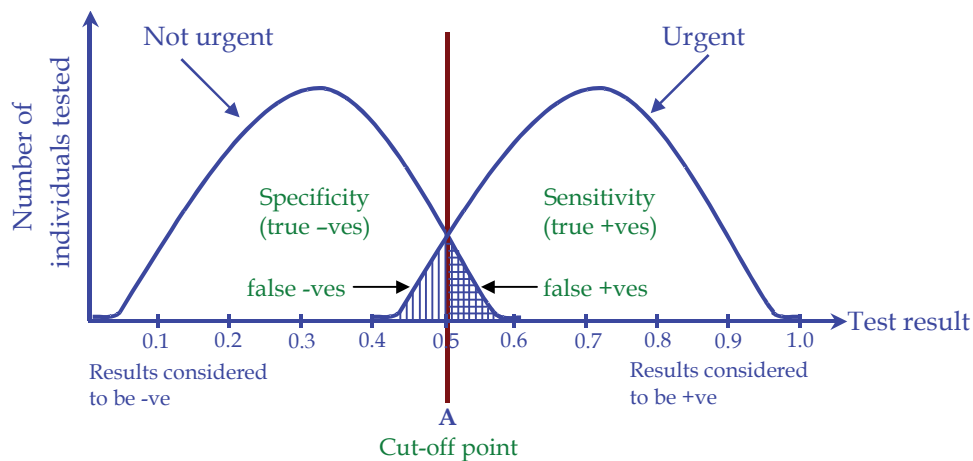
1. Sensitivity = $a/(a+c)$, Specificity = $d/(d+b)$, PV+ = $a/(a+b)$, PV- = $d/(c+d)$, $a+b+c+d = N$
2. TP = true positive, FP = false positive, FN = false negative, TN = true negative

Source: Fletcher, Fletcher & Wagner 1996

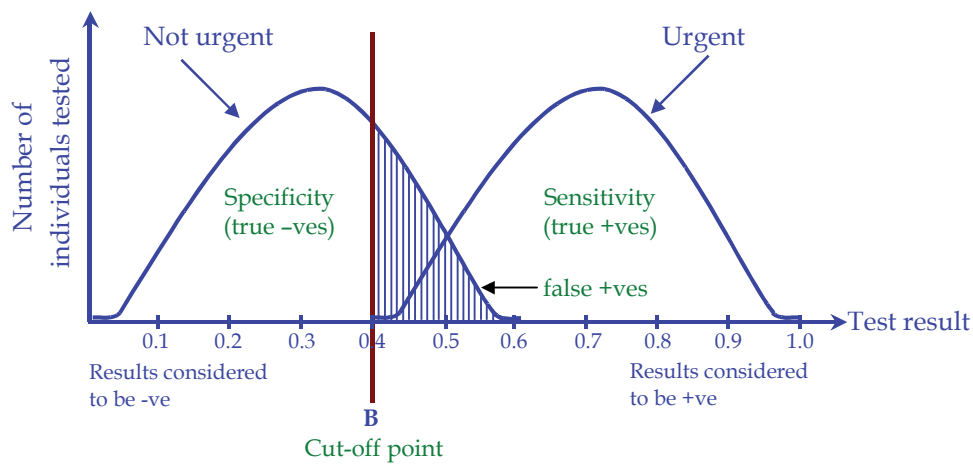
Hypothetical distribution of test results

A hypothetical distribution of test results for 'not-urgent' and 'urgent' individuals is illustrated in Figure 1.

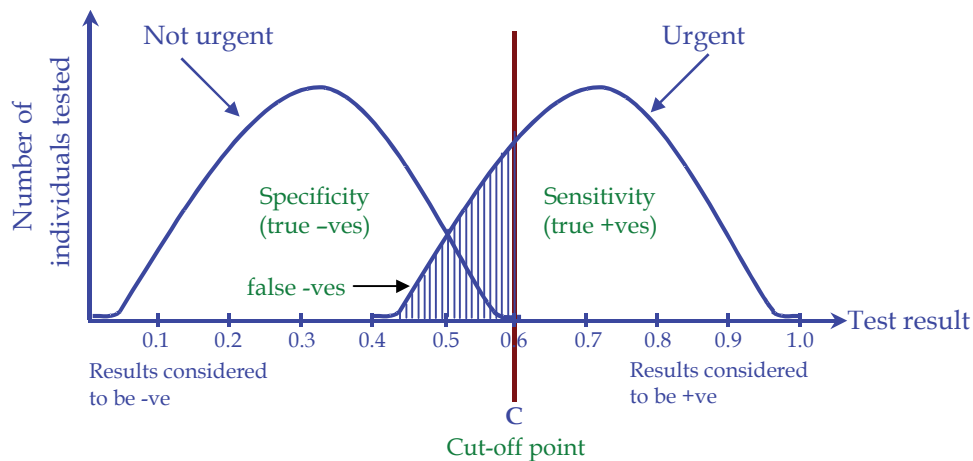
Because the 'not urgent' and 'urgent' ranges of values often overlap, a cut-off point in the overlapping range is used to define the 'decision threshold' that can be varied to alter the test's sensitivity and specificity. The position of the cut-off point between 'negative' and 'positive' test results determines the test's sensitivity and specificity. The cut-off point is the value above which a test is interpreted as 'urgent'. If the cut-off point is modified, sensitivity will be enhanced at the expense of specificity and vice versa. Cut-off values are selected such that the desired sensitivity and specificity are achieved.



Selecting a cut-off point, say A = 0.5, in the middle of the overlapping range balances the number of false positives and false negatives.



Moving the cut-off point to 0.4 (i.e. choosing cut-off point B) eliminates false negative results but increases the proportion of false positive test results. In this case the test would have 100% sensitivity but low specificity.



Choosing cut-off point C = 0.6 eliminates false positive results but increases the proportion of false negative test results. In this case the test would have 100% specificity but low sensitivity.

Figure 1: Hypothetical distribution of test results

As illustrated in Figure 1, an important use of the concepts of sensitivity, specificity and predictive values is in the determination of an optimal cut-off value or clinical decision limit for a test. Sensitivity and specificity are dependent on the cut-off value selected – the decision on what cut-off value to choose is arbitrary. It is important to note that whenever a clinical decision limit is changed, there is a trade-off between the sensitivity and specificity of a test.

For example, it would be desirable to maximise sensitivity (i.e. have few false -ves) when there is an important penalty (social impact/political) for missing an urgent case; or to maximise specificity (i.e. have few false +ves) when it is important (in terms of equity and allocative efficiency) not to treat false +ves as urgent. Note that some sort of ‘safety net’ or appeal mechanism should be considered for false -ves who recontact the clinic for care.

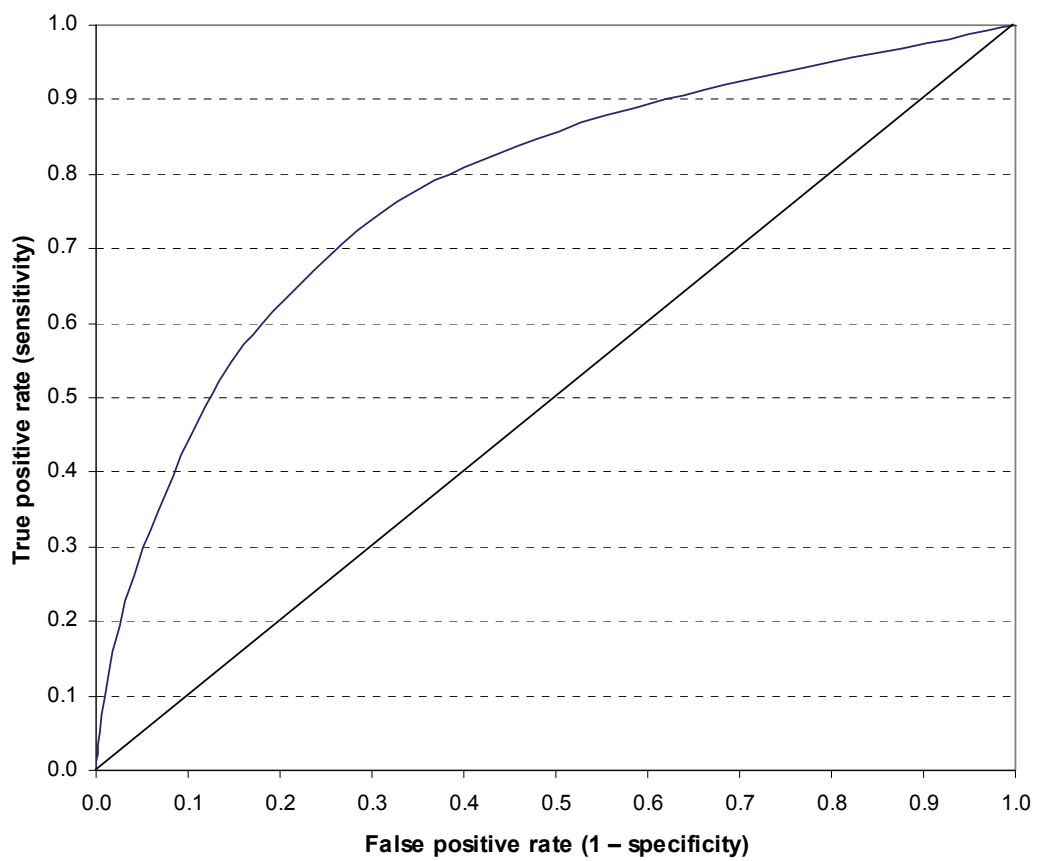
Clinicians have to collaborate and agree on the balance of false positives versus false negatives for each diagnostic situation. The intended clinical use of a test will also be a factor in selecting the best cut-off value. In a given clinical setting the consequences of a false negative result may be far more serious than those of a false positive result and vice versa. There is no simple way to select the optimum combination of sensitivity and specificity. The choice depends on the nature of the disease, the clinical population and the relative cost of a false positive or false negative result.

In the next section the relationship between the cut-off point and sensitivity/specificity will be examined through the construction of receiver operating characteristic (ROC) curves.

ROC curves

A useful way to present the characteristics of a diagnostic test is through a receiver operating characteristic (ROC) curve. A ROC curve can be constructed by plotting the true positive rate (sensitivity) against the false positive rate (1-specificity) for the different possible cut-off values of a diagnostic test. The values on the axes run from a probability of 0 to 1.0, or alternatively from 0% to 100% (Figure 2).

ROC curves show how severe the trade-off between sensitivity and specificity is for a test and can be used to help decide where the best cut-off point would be. ROC curves represent the accuracy of a test over a range of cut-off points. As the decision threshold is varied (i.e. as the cut-off point that separates ‘not-urgent’ patients from ‘urgent’ ones is changed), the sensitivity and specificity of the test also change. The best cut-off point for balancing the sensitivity and specificity of a test is the one on the curve closest to the upper left-hand corner. Cut-off points closest to the upper left-hand corner maximise the number of true positive results and minimise the number of false positive results. A ROC curve that operates no better than chance for detecting urgent patients will lie along the 45-degree line that runs from the intersection of the X and Y axes to the upper right-hand corner of the graph. Points on this line indicate that the test provides an equal number of true positives and false positives; that is, it does not discriminate between ‘not urgent’ and ‘urgent’ patients.



Note: 45° line represents line of zero discrimination

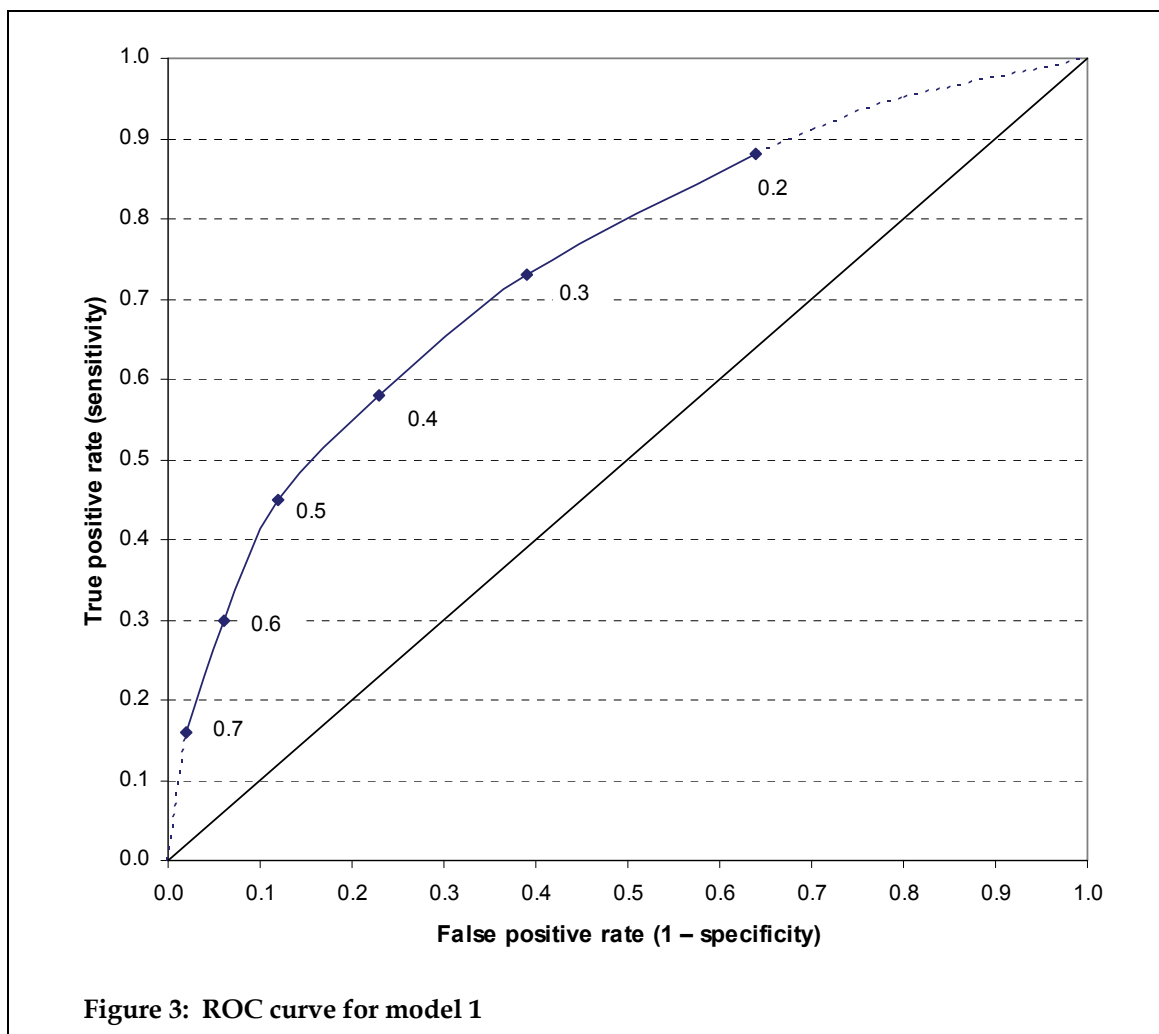
Figure 2: ROC curve

ROC curve for emergency model 1

The ROC curve for emergency model 1 examining urgency of <48 hours vs 2+ days is shown in Figure 3. If the probability of needing care within 48 hours is required to be greater than 0.7 to diagnose urgent cases, all patients diagnosed as 'urgent' would certainly be urgent, but many other urgent people would be missed using this definition of urgency. The test would be very specific at the expense of sensitivity.

At the other extreme, if anyone with a probability of needing care within 48 hours is less than 0.2, very few urgent patients would be missed, but most non-urgent people would be falsely labelled as being urgent. The test would then be very sensitive but nonspecific.

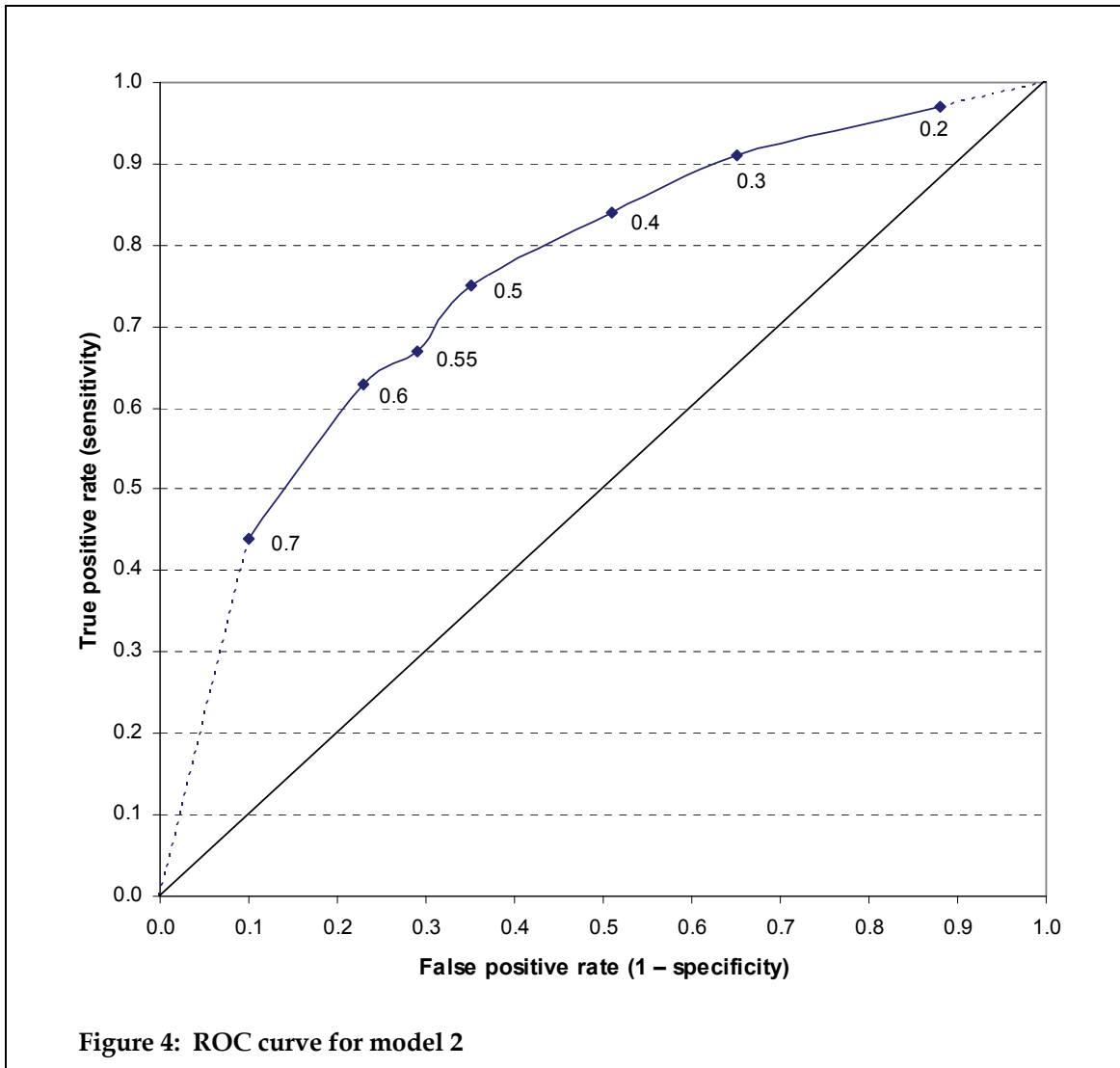
The key point is that there is generally a trade-off between the sensitivity and specificity of a test. It is obviously desirable to have a test that is both highly sensitive and highly specific but this is usually not possible. A trade-off between sensitivity and specificity is required when clinical data take on a range of values. In these situations the location of a cut-off point on the continuum between non-urgent and urgent is an arbitrary decision.



ROC curve for emergency model 2

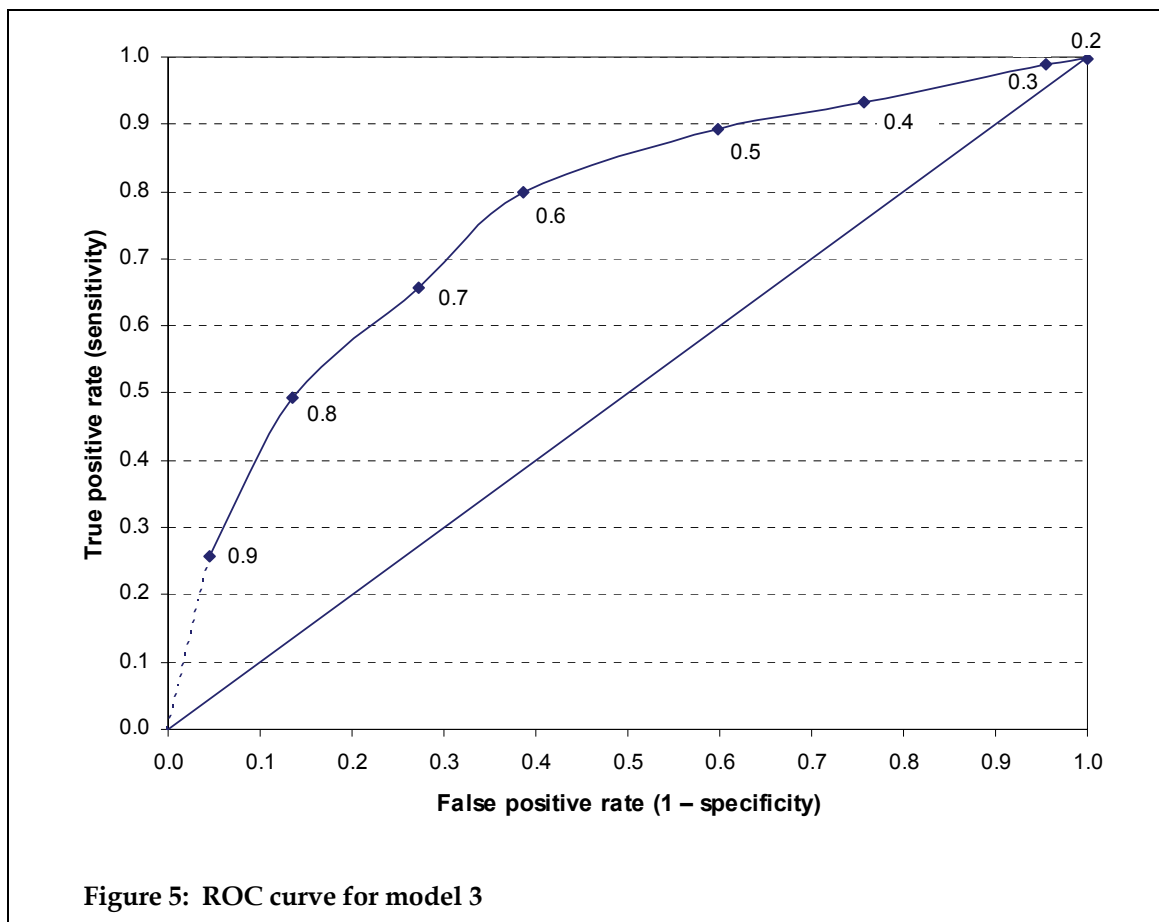
The ROC curve for emergency model 2 examining urgency of 2-7 days vs 8+ days is shown in Figure 4. The cut-off values on the curve represent the probability of needing treatment in 2-7 days.

If we want to ensure that more urgent patients are not missed, a low cut-off point should be chosen. To have fewer false positives (i.e. correctly identify more non-urgent patients), a higher cut-off value should be considered.



ROC curve for emergency model 3

The ROC curve for emergency model 3 examining urgency of ≤ 7 days vs 8+ days is shown in Figure 5. The cut-off values on the curve represent the probability of needing treatment within 7 days.



Results – diagnostic test indicators

This section presents tables detailing the trade-off between the sensitivity and specificity of a test when different cut-off points are chosen, along with the predictive values of the test at each cut-off point. By varying the cut-off point, different values of sensitivity and specificity are obtained. Sensitivity and specificity exhibit opposite behaviours: a higher value of sensitivity is paid for by a lower value of specificity. The relative consequences of false negative and false positive test results need to be considered when selecting the cut-off point.

Emergency model 1

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 1 at varying cut-off values are presented in Table 18.

Table 18: Sensitivity, specificity and predictive values for emergency model 1

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.88	0.36	0.43	0.84
0.3	0.73	0.61	0.51	0.81
0.4	0.58	0.77	0.59	0.77
0.5	0.45	0.88	0.67	0.74
0.6	0.30	0.94	0.75	0.71
0.7	0.16	0.98	0.78	0.68

If sensitivity and specificity are regarded as being of equal importance, a cut-off value somewhere around 0.3 might be chosen. However, choosing a test that results in the same sensitivity and specificity implies that the costs of a false positive and false negative test results are equivalent.

Suppose a cut-off value of 0.20 is chosen. The test is therefore 88% sensitive, meaning that 88% of urgent patients test positive and 12% are potentially misclassified (i.e. 12% of urgent people will be missed). Specificity for the test is 36%, meaning that 36% of non-urgent patients test negative (i.e. 64% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 43% but there is a 57% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 16%, which indicates an 84% chance that the patient is not urgent.

Suppose a cut-off value of 0.70 is chosen. The test sensitivity in this case is 16%, which indicates that 16% of urgent patients test positive and 84% are potentially misclassified (i.e. 84% of urgent people will be missed). Specificity for the test is 98%, meaning that 98% of non-urgent patients test negative (i.e. 2% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 78% but there is still a 22% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 32%, which indicates a 68% chance that the patient is not urgent.

Example interpretation of emergency model 1

Suppose there are 100 patients presenting for emergency dental care. According to the assessing dentist, approximately 36% require care within 48 hours and a further 64% are classified as being able to wait 2 or more days for treatment (see Table 7).

However, of those patients classified as urgent (i.e. requiring care within 48 hours), the number actually seen within 48 hours will depend on the cut-off value selected. To illustrate this, the model is interpreted for two different cut-off values, a low cut-off of 0.2 and a high cut-off of 0.7.

Decision 1: cut-off = 0.2

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.88	0.36	0.43	0.84

The first thing to note is the model has high sensitivity but low specificity when using a cut-off value of 0.2. This indicates that the model will tend to identify most urgent cases (i.e. have fewer false negative results) but at the same time will also identify more non-urgent patients as urgent (i.e. have more false positives results).

Therefore, using a cut-off value of 0.2, the model sensitivity is 88%. The specificity is 36%, indicating that of those 36 patients actually requiring care within 48 hours, 32 (88%) will be correctly identified as urgent and will therefore be seen within 48 hours, but 4 patients (12%), will be misclassified and receive care in 2 or more days time (i.e. 4 patients end up with false negative results).

Of the 64 patients who are considered able to wait 2 or more days for treatment, 23 (36%) without urgent need will actually test negative but 41 (64%) will be misclassified (i.e. 41 patients end up with false positive results) and receive care within 48 hours.

These results are summarised in Table 19. Of the 100 patients presenting for emergency care, 27 will not be seen immediately.

Table 19: Example using emergency model 1 with cut-off = 0.2 to assign priority to 100 patients presenting for emergency dental care

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	32	41 (FP)	73
	2+ days -ve	4 (FN)	23	27*
	Total	36	64	100

* Not seen

FP = false positive, FN = false negative

Decision 2: cut-off = 0.7

Cut-off	Sensitivity	Specificity	PV+	PV-
0.7	0.16	0.98	0.78	0.68

Using a higher cut-off value increases the specificity at the expense of the sensitivity. In this particular case, 30 patients end up with false negative test results and only 1 patient ends up with a false positive result (Table 20).

Table 20: Example using emergency model 1 with cut-off = 0.7 to assign priority to 100 patients presenting for emergency dental care

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	6	1 (FP)	7
	2+ days -ve	30 (FN)	63	93
	Total	36	64	100

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix A1).

Emergency model 2

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 2 at varying cut-off values are presented in Table 21.

Table 21: Sensitivity, specificity and predictive values for emergency model 2

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.97	0.12	0.56	0.79
0.3	0.91	0.35	0.62	0.76
0.4	0.84	0.49	0.66	0.73
0.5	0.75	0.65	0.71	0.69
0.55	0.67	0.71	0.73	0.65
0.6	0.63	0.77	0.76	0.64
0.7	0.44	0.90	0.84	0.58

Suppose, for example, a cut-off value of 0.40 is chosen. The test is 84% sensitive, meaning that 84% of urgent patients test positive and 16% are potentially misclassified (i.e. 16% of urgent people will be missed). Specificity for the test is 49%, meaning that 49% of non-urgent patients test negative (i.e. 51% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 66%, but there is a 34% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 27%, which indicates a 73% chance that the patient is not urgent.

Example interpretation of emergency model 2

When a cut-off value of 0.2 was used for emergency model 1, 27 of the 100 patients presenting for emergency dental care were not classified as needing to be seen immediately, i.e. 73 were classified as requiring care within 48 hours while the remaining 27 patients were considered able to wait 2+ days for dental treatment.

Consider what happens to these 27 patients when emergency model 2 is used (assuming a cut-off value of 0.2 for emergency model 1). To determine how many of these 27 patients are classified as needing to be seen in the period 2–7 days or in 8+ days, a cut-off value needs to be selected. As discussed previously, the predictive capability of the model is dependent upon the cut-off value chosen. To illustrate this, emergency model 2 is interpreted for 2 different cut-off values, a low cut-off of 0.4 and a high cut-off of 0.7.

Decision 1: cut-off = 0.4

Cut-off	Sensitivity	Specificity	PV+	PV-
0.4	0.84	0.49	0.66	0.73

Based on the above values of sensitivity, specificity and positive and negative predictive values, and solving the relationships between the test result and the clinician's urgency assessment presented in Table 17, the following results are obtained (Table 22).

Table 22: Example using emergency model 2 with cut-off = 0.4 to assign priority to the patients not classified as requiring care within 48 hours

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	12	7 (FP)	19
	8+ days -ve	2 (FN)	6	8
	Total	14	13	27

FP = false positive, FN = false negative

The results presented in Table 22 show that 8 of the 27 patients initially presenting for emergency care are classified as able to wait 8 or more days for dental care.

Decision 2: cut-off = 0.7

Cut-off	Sensitivity	Specificity	PV+	PV-
0.7	0.44	0.90	0.84	0.58

Using a higher cut-off value (0.7) increases the specificity at the expense of the sensitivity. Therefore, there will be fewer false positive results but more false negative test results (Table 23).

Table 23: Example using emergency model 2 with cut-off = 0.7 to assign priority to the patients not classified as requiring care within 48 hours

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	7	1 (FP)	8
	8+ days -ve	8 (FN)	11	19
	Total	15	12	27

FP = false positive, FN = false negative

The results presented in Table 23 show that 19 of the 27 patients initially presenting for emergency care are classified as able to wait 8 or more days for dental care.

Similar calculations can be made for the other cut-off values (see Appendix A1).

Emergency model 3

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 3 at varying cut-off values are presented in Table 24. As the cut-off value is lowered, the sensitivity increases but the specificity decreases.

Table 24: Sensitivity, specificity and predictive values for emergency model 3

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	1.00	0.00	0.70	0.00
0.3	0.99	0.04	0.71	0.67
0.4	0.93	0.24	0.74	0.61
0.5	0.89	0.40	0.77	0.62
0.6	0.80	0.61	0.83	0.56
0.7	0.66	0.73	0.85	0.47
0.8	0.49	0.87	0.90	0.42
0.9	0.26	0.96	0.93	0.35

Suppose the cut-off value is set at 0.6. Of the patients who actually are urgent, 80% will have positive test results. This is the percentage of 'true positive' results. The remaining 20% of urgent patients have negative test results but are nonetheless urgent. This is the percentage of patients with 'false negative' test results, i.e. 20% of urgent people will be misclassified as not urgent.

Of the patients who are not urgent, 61% will have negative test results. This is the percentage of 'true negative' results. The remaining 39% of non-urgent patients have positive test results, but are not urgent. This is the percentage of patients with 'false positive' test results, i.e. 39% of non-urgent patients will be misclassified as urgent.

If the test is positive, the probability of being urgent is 83% (i.e. 83 of 100 patients with positive test results will likely be urgent). Hence, if the test is positive, there is a 17% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 44%, which indicates a 56% chance that the patient is not urgent.

Example interpretation of emergency model 3

Suppose there are 100 patients presenting for emergency dental care. According to the assessing dentist, approximately 71% require care within 7 days (i.e. 36% require care within 48 hours and a further 35% need to be seen between 2 and 7 days) and the remaining 29% are considered able to wait 8 or more days for dental care (i.e. 10% are classified as requiring care in 8-13 days and 19% are considered able to wait 14+ days for treatment) (see Table 7).

Let us now consider what happens to these 100 patients when a cut-off point of 0.6 is selected.

Decision 1: cut-off = 0.6

Cut-off	Sensitivity	Specificity	PV+	PV-
0.6	0.80	0.61	0.83	0.56

Using a cut-off value of 0.6, the model sensitivity is 80%. The specificity is 61%, indicating that of those 71 patients actually requiring care within 7 days, 57 (80%) will be correctly identified as urgent and will therefore be seen within 7 days, but 14 patients (20%) will be misclassified and receive care in 8 or more days time (i.e. 14 patients end up with false negative results).

Of the 29 patients who are considered able to wait 8 or more days for treatment, 18 (61%) without urgent need will actually test negative but 11 (39%) will be misclassified (i.e. 11 patients end up with false positive results) and receive care within 7 days.

These results are summarised in Table 25. Of the 100 patients presenting for emergency care, 32 will not be seen within 7 days.

Table 25: Example using emergency model 3 with cut-off = 0.6 to assign priority to 100 patients presenting for emergency dental care

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	57	11 (FP)	68
	8+ days -ve	14 (FN)	18	32*
	Total	71	29	100

* Not seen

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix A1).

False negative results

One important question left to answer is ‘What happens to patients who receive a false negative classification in these models?’

Recall that patients with a false negative result are patients who are in fact ‘urgent’ but instead are incorrectly classified as ‘not urgent’.

The main concern here is that these urgent patients will go untreated, potentially leading to the deterioration of their oral health condition and increasing the risk of their condition impacting negatively on their quality of life.

There are, however, systemic steps that can be taken to widen the ‘safety net’ for such patients. One such step would be to develop and implement a procedure which tags patients who are misclassified (i.e. classified as ‘not urgent’ and are sent away or their treatment is delayed). If they were to recontact the clinic they would be immediately identifiable and could be asked to come in for an assessment to ascertain their true treatment need status.

3 General dental care

3.1 Participants

Of the 900 participants required for the general component of the RNI Study, 740 patients requesting routine dental care were recruited across SA and NSW. Overall, 82.2% of the anticipated sample was collected. A breakdown of the sample collected at each clinic in each state is given in Table 26.

In SA 471 eligible patients requesting routine dental care were recruited for the study. Overall, 85.6% of the required sample for SA was collected. In NSW, 269 patients were selected for inclusion in the study, making up 76.9% of the required sample for that state.

Table 26: Sample size collected from selected dental clinics in SA and NSW

State	Community Dental Service Clinic	Anticipated sample size	Sample size achieved
SA	East Marden	80	49
	Gawler	60	60
	Gilles Plains	130	133
	Kadina	30	31
	Parks	90	92
	Somerton Park	100	101
	Victor Harbor	60	4
	SA total	550	471 (85.6%)
NSW	United Dental Hospital	120	129
	Western Sydney Area Health Service – Mt Druitt	70	70
	Illawarra Area Health Service – Bulli	70	70
	South Western Sydney Area Health Service – Narellan	90	0
	NSW total	350	269 (76.9%)
Total sample		900	740 (82.2%)

3.2 Population characteristics

Sociodemographic characteristics of respondents

The percentages of respondents in each of several sociodemographic groupings for both SA and NSW, as well as in the overall sample are shown in Table 27.

Almost 42% of respondents were aged 25–44 years and a further 28% were aged 45–64 years, while 9.1% were in the youngest age group, which spanned only 7 years. There is an over-representation of females in the sample but this could be because females tend to use dental services more so than men. The majority of respondents had completed some or all of their secondary school education (59.3%), 32.1% had some secondary school education and a further 27.2% had completed secondary school. Almost 52% of patients presenting for general dental care held a full-entitlement pensioner concession card and approximately 43% of the sample had a health care card.

Table 27: Distribution of sample sociodemographic characteristics by state

	SA (n = 471) %	NSW (n = 269) %	Total (n = 740) %
Age group	n = 469	n = 268	n = 737
18–24 years	10.4	6.7	9.1
25–44 years	39.7	44.8	41.5
45–64 years	27.9	28.4	28.1
65+ years	22.0	20.1	21.3
Sex of patient	n = 471	n = 269	n = 740
Male	41.0	45.4	42.6
Female	59.0	54.6	57.4
Born in Australia	n = 471	n = 268	n = 739
Yes	60.1	53.0	57.5
No	39.9	47.0	42.5
Language mainly spoken at home[†]	n = 471	n = 269	n = 740
English	89.8	73.6	83.9
Other	10.2	26.4	16.1
Indigenous status[†]	n = 470	n = 268	n = 738
No	98.9	95.1	97.6
Yes, Aboriginal	1.1	2.2	1.5
Yes, Torres Strait Islander	–	2.6	0.9
Highest level of education	n = 471	n = 268	n = 739
Primary school	6.4	7.1	6.6
Some secondary school	33.8	29.1	32.1
Completed secondary school	26.1	29.1	27.2
Some university or higher education	7.9	5.6	7.0
Completed university or higher education	8.1	7.1	7.7
Some TAFE, CAE or vocational course	7.0	6.7	6.9
Completed TAFE, CAE or vocational course	9.6	13.4	11.0
Other	1.3	1.9	1.5
Usual/previous occupation	n = 453	n = 261	n = 714
Manager/professional	11.3	11.5	11.3
Para-professional/trade	22.3	18.0	20.7
Clerk/sales/driver/labourer	45.0	50.6	47.1
Self-employed	1.8	1.1	1.5
Home duties	8.6	12.6	10.1
Other	11.0	6.1	9.2
Health care card status	n = 470	n = 269	n = 739
Pensioner Concession Card (full) only	48.5	57.2	51.7
Pensioner Concession Card (part) only	4.0	2.2	3.4
Health Care Card only	45.1	38.3	42.6
Other card(s)	2.3	2.2	2.3

* Statistically significant chi-square, P<0.05

Access to dental services

Dental visiting patterns of respondents in both SA and NSW, and in the overall sample, are shown in Table 28.

Almost 60% of respondents reported that a dental problem was their usual reason for a dental visit and 35% visited a dentist in the last 12 months. It should be noted that those who last visited a dentist 12 months ago would have visited for emergency care since the inclusion criteria for the general RNI sample states that patients should not have visited the dentist for routine dental care in the last year. Just over 60% of respondents received their last course of care at a public dental hospital/clinic.

Table 28: Dental visiting factors by state

	SA (n = 471) %	NSW (n = 269) %	Total (n = 740) %
Dentate status	n = 470	n = 268	n = 738
Natural teeth only	82.6	78.0	80.9
Denture (U and/or L) and natural teeth	17.4	22.0	19.1
Private dental insurance*	n = 471	n = 269	n = 740
Yes	5.1	1.9	3.9
No	94.9	98.1	96.1
Usual reason for visit*	n = 470	n = 263	n = 733
Check-up	51.5	14.1	38.1
Problem/pain	44.3	81.7	57.7
Check-up/problem/pain	4.3	4.2	4.2
Time since last visit*	n = 469	n = 268	n = 737
<12 months	27.1	48.9	35.0
12-<2 years	20.3	15.3	18.5
2-<3 years	15.8	10.4	13.8
3-<5 years	17.7	10.4	15.1
5+ years	19.0	14.6	17.4
Never	0.2	0.4	0.3
Place of last visit*	n = 464	n = 267	n = 731
Private practice	35.3	27.0	32.3
Public hospital/clinic	53.7	71.5	60.2
School Dental Service	8.8	1.1	6.0
Other	2.2	0.4	1.5
Frequency of dental visits*	n = 467	n = 266	n = 733
More than 2 times a year	5.6	6.4	5.9
2 times a year	7.5	7.1	7.4
Once a year	16.1	13.2	15.0
Once every 2 years	34.0	22.6	29.9
Once every 5 years	23.3	19.9	22.1
Less often than that	13.5	30.8	19.8

* Statistically significant chi-square, P<0.05

3.3 Data variables

Dependent variable

The aim of this study was to determine levels of priority of those people seeking routine dental care. Urgency of care, based on the assessing dentist's clinical judgment, was therefore used as the dependent variable. This variable consists of the following four categories into which a patient's urgency for dental treatment may be classified by the assessing dentist: <1 month, 1-3 months, 4-6 months or 7+ months.

Independent variables

Questionnaire variables were developed from the literature to reflect potential predictors of urgency of care. These variables are described in Table 29.

Table 29: Potential predictors of urgency of dental care

Sociodemographic variables	<ul style="list-style-type: none"> • age group • sex of patient • born in Australia • language mainly spoken at home • maximum education
Dental visiting factors	<ul style="list-style-type: none"> • usual reason for visit • time since last dental visit • place of last dental visit • frequency of dental visits
Ability to chew^(a)	<p>Are you usually able to:</p> <ul style="list-style-type: none"> • chew a piece of fresh carrot? • chew boiled vegetables? • chew fresh lettuce salad? • chew firm food such as steaks or dried apricots? • bite off and chew a piece of whole fresh apple? • chew hamburger? <p><i>Response format: yes/no</i></p>
Ability to speak^(a)	<p>Thinking about problems with your teeth or mouth...</p> <ul style="list-style-type: none"> • do you ever have difficulty pronouncing any words? • do you ever have difficulty speaking clearly? • do you have difficulty making yourself understood? <p><i>Response format: yes/no</i></p>
Oral and facial pain symptoms^(a)	<p>In the last four weeks, have you had the following problems?</p> <ul style="list-style-type: none"> • toothache • pain in teeth with hot food or fluids • pain in teeth with cold food or fluids • pain in teeth with sweet food • pain in jaw while chewing • pain in jaw when opening mouth wide • pain in front of ear • burning sensation in tongue or other parts of mouth • shooting pain in face or cheeks • pain or discomfort from denture <p><i>Response format: yes/no</i></p>

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

(continued)

Table 29: Potential predictors of urgency of dental care (continued)

Other oral symptoms[†]	<p>In the last four weeks, have you had the following problems?</p> <ul style="list-style-type: none"> • mouth ulcers • cold sores • sore gums • bleeding gums • bad breath • dryness of mouth • unpleasant taste • changes in ability to taste • clicking/grating noise in jaw joint • difficulty opening mouth wide <p><i>Response format: yes/no</i></p>
Eating impact scale^(a)	<p>Thinking about your dental health over the last year, how often...</p> <ul style="list-style-type: none"> • have you been prevented from eating foods you would like to eat? • have you found your enjoyment of food less than it used to be? • did it take you longer to finish a meal than other people? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Communication/social relations impact scale^(a)	<p>Thinking about your dental health over the last year, how often...</p> <ul style="list-style-type: none"> • did you avoid eating with other people because of problems with chewing? • were you embarrassed by the appearance or health of your teeth or mouth? • did you avoid laughing or smiling? • did you avoid conversations with others? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Activities of daily living impact scale^(a)	<p>During the past year, how often have pain, discomfort or other problems with your teeth, mouth or dentures caused you to...</p> <ul style="list-style-type: none"> • have difficulty sleeping? • stay home more than usual? • stay in bed more than usual? • take time off work? • be unable to do household chores? • avoid usual leisure activities? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Worry/concern impact scale^(a)	<p>During the past year, how often have you worried about...</p> <ul style="list-style-type: none"> • the appearance of your teeth or mouth? • the health of your teeth or mouth? <p><i>Response format: all the time, very often, fairly often, sometimes, never</i></p>
Shortened OHIP Functional limitation scale	<p>During the past year...</p> <ul style="list-style-type: none"> • have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures? • have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?
Physical pain scale	<ul style="list-style-type: none"> • have you had a painful aching in your mouth? • have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

(continued)

Table 29: Potential predictors of urgency of dental care (continued)

Psychological discomfort scale	<ul style="list-style-type: none"> • have you been self-conscious because of problems with your teeth, mouth or dentures • have you felt tense because of problems with your teeth, mouth or dentures?
Physical disability scale	<ul style="list-style-type: none"> • has your diet been unsatisfactory because of problems with your teeth, mouth or dentures? • have you had to interrupt meals because of problems with your teeth, mouth or dentures?
Psychological disability scale	<ul style="list-style-type: none"> • have you found it difficult to relax because of problems with your teeth, mouth or dentures? • have you been a bit embarrassed because of problems with your teeth, mouth or dentures?
Social disability scale	<ul style="list-style-type: none"> • have you been a bit irritable with other people because of problems with your teeth, mouth or dentures? • have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?
Handicap scale	<ul style="list-style-type: none"> • have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures? • have you been totally unable to function because of problems with your teeth, mouth or dentures?
	<i>Response format: responses scored from 1 to 5 (i.e. from 'very often' to 'never')</i>
Other symptoms	<p>In the last four weeks, have you had the following problems?</p> <ul style="list-style-type: none"> • pain which is worse in the middle of the day • pain at night • swelling on gums • swelling of your face or neck • a lost filling • a lost crown • a broken filling • a broken crown • a loose tooth • a cracked tooth • high temperature
	<i>Response format: yes/no</i>
Other questions	<ul style="list-style-type: none"> • Do you take any regular medication? • Do you have diabetes? • Do you smoke tobacco?
	<i>Response format: yes/no</i>
Dental anxiety	<ul style="list-style-type: none"> • Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? • Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel? • Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel? • Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel?
	<i>Response format: responses scored from 1 to 5</i>

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

Distribution of responses to dependent and independent variables

Dependent variable distribution – urgency of care

The percentage of respondents falling into each category of urgency of care, as determined by the assessing dentist, by state and total sample is shown in Table 30.

Table 30: Percentage of respondents placed in categories of urgency of care

	SA (n = 428) %	NSW (n = 259) %	Total (n = 687) %
Urgency of care			
<1 month	7.5	25.5	14.3
1–3 months	18.2	37.5	25.5
4–6 months	15.9	23.2	18.6
7+ months	58.4	13.9	41.6

According to the assessing dentist, just over 14% of respondents required dental care within 1 month and a further 25.5% needed to be seen between 1 and 3 months. Almost 42% of respondents were classified in the '7+ months' category, suggesting that their dental treatment needs did not require immediate attention.

Frequency of responses to independent variables

The percentage of respondents reporting 'yes' to various symptoms by state and overall sample is shown in Table 31. Patients were questioned about various problems they may have experienced in the last year.

Table 31: Frequency of responses

	SA % within state	NSW % within state	Total % within state	Sig.
Ability to chew				
Able to chew piece of fresh carrot	88.1	69.5	81.4	*
Able to chew boiled vegetables	94.3	96.6	95.1	n.s.
Able to chew fresh lettuce salad	94.0	97.0	95.1	n.s.
Able to chew firm food such as steak or dried apricots	89.6	73.9	83.9	*
Able to bite off and chew a piece of whole fresh apple	87.2	72.8	82.0	*
Able to chew hamburger	92.1	88.0	90.6	n.s.
Ability to speak				
Difficulty pronouncing any words	11.1	22.0	15.0	*
Difficulty speaking clearly	7.2	20.5	12.1	*
Difficulty making yourself understood	6.8	15.3	9.9	*
Oral and facial pain symptoms				
Toothache	35.9	60.1	44.7	*
Pain in teeth with cold food or fluids	35.9	60.1	44.7	*
Pain in teeth with hot food or fluids	26.9	45.0	33.5	*
Pain in jaw while chewing	14.0	34.0	21.3	*
Pain in teeth with sweet food	17.6	38.7	25.2	*
Pain in front of ear	16.0	26.9	19.9	*
Shooting pain in face or cheeks	8.5	19.0	12.3	*
Pain in jaw when opening mouth wide	11.0	23.6	15.6	*
Burning sensation in tongue or other parts of mouth	2.8	10.9	5.7	*
Pain or discomfort from denture	5.3	12.7	8.0	*
Other oral symptoms				
Dryness of mouth	31.5	44.8	36.3	*
Sore gums	21.3	38.2	27.4	*
Unpleasant taste	24.5	38.8	29.7	*
Bleeding gums	29.8	39.7	33.4	*
Bad breath	29.4	45.1	35.1	*
Difficulty opening mouth wide	11.0	23.6	15.6	*
Clicking/grating noise in jaw joint	16.2	25.7	19.6	*
Changes in ability to taste	7.5	16.3	10.7	*
Mouth ulcers	16.0	18.0	16.7	n.s.
Cold sores	10.0	16.9	12.5	*
Eating impact scale				
Prevented from eating foods you would like to eat	31.1	58.4	41.0	*
Have found enjoyment of food less than it used to be	21.9	46.5	30.9	*
Has taken longer to finish a meal than other people	20.0	50.7	31.2	*
Communication/social relations impact scale				
Avoided eating with other people	5.3	21.2	11.1	*
Embarrassed by appearance/health of teeth or mouth	35.7	56.7	43.4	*
Avoided laughing or smiling	26.1	48.0	34.1	*
Avoided conversations with others	11.9	33.6	19.8	*
Activities of daily living impact scale				
Have difficulty sleeping	21.9	52.4	33.0	*
Stay home more than usual	5.5	28.6	13.9	*
Avoid usual leisure activities	5.7	27.9	13.8	*
Be unable to do household chores	3.4	18.2	8.8	*
Stay in bed more than usual	2.3	17.5	7.8	*
Take time off work	2.1	7.1	3.9	*
Worry/concern impact scale				
Worry about health of teeth or mouth	74.8	63.6	79.0	*
Worry about appearance of teeth or mouth	63.3	75.8	67.8	*

* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

(continued)

Table 31: Frequency of responses (continued)

	SA % within state	NSW % within state	Total % within state	Sig.
Shortened OHIP				
Trouble pronouncing words	8.9	27.1	15.5	*
Sense of taste worsened	11.7	29.4	18.1	*
Painful aching in mouth	40.6	69.0	50.9	*
Uncomfortable to eat any foods	36.9	70.6	49.2	*
Been self-conscious	38.2	61.3	46.6	*
Felt tense	23.4	53.2	34.2	*
Diet been unsatisfactory	11.7	34.9	20.1	*
Had to interrupt meals	13.0	47.2	25.4	*
Found it difficult to relax	20.6	50.7	31.5	*
Been a bit embarrassed	30.4	58.0	40.4	*
Been a bit irritable with other people	16.0	43.5	26.0	*
Had difficulty doing usual jobs	7.4	26.0	14.2	*
Felt that life in general was less satisfying	16.6	45.7	27.2	*
Been totally unable to function	5.9	21.6	11.6	*
Other symptoms				
Pain at night	12.3	30.7	19.0	*
A lost filling	11.7	24.0	16.1	*
A cracked tooth	5.3	17.7	9.8	*
A broken filling	8.3	24.1	14.0	*
A broken tooth from an accident	0.6	4.9	2.2	*
Swelling on gums	12.8	23.2	16.6	*
A loose tooth	5.1	15.0	8.7	*
A chipped tooth	11.9	27.7	17.7	*
Swelling of your face or neck	4.9	12.8	7.8	*
Pain which is worse in the middle of the day	4.5	15.7	8.5	*
High temperature	7.0	9.0	7.7	n.s.
A broken crown	1.7	4.5	2.7	*
A lost crown	0.9	4.9	2.3	*
Taking any regular medication	52.8	51.7	52.4	n.s.
Smokes tobacco	27.6	42.0	32.9	*
Diabetic	5.3	3.7	4.7	n.s.
Dental Anxiety Scale (DAS) score				
DAS score ≥13	10.0	22.3	14.5	*
DAS score <13	90.0	77.7	85.5	

* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

Analyses

Reliability analysis of scales

The internal reliability of each scale, i.e. that the items grouped within the scale measured the same concept, was tested using the Cronbach alpha test of inter-item reliability.

The Cronbach alpha values of the scales are shown in Table 32. For each scale, α is above the level of 0.50 (which is recommended for inter-group comparisons), indicating adequate reliability for each of the scales.

Table 32: Scale reliability analysis

Scale	Cronbach's alpha, α
Ability to chew	0.8730
Ability to speak	0.8615
Oral and facial pain symptoms ^(a)	0.6906
Other oral symptoms	0.6814
Eating impact scale	0.8169
Communication/social relations impact scale	0.8436
Activities of daily living impact scale	0.8401
Worry/concern impact scale	0.8731
Shortened OHIP (total)	0.9252

(a) If remove 'Pain or discomfort from a denture', $\alpha = 0.7702$

Bivariate analyses

An initial analysis of the data was carried out to determine if any of the potential predictor variables (see section 3.3) should be considered for use in a multivariate model. Bivariate associations between the potential predictor variables and urgency of care were therefore examined. The results are displayed in Table 33.

Table 33: Bivariate associations between independent variables and urgency of care

Symptom	Response	Urgency of care (Per cent within urgency of care)				Total	Sig.	
		<1 month	1-3 months	4-6 months	7+ months			
Ability to chew								
Chew fresh carrot	No	33.7	23.0	17.3	11.5	18.7	0.000	*
Chew boiled vegetables	No	6.1	6.3	1.6	4.5	4.7	0.229	n.s.
Chew fresh lettuce salad	No	7.1	4.6	3.1	4.6	4.7	0.563	n.s.
Chew firm foods	No	30.6	17.8	15.6	9.8	15.9	0.000	*
Bite off and chew a piece of apple	No	31.6	18.9	17.3	11.5	17.3	0.000	*
Chew hamburger	No	14.4	10.4	7.9	6.6	8.9	0.107	n.s.
Ability to speak								
Difficulty pronouncing words	Yes	23.5	20.1	10.2	11.5	15.2	0.003	*
Difficulty speaking clearly	Yes	17.3	16.2	10.9	9.5	12.6	0.076	n.s.
Difficulty being understood	Yes	13.3	15.0	7.8	7.4	10.2	0.034	*
Oral and facial pain symptoms								
Toothache	Yes	72.4	54.0	44.5	29.4	44.6	0.000	*
Pain in teeth with hot food or fluids	Yes	50.0	45.4	32.0	21.8	33.7	0.000	*
Pain in teeth with cold food or fluids	Yes	75.5	57.7	43.0	38.1	49.3	0.000	*
Pain in teeth with sweet food	Yes	49.0	32.8	22.2	15.4	25.9	0.000	*
Pain in jaw while chewing	Yes	38.8	30.5	17.2	11.5	21.3	0.000	*
Pain in jaw when open mouth wide	Yes	22.4	19.7	14.8	11.2	15.6	0.019	*
Pain in front of ear	Yes	29.6	27.0	19.5	12.9	20.1	0.000	*
Burning sensation in tongue/mouth	Yes	8.2	8.7	5.5	3.1	5.7	0.060	*
Shooting pain in face or cheeks	Yes	21.4	17.2	10.9	5.9	12.0	0.000	*
Pain or discomfort from denture	Yes	47.6	39.6	29.5	18.9	29.9	0.023	*
Other oral symptoms								
Mouth ulcers	Yes	17.3	17.0	18.8	15.0	16.5	0.804	n.s.
Cold sores	Yes	13.3	17.1	14.1	10.5	13.2	0.248	n.s.
Sore gums	Yes	37.8	36.0	21.1	21.0	27.2	0.000	*
Bleeding gums	Yes	50.0	36.0	37.5	26.6	34.4	0.000	*
Bad breath	Yes	48.0	45.1	35.9	24.8	35.3	0.000	*
Dryness of mouth	Yes	40.8	42.8	36.7	30.1	36.1	0.032	*
Unpleasant taste	Yes	41.8	36.0	29.7	20.3	29.1	0.000	*
Changes in ability to taste	Yes	16.3	18.2	5.6	6.7	10.8	0.000	*
Difficulty opening mouth wide	Yes	22.4	19.7	14.8	11.2	15.6	0.019	*
Clicking/grating noise in jaw joint	Yes	21.4	25.1	15.7	17.8	19.8	0.154	n.s.

* Statistically significant chi-square
n.s. Not statistically significant

(continued)

Table 33: Bivariate associations between independent variables and urgency of care (continued)

Eating impact scale								
Have been prevented from eating certain foods	All the time	9.2	3.4	4.7	0.7	3.4	0.000	*
	Very often	12.2	8.0	3.1	1.4	5.0		
	Often	9.2	8.0	6.3	4.6	6.4		
	Sometimes	31.6	29.7	31.3	20.0	26.2		
	Never	37.8	50.9	54.7	73.3	59.0		
Have found enjoyment of food less than it used to be	All the time	8.2	5.7	4.7	1.4	4.1	0.000	*
	Very often	12.2	7.4	3.9	2.5	5.4		
	Often	9.2	5.7	5.5	2.8	5.0		
	Sometimes	19.4	22.3	20.3	12.3	17.3		
	Never	51.0	58.9	65.6	81.1	68.2		
Has taken longer to finish a meal than other people	All the time	24.5	14.4	13.3	3.2	10.9	0.000	*
	Very often	6.1	6.3	2.3	3.2	4.2		
	Often	8.2	9.2	8.6	2.5	6.1		
	Sometimes	14.3	12.6	11.7	8.4	10.9		
	Never	46.9	57.5	64.1	82.8	67.7		
Communication/social relations impact								
Avoided eating with others	All the time/very often/often	16.3	9.1	4.7	1.8	6.3	0.000	
	Sometimes	6.1	9.1	7.8	0.7	5.0		
	Never	77.6	81.7	87.5	97.5	88.8		
Were embarrassed by appearance or health of teeth or mouth	All the time/very often/ often	45.9	33.9	28.1	12.6	25.7	0.000	
	Sometimes	13.3	19.0	22.7	16.8	18.0		
	Never	40.8	47.1	49.2	70.5	56.4		
Avoided laughing or smiling	All the time/very often/often	41.8	31.4	22.7	9.4	22.1	0.000	
	Sometimes	9.2	12.0	14.1	11.9	11.9		
	Never	49.0	56.6	63.3	78.7	65.9		
Avoided conversations with others	All the time/very often/often	22.4	19.5	8.6	3.1	11.1	0.000	
	Sometimes	11.2	9.8	10.9	6.6	8.9		
	Never	66.3	70.7	80.5	90.2	80.0		
Activities of daily living impact scale								
Have difficulty sleeping	Yes	68.4	39.4	36.7	16.8	33.6	0.000	
	Never	31.6	60.6	63.3	83.2	66.4		
Stay home more than usual	Yes	32.7	22.3	12.5	3.1	14.0	0.000	
	Never	67.3	77.7	87.5	96.9	86.0		
Stay in bed more than usual	Yes	15.3	13.1	7.0	1.7	7.6	0.000	
	Never	84.7	86.9	93.0	98.3	92.4		
Take time off work	Yes	28.6	8.5	7.1	2.8	7.8	0.000	
	Never	71.4	91.5	92.9	97.2	92.2		
Be unable to do household chores	Yes	20.4	12.6	8.6	2.5	8.7	0.000	
	Never	79.6	87.4	91.4	97.5	91.3		
Avoid usual leisure activities	Yes	36.7	18.9	10.2	4.9	14.0	0.000	
	Never	63.3	81.1	89.8	95.1	86.0		

* Statistically significant chi-square
n.s. Not statistically significant

(continued)

Table 33: Bivariate associations between independent variables and urgency of care (continued)

Worry/concern impact scale									
Worry about appearance of teeth or mouth	All the time	34.7	18.3	16.4	7.7	15.9	0.000	*	
	Very often	14.3	11.4	7.8	4.2	8.2			
	Often	10.2	16.6	14.1	15.4	14.7			
	Sometimes	23.5	27.4	29.7	30.8	28.7			
	Never	17.3	26.3	32.0	42.0	32.6			
Worry about health of teeth or mouth	All the time	36.7	20.0	16.4	6.7	16.2	0.000	*	
	Very often	14.3	14.9	10.2	6.3	10.4			
	Often	12.2	24.0	19.5	20.8	20.1			
	Sometimes	25.5	26.9	34.4	37.3	32.4			
	Never	11.2	14.3	19.5	28.9	20.9			
Other symptoms									
Pain worse in the middle of the day	Yes	21.6	10.9	7.0	3.5	8.6	0.000	*	
	No								
Pain at night	Yes	38.8	27.6	12.5	9.8	19.0	0.000	*	
Swelling on gums	Yes	31.6	22.7	16.4	8.0	16.7	0.000	*	
Swelling of face or neck	Yes	14.3	10.0	5.5	4.9	7.6	0.010	*	
A lost filling	Yes	27.6	25.6	13.3	7.0	15.8	0.000	*	
A lost crown	Yes	11.2	0.6	2.3	0.7	2.5	0.000	*	
A broken filling	Yes	30.6	17.0	13.3	6.3	13.8	0.000	*	
A broken crown	Yes	9.2	0.6	2.3	2.4	2.9	0.001	*	
A loose tooth	Yes	17.5	14.0	10.9	1.7	8.8	0.000	*	
A chipped tooth	Yes	35.1	16.9	19.5	11.5	17.7	0.000	*	
A cracked tooth	Yes	25.5	12.3	5.5	5.2	10.0	0.000	*	
A broken tooth from an accident	Yes	4.1	3.5	0.8	1.0	2.0	0.099	n.s.	
High temperature	Yes	8.2	11.0	6.3	5.6	7.5	0.172	n.s.	
Shortened OHIP									
Trouble pronouncing words	Yes	26.5	21.7	14.8	8.4	15.6	0.000	*	
Sense of taste worsened	Yes	35.7	26.9	15.6	8.4	18.4	0.000	*	
Painful aching in mouth	Yes	75.5	66.9	51.2	34.6	51.7	0.000	*	
Uncomfortable to eat any foods	Yes	69.4	63.4	53.1	33.2	49.8	0.000	*	
Have been self-conscious	Yes	72.4	56.0	52.3	30.5	47.1	0.000	*	
Felt tense	Yes	54.1	44.0	40.6	18.9	34.4	0.000	*	
Diet has been unsatisfactory	Yes	37.8	29.7	21.1	8.0	20.2	0.000	*	
Have had to interrupt meals	Yes	48.0	35.4	28.1	11.2	25.8	0.000	*	
Difficult to relax	Yes	63.3	39.4	33.9	16.4	32.2	0.000	*	
Been a bit embarrassed	Yes	62.2	49.1	46.9	25.5	40.8	0.000	*	
Been a bit irritable with others	Yes	45.4	33.1	34.4	12.6	26.5	0.000	*	
Difficulty doing usual jobs	Yes	27.6	21.7	14.1	5.2	14.3	0.000	*	
Life in general has been less satisfying	Yes	49.0	37.1	29.7	12.9	27.4	0.000	*	
Totally unable to function	Yes	22.4	17.7	10.9	4.9	11.8	0.000	*	
Other questions									
Smoker	Yes	45.9	41.1	28.9	24.1	32.5	0.000	*	
Taking any regular medication	Yes	51.0	48.0	62.5	51.9	52.8	0.084	n.s.	
Diabetic	Yes	2.0	4.0	4.7	5.6	4.5	0.518	n.s.	

* Statistically significant chi-square
n.s. Not statistically significant

(continued)

Table 33: Bivariate associations between independent variables and urgency of care (continued)

Sociodemographic variables								
Age group	18–24 years	10.3	3.4	7.0	12.3	8.8	0.001	*
	25–44 years	51.5	47.1	34.4	37.5	41.4		
	45–64 years	26.8	31.0	29.7	26.0	28.1		
	65+ years	11.3	18.4	28.9	24.2	21.8		
Maximum education	Primary	6.2	6.3	7.8	6.3	6.6	0.390	n.s.
	Some secondary	39.2	32.0	27.3	32.2	32.2		
	Completed secondary	28.9	26.9	30.5	24.1	26.7		
	Some university	5.2	5.1	6.3	9.8	7.3		
	Completed university	10.3	9.1	6.3	6.3	7.6		
	Some TAFE	5.2	6.3	6.3	8.4	7.0		
	Completed TAFE	5.2	12.0	12.5	12.2	11.2		
	Other	–	2.3	3.1	0.7	1.5		
	Usual/previous occupation	Manager/professional	10.5	11.8	11.3	11.7		
Para-professional/trade		11.6	15.9	27.4	24.9	21.1		
Clerk/sales/driver/labourer		57.9	51.2	40.3	43.6	47.0		
Self-employed		–	2.4	2.4	1.1	1.5		
Home duties		11.6	13.5	9.7	7.7	10.1		
Other		8.4	5.3	8.9	11.0	8.8		
Sex of patient	Female	65.3	48.0	54.7	59.8	57.6	0.131	n.s.
	Male	34.7	52.0	45.3	40.2	42.4		
Language mainly spoken at home	English	82.7	81.1	82.8	87.1	84.1	0.342	n.s.
	Other	17.3	18.9	17.2	12.9	15.9		
Country of birth	Australia	61.2	55.7	54.7	57.3	57.0	0.773	n.s.
	Other	38.8	44.3	45.3	42.7	43.0		
Dental Anxiety Scale (DAS) score	DAS score <13	73.5	87.4	82.8	89.9	85.6	0.001	*
	DAS score ≥13	26.5	12.6	17.2	10.1	14.4		
Dental visiting factors								
Usual reason for dental visit	Check-up	8.2	28.2	28.9	54.4	36.5	0.000	*
	Problem	87.6	69.4	67.2	40.0	59.3		
Time since last dental visit	Check-up/problem	4.1	2.4	3.9	5.6	4.3	0.000	*
	<12 months	51.0	40.8	45.7	23.9	36.1		
	1–<2 years	14.3	16.1	16.5	21.4	18.1		
	2–<3 years	8.2	13.8	10.2	16.8	13.6		
	3–<5 years	13.3	11.5	12.6	18.6	14.9		
	5+ years	13.3	17.2	15.0	19.3	17.1		
Place of last dental visit	Never	0.0	0.6	0.00	0.0	0.1	0.046	*
	Private practice	24.5	30.1	25.2	39.9	32.4		
	Public hospital/clinic	73.5	64.7	64.6	50.9	60.2		
	School dental service	2.0	3.5	7.9	7.8	5.9		
Frequency of dental visits	Other	0.0	1.7	2.4	1.4	1.5	0.069	n.s.
	>2 times a year	8.2	5.8	3.1	5.6	5.6		
	2 times a year	6.2	6.9	9.4	7.4	7.5		
	Once a year	15.5	12.7	14.2	17.6	15.4		
	Once every 2 years	19.6	27.2	32.3	32.4	29.2		
	Once every 5 years	26.8	20.2	18.9	23.6	22.3		
< Once every 5 years	23.7	27.2	22.0	13.4	20.0			

* Statistically significant chi-square

n.s. Not statistically significant

Bivariate associations between the subjective oral health status and OHIP scales and the urgency of care were also examined. The results are presented in Table 34.

The 'Oral and facial pain symptoms' and 'Other oral symptoms' scales are a 10-item scale with 'yes' and 'no' response options whereby 'yes' is represented by 1 and 'no' by 0. Adding the responses to each item yields a total score ranging from 0 to 10. Zero represents no oral and facial pain symptoms or any other oral symptoms, while 10 represents high experience of oral and facial pain symptoms and other oral symptoms. The 'Ability to chew' and 'Ability to speak' scales are 6-item and 3-item scales respectively. The mean number of oral symptoms for each urgency of care category is presented in Table 34.

The 'Activities of daily living scale' and 'Worry/concern impact scale' consisted of five and two items respectively. Responses to each item were made on a Likert-type scale whereby respondents were asked to indicate their level of experience with each of the items in question. The response format was a 5-point scale (scored from 1 to 5) ranging from 'all the time' to 'never'. The mean score for each item by category of urgency of care is presented in Table 34.

Table 34: Bivariate associations between subjective oral health scales and urgency of care

Scale		Urgency of care					Sig.
		<1 month	1-3 months	4-6 months	7+ months	Total	
Ability to chew (‘yes’ responses)	Valid n	98	175	128	286	687	0.000 ***
	Mean	4.76	5.17	5.35	5.51	5.28	
	Std Dev.	1.79	1.55	1.31	1.33	1.48	
Ability to chew (‘no’ responses)	Valid n	98	175	128	286	687	0.000 ***
	Mean	1.24	0.83	0.65	0.49	0.72	
	Std Dev.	1.79	1.55	1.31	1.33	1.48	
Ability to speak	Valid n	98	175	128	286	687	0.008 ***
	Mean	0.54	0.51	0.29	0.28	0.38	
	Std Dev.	0.99	1.04	0.73	0.78	0.88	
Eating impact scale	Valid n	98	175	128	285	686	0.000 ***
	Mean	3.74	4.10	4.26	4.66	4.31	
	Std Dev.	1.26	1.07	1.02	0.65	1.00	
Communication/social relations impact scale	Valid n	98	175	128	286	687	0.000 ***
	Mean	3.82	4.16	4.36	4.69	4.37	
	Std Dev.	1.27	1.07	0.89	0.69	0.98	
Oral and facial pain symptoms	Valid n	98	175	128	286	687	0.000 ***
	Mean	3.78	3.02	2.20	1.54	2.36	
	Std Dev.	2.20	2.44	2.03	1.78	2.23	
Other oral symptoms	Valid n	98	175	128	286	687	0.000 ***
	Mean	3.09	2.88	2.30	1.84	2.37	
	Std Dev.	2.13	2.54	1.93	1.78	2.13	
Activities of daily living impact scale	Valid n	98	175	128	284	685	0.000 ***
	Mean	4.51	4.67	4.82	4.91	4.77	
	Std Dev.	0.57	0.63	0.32	0.29	0.47	
Worry/concern impact scale	Valid n	98	175	128	284	685	0.000 ***
	Mean	2.67	3.16	3.42	3.86	3.43	
	Std Dev.	1.45	1.30	1.32	1.07	1.30	
OHIP (total)	Valid n	98	175	128	286	687	0.000 ***
	Mean	3.76	4.06	4.29	4.65	4.31	
	Std Dev.	0.95	0.89	0.77	0.54	0.82	
Functional limitation scale	Valid n	98	175	128	285	686	0.000 ***
	Mean	4.32	4.43	4.71	4.82	4.63	
	Std Dev.	0.93	0.96	0.61	0.55	0.77	
Physical pain scale	Valid n	98	175	127	286	686	0.000 ***
	Mean	3.13	3.41	3.86	4.30	3.82	
	Std Dev.	1.26	1.20	1.08	0.95	1.18	
Psychological discomfort scale	Valid n	98	175	128	285	686	0.000 ***
	Mean	3.22	3.67	3.85	4.44	3.96	
	Std Dev.	1.40	1.37	1.28	0.90	1.26	
Physical disability scale	Valid n	98	175	128	286	687	0.000 ***
	Mean	3.92	4.23	4.48	4.80	4.47	
	Std Dev.	1.28	1.10	0.91	0.60	0.97	
Psychological disability scale	Valid n	98	175	127	286	686	0.000 ***
	Mean	3.43	3.94	4.09	4.56	4.15	
	Std Dev.	1.26	1.16	1.07	0.78	1.09	
Social disability scale	Valid n	97	175	128	286	686	0.000 ***
	Mean	4.20	4.37	4.51	4.83	4.56	
	Std Dev.	1.04	1.03	0.83	0.54	0.86	
Handicap scale	Valid n	98	175	128	286	687	0.000 ***
	Mean	4.13	4.37	4.58	4.81	4.56	
	Std Dev.	1.10	1.01	0.77	0.56	0.86	

*** Statistically significant ANOVA

A number of variables had a significant association with urgency of care and are marked by asterisks. Significant variables from the bivariate analyses will be further examined by means of logistic regression so as to develop a prediction model for urgency of care.

Logistic regression

To further examine factors associated with the urgency of care, logistic regression analysis was performed using a range of predictor variables. Predictor variables with a significant bivariate association with urgency of care (see section 3.4) were entered in a binary logistic regression in order to determine the strengths of the independent association of these variables. These predictor variables included patient characteristics (e.g. age, sex), subjective oral health status indicators (e.g. experience of pain or other oral symptoms) and oral health impact profile (OHIP) scale.

Note: Although occupation has a significant association with urgency of care, it will not be included in the models since relative need should really be determined by reported symptoms and should not be influenced by the socioeconomic characteristics of the patient.

For the purpose of this analysis, urgency of care has been dichotomised (since the outcome variable in a logistic regression is binary or dichotomous) and two logistic regression models will be fitted, one for each of the new urgency of care variables:

Urgency of care	New urgency of care		
1 = <1 month	}	Model 1	Model 2
2 = 1–3 months		1 = <6 months	1 = ≤3 months
3 = 4–6 months		0 = 7+ months	0 = 7+ months
4 = 7+ months			

Model 1: New urgency of care = ≤6 months or 7+ months

Of the variables and scales with a statistically significant bivariate association with urgency of care, four were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 35.

The odds ratio indicated that persons who experienced oral and facial pain symptoms were 1.2 times more likely to require treatment within 6 months compared to those who did not have these symptoms.

Persons who reported higher OHIP scores were less likely to require general care within 6 months than those who reported lower scores (N.B. responses to each item in the OHIP scale were made on a 5-point Likert scale, scored from 1 to 5, whereby a score of 1 represents high experience of symptoms while 5 represents no experience of symptoms).

Those who reported a problem as their usual reason for visiting the dentist had 2.3 times the odds of requiring general dental treatment within 6 months compared to those who reported a check-up as their usual reason for visiting the dentist.

Time since last visit was also a significant predictor of urgency of care in the logistic model. It was found that persons who last visited a dentist 12 months ago were 2.0 times the odds of requiring general dental care within 6 months compared to those who last visited 3 or more years ago. (Note that those who last visited a dentist 12 months ago would have visited for emergency care since the inclusion criteria for the general RNI sample states that patients should not have visited the dentist for routine dental care in the last year).

Table 35: Logistic regression coefficients for model 1

Variable	B	S.E.	P-value	OR	Lower	Upper	Sig.
Oral and facial pain symptoms	0.147	0.052	0.004	1.158	1.047	1.282	*
Shortened OHIP	-0.727	0.163	0.000	0.483	0.351	0.666	*
Usual reason for dental visit			0.000				*
Check-up	REF.						
Problem	0.837	0.193	0.000	2.309	1.581	3.373	*
Check-up/problem	-0.158	0.444	0.722	0.854	0.357	2.040	
Time since last dental visit			0.005				*
<12 months	0.688	0.217	0.001	1.990	1.302	3.042	*
1-<3 years	0.193	0.215	0.370	1.213	0.796	1.848	
3+ years	REF.						
Smoker							
Yes/occasionally	-0.329	0.196	0.094	0.720	0.490	1.058	n.s.
No	REF.						
Model constant	3.006	0.872	0.001	20.202			

Analysis used n = 678 cases with complete data on all variables

REF. Reference category for odds ratio

* Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 35 can be represented as followed:

$$P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5)}}$$

(see Table 36 for interpretation of values in this equation).

Table 36: Independent predictor variables for Model 1: response values, logistic regression beta coefficients and standard errors

i	Independent variable	Response value (x _i)	Beta coefficient (b _i)	SE
0	Model constant	..	3.006	0.872
1	Oral and facial pain symptoms	Continuous variable, values range (calculate a score)	0.147	0.052
2	Shortened OHIP	Continuous variable, values range (calculate a score)	-0.727	0.163
3	Usual reason for dental visit	1 = Check-up [†] 2 = Problem 3 = Check-up/ problem	0.837 -0.158	0.193 0.444
4	Time since last dental visit	1 = <12 months 2 = 1–<3 years 3 = 3+ years [†]	0.688 0.193	0.217 0.215
5	Smoker	1 = Yes 0 = No [†]	-0.329	0.196

† Reference category

Since the results of logistic regression analysis are in terms of probability of a particular outcome (e.g. needing to be seen within 6 months), the cut-off value chosen for assignment to a category is critical in evaluating the success of the model.

Model 2: New urgency of care = ≤3 months or 4+ months

Of the variables and scales with a statistically significant bivariate association with urgency of care, seven were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 36.

The odds ratio indicated that persons who experienced oral and facial pain symptoms were 1.2 times more likely to require treatment within 3 months compared to those who did not have these symptoms.

Persons who reported higher OHIP scores were less likely to require general care within 3 months than those who reported lower scores (N.B. responses to each item in the OHIP scale were made on a 5-point Likert scale, scored from 1 to 5, whereby a score of 1 represents high experience of symptoms while 5 represents no experience of symptoms).

Those who reported a problem as their usual reason for visiting the dentist were 1.7 times more likely to require general dental treatment within 3 months compared to those who reported a check-up as their usual reason for visiting the dentist.

People who last visited a SDS clinic or other clinic (not private) were less likely to require care within 3 months compared to people who last visited a public dental clinic.

Experience of a lost filling and loose tooth were also significant predictors of urgency of care in the logistic model. In fact, those who reported having a lost filling or loose

tooth in the last four weeks had just over 2.0 times the odds of requiring care within 3 months compared to those who did not report these symptoms.

Lastly, smokers had 1.8 times the odds of requiring general dental care within 3 months compared to non-smokers.

Table 37: Logistic regression coefficients for model 2

Variable	B	S.E.	P-value	OR	Lower	Upper	Sig.
Oral and facial pain symptoms	0.169	0.049	0.001	1.184	1.074	1.304	*
Shortened OHIP	-0.457	0.138	0.001	0.633	0.483	0.830	*
Usual reason for dental visit			0.020				*
Check-up	REF.						
Problem	0.514	0.207	0.013	1.671	1.114	2.509	*
Check-up/problem	-0.260	0.505	0.606	0.771	0.287	2.073	
Place of last dental visit			0.029				*
Private practice	-0.324	0.195	0.096	0.723	0.493	1.059	
Public hospital/clinic	REF.	0.415	0.020	0.381	0.169	0.860	*
SDS/other	-0.964						
Lost filling							
Yes	0.734	0.251	0.003	2.084	1.274	3.408	*
No	REF.						
Loose tooth							
Yes	0.710	0.328	0.030	2.033	1.069	3.866	*
No	REF.						
Smoker							
Yes	0.592	0.192	0.002	1.808	1.241	2.634	*
No	REF.						
Model constant	0.586	0.700	0.403	1.796			

Analysis used n = 669 cases with complete data on all variables

REF. Reference category for odds ratio

* Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in the Table 37 can be represented as followed:

$$P(\text{'urgent'}) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7)}}$$

(see Table 38 for interpretation of values in this equation).

Table 38: Independent predictor variables for Model 2: response values, logistic regression beta coefficients and standard errors

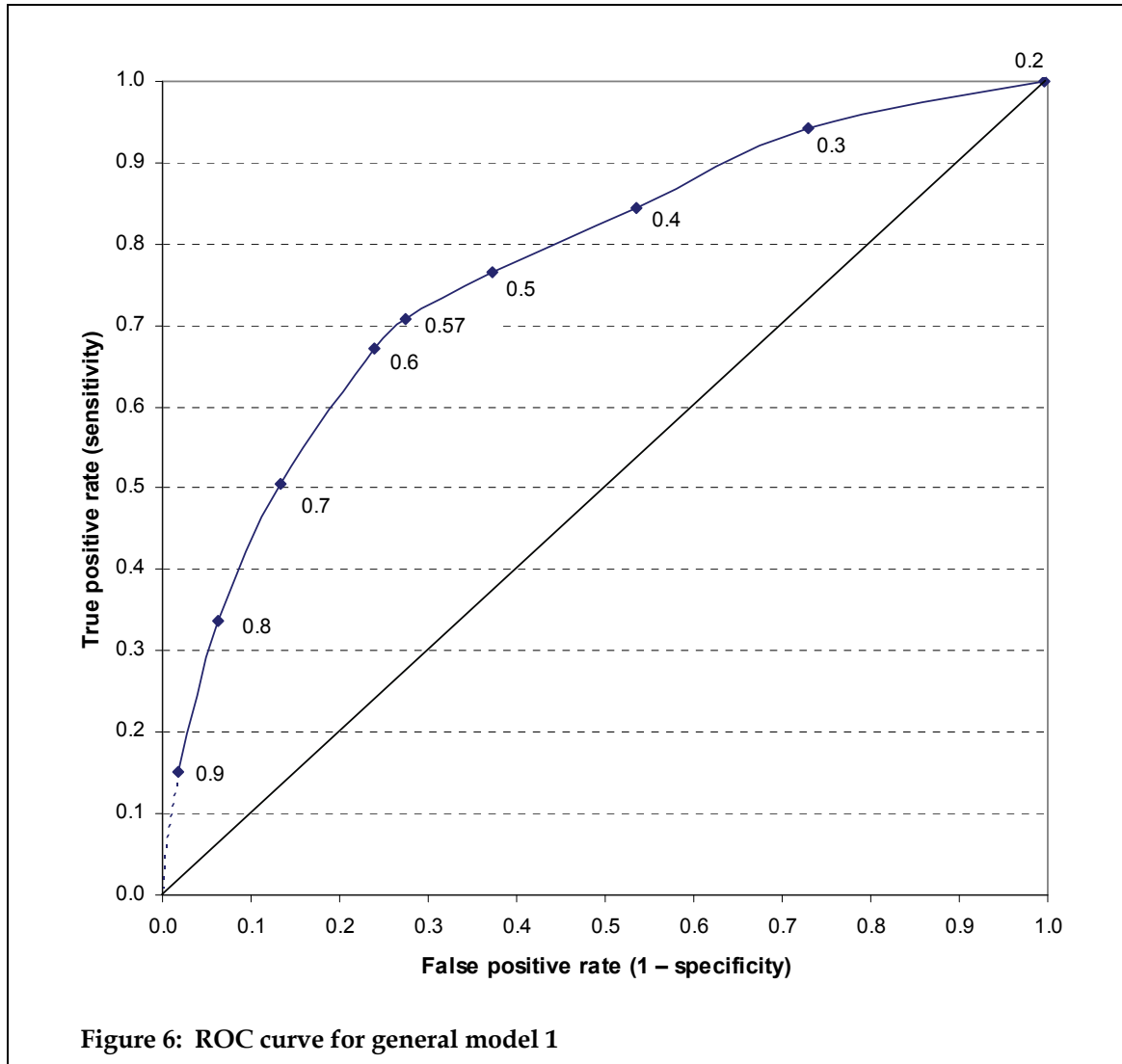
i	Independent variable	Response value (x_i)	Beta coefficient (b_i)	SE
0	Model constant	..	0.586	0.700
1	Oral and facial pain symptoms	Continuous variable, values range (calculate a score)	0.169	0.049
2	Shortened OHIP	Continuous variable, values range (calculate a score)	-0.457	0.138
3	Usual reason for dental visit	1 = Check-up [†]		
		2 = Problem	0.514	0.207
		3 = Check-up/ problem	-0.260	0.505
4	Place of last dental visit	1 = Private practice	-0.324	0.195
		2 = Public hospital/ clinic [†]		
		3 = SDS/other	-0.964	0.415
5	A lost filling	1=Yes 0=No [†]	0.734	0.251
6	A loose tooth	1=Yes 0=No [†]	0.710	0.328
7	Smoker	1=Yes 0=No [†]	0.592	0.192

† Reference category

ROC curves

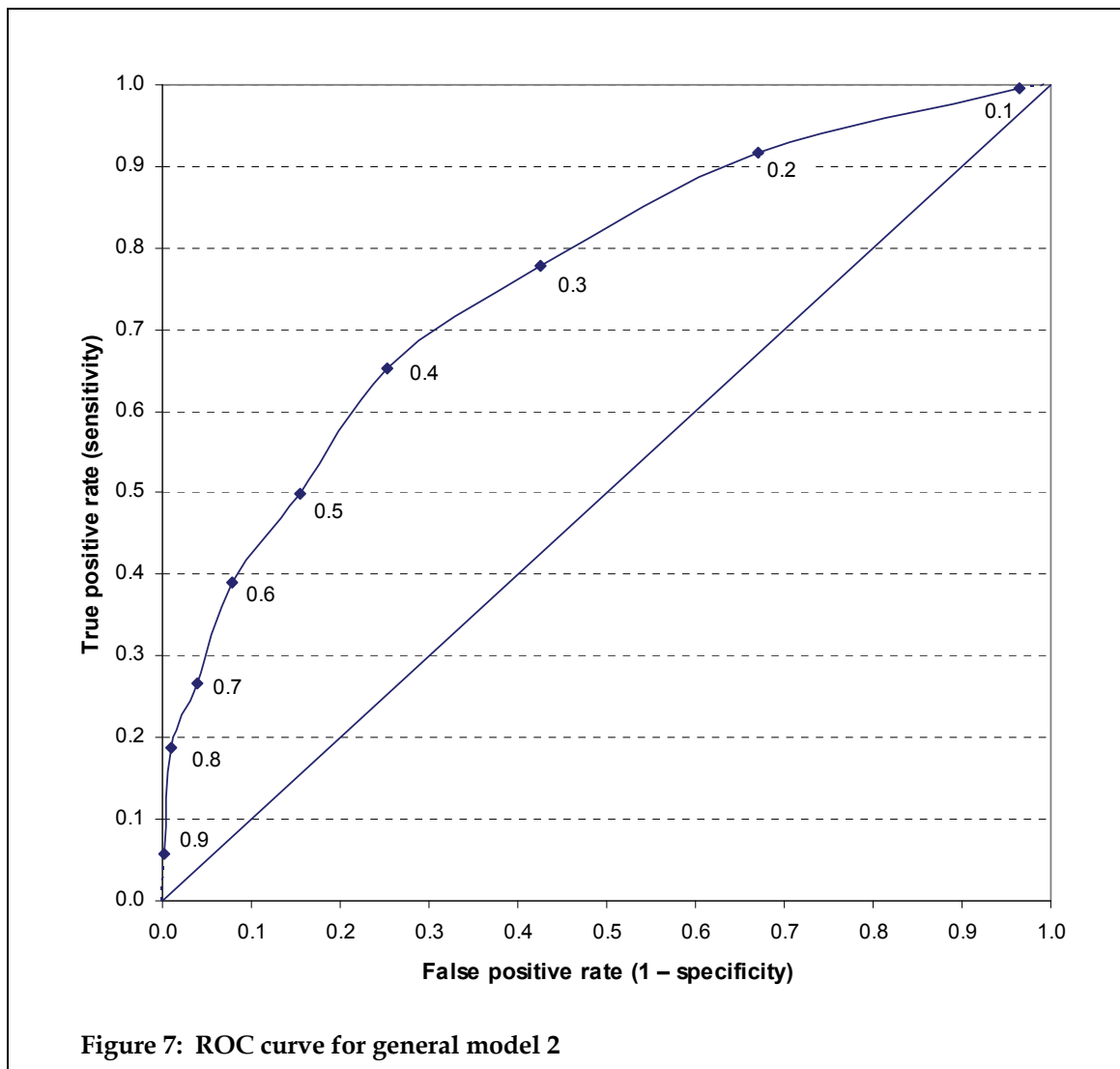
ROC curve for general model 1

The ROC curve for general model 1 examining urgency of ≤ 6 months vs 7+ months is shown in Figure 6. The cut-off values on the curve represent the probability of needing treatment within 6 months.



ROC curve for general model 2

The ROC curve for general model 2 is shown in Figure 7.



Results – diagnostic test indicators

General model 1

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for general model 1 at varying cut-off values are presented in Table 39.

Table 39: Sensitivity, specificity and predictive values for general model 1

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	1.00	0.004	0.58	1.00
0.3	0.94	0.27	0.64	0.77
0.4	0.85	0.46	0.69	0.68
0.5	0.77	0.63	0.74	0.66
0.57	0.71	0.73	0.78	0.64
0.6	0.67	0.76	0.80	0.63
0.7	0.51	0.87	0.84	0.56
0.8	0.34	0.94	0.88	0.50
0.9	0.15	0.98	0.92	0.46

As can be seen from Table 39, as the cut-off value is lowered, the sensitivity increases but the specificity decreases. Hence, fewer false negative results are obtained but the proportion of false positive test results increases. The opposite is true when higher cut-off values are selected.

Suppose a low cut-off value of 0.3 is selected. Of the patients who actually require care within 6 months, 94% will have positive test results. This is the percentage of 'true positive' results. The remaining 6% of patients requiring care within 6 months have negative test results but are nonetheless in need of care within the 6 months timeframe. This is the percentage of patients with 'false negative' test results, i.e. 6% of patients in need of dental care within 6 months will be misclassified as able to wait 7 or more months for treatment.

Of the patients who are not urgent i.e. can wait 7 or more months for treatment, 27% will have negative test results. This is the percentage of 'true negative' results. The remaining 73% of non-urgent patients have positive test results but are not urgent. This is the percentage of patients with 'false positive' test results i.e. 73% of patients who are able to wait 7 or more months for treatment will be misclassified and receive care within 6 months.

If the test is positive, the probability of being urgent is 64% (i.e. a positive predictive value of 64% means that 64 of 100 patients with positive test results will likely require care within 6 months). Hence, there is a 36% chance that the patient is not urgent. If the test is negative, the probability of needing care within 6 months is 23%, which indicates a 77% chance that the patient is not urgent.

Example interpretation of general model 1

Suppose there are 100 patients presenting for general dental care. According to the assessing dentist, approximately 58% require care within 6 months and a further 42% are able to wait a longer period of 7 or more months for treatment (see Table 29).

Consider what happens to these 100 patients when a cut-off point of 0.3 is selected.

Decision 1: cut-off = 0.3

Cut-off	Sensitivity	Specificity	PV+	PV-
0.3	0.94	0.27	0.64	0.77

Using a cut-off value of 0.3, the model sensitivity is 94%. The specificity is 27%, indicating that of those 58 patients actually requiring care within 6 months, 55 (94%) will be correctly identified as more urgent and will therefore be seen within 6 months, but 3 patients (6%) will be misclassified and receive care in 7 or more months time (i.e. patients end up with false negative results).

Of the 42 patients who are considered able to wait 7 or more months for treatment, 11 (27%) without urgent need will actually test negative but 31 (73%) will be misclassified (i.e. 31 patients end up with false positive results) and receive care within 6 months.

These results are summarised in Table 40.

Table 40: Example using general model 1 with cut-off = 0.3 to assign priority to 100 patients presenting for general dental care

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	55	31 (FP)	86
	7+ months -ve	3 (FN)	11	14
	Total	58	42	100

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix B1).

General model 2

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for general model 2 at varying cut-off values are presented in Table 41.

Table 41: Sensitivity, specificity and predictive values for general model 2

Cut-off	Sensitivity	Specificity	PV+	PV-
0.1	1.00	0.03	0.40	0.93
0.2	0.92	0.32	0.47	0.86
0.3	0.78	0.58	0.55	0.80
0.4	0.63	0.74	0.61	0.76
0.5	0.50	0.85	0.68	0.73
0.6	0.40	0.92	0.76	0.70
0.7	0.27	0.96	0.82	0.67
0.8	0.16	0.99	0.88	0.65
0.9	0.05	1.00	0.92	0.62

Suppose, for example, a cut-off value of 0.5 is chosen. The test is 50% sensitive, meaning that 50% of urgent patients test positive and 50% are potentially misclassified (i.e. 50% of urgent people will be missed). Specificity for the test is 85%, meaning that 85% of non-urgent patients test negative (i.e. 15% of non-urgent patients will be

misclassified as urgent). If the test is positive, the probability of being urgent is 68%, but there is a 32% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 27%, which indicates a 73% chance that the patient is not urgent.

Example interpretation of general model 2

Suppose there are 100 patients presenting for general dental care. According to the assessing dentist, approximately 40% require care within 3 months (i.e. 14.3% require care within 1 month and 25.5% require care in 1–3 months) and the remaining 60% are considered able to wait 4 or more months for dental care (i.e. 18.6% are classified as requiring care in 4–6 months and 60.2% are considered able to wait 7+ months for treatment) (see Table 29).

The way in which general model 2 classifies these 100 patients into the two treatment urgency categories, namely ≤ 3 months or 4+ months, depends upon the cut-off value selected. To illustrate how the model classifies these patients, suppose a cut-off value of 0.5 is used.

Decision 1: cut-off = 0.5

Cut-off	Sensitivity	Specificity	PV+	PV-
0.5	0.50	0.85	0.68	0.73

Of those 40 patients actually requiring care within 3 months, 20 (50%) will be correctly identified as more urgent and will therefore be seen within 3 months, but 20 patients will be misclassified and receive care in 4 or more months time (i.e. 20 patients end up with false negative results).

Of the 60 patients who are considered able to wait 4 or more months for treatment, 51 (85%) without urgent need will actually test negative but 9 (15%) will be misclassified (i.e. 9 patients end up with false positive results) and receive care within 3 months.

These results are summarised in Table 42.

Table 42: Example using general model 2 with cut-off = 0.5 to assign priority to 100 patients presenting for general dental care

		Clinician urgency (clinical assessment of urgency)		Total
		≤ 3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤ 3 months +ve	20	9 (FP)	29
	4+ months -ve	20 (FN)	51	71
	Total	40	60	100

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix B1).

References

Corah NL (1969) Development of a dental anxiety scale. *Journal of Dental Research* 48, 596.

Fletcher RH, Fletcher SW and Wagner EH (1996) *Clinical Epidemiology: The Essentials*, 3rd edn. Baltimore: Williams and Wilkins.

Locker D (1997) Subjective oral health status indicators. In: *Measuring oral health and quality of life*; Ed. Slade GD pp105-112. Chapel Hill: University of North Carolina, Dental Ecology.

Appendix A1: Emergency model results using various cut-off values

Additional 2x2 tables for various cut-off values for each emergency model are included in this section.

Emergency model 1

1. cut-off = 0.3, sensitivity = 0.73, specificity = 0.61

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	26	25 (FP)	51
	2+ days -ve	10 (FN)	39	49
	Total	36	64	100

2. cut-off = 0.4^(a), sensitivity = 0.58, specificity = 0.77

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	21	15 (FP)	36
	2+ days -ve	15 (FN)	49	64
	Total	36	64	100

(a) This particular cut-off point produces test results which are consistent with the clinician's assessment of urgency.

3. cut-off = 0.5, sensitivity = 0.45, specificity = 0.88

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	16	8 (FP)	24
	2+ days -ve	20 (FN)	56	76
	Total	36	64	100

4. cut-off = 0.6, sensitivity = 0.30, specificity = 0.94

		Clinician urgency (clinical assessment of urgency)		Total
		<48 hours (+ve)	2+days (-ve)	
Test result (based on predictor variables)	<48 hours +ve	11	4 (FP)	15
	2+ days -ve	25 (FN)	60	85
	Total	36	64	100

Note: FP = false positive, FN = false negative

Emergency model 2

Assuming cut-off = 0.2 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	13	12 (FP)	25
	8+ days -ve	0 (FN)	2	2
	Total	13	14	27

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	14	8 (FP)	22
	8+ days -ve	1 (FN)	4	5
	Total	15	12	27

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	12	7 (FP)	19
	8+ days -ve	2 (FN)	6	18
	Total	14	13	27

4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	11	4 (FP)	15
	8+ days -ve	4 (FN)	8	12
	Total	15	12	27

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	10	3 (FP)	13
	8+ days -ve	5 (FN)	9	14
	Total	14	13	27

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	9	3 (FP)	12
	8+ days -ve	5 (FN)	10	15
	Total	14	13	27

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	7	1 (FP)	8
	8+ days -ve	8 (FN)	11	19
	Total	15	12	27

Note: FP = false positive, FN = false negative

Assuming cut-off = 0.3 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	24	21 (FP)	45
	8+ days -ve	1 (FN)	3	4
	Total	25	24	49

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	25	14 (FP)	39
	8+ days -ve	2 (FN)	8	10
	Total	27	22	49

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	22	12 (FP)	34
	8+ days -ve	4 (FN)	11	15
	Total	26	23	49

4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	20	8 (FP)	28
	8+ days -ve	6 (FN)	15	21
	Total	26	23	49

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	17	7 (FP)	24
	8+ days -ve	9 (FN)	16	25
	Total	26	23	49

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	17	5 (FP)	22
	8+ days -ve	10 (FN)	17	27
	Total	27	22	49

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	12	2 (FP)	14
	8+ days -ve	15 (FN)	20	35
	Total	27	22	49

Note: FP = false positive, FN = false negative

Assuming cut-off = 0.4 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	32	27 (FP)	59
	8+ days -ve	1 (FN)	4	5
	Total	33	31	64

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	32	19 (FP)	51
	8+ days -ve	3 (FN)	10	13
	Total	35	29	64

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	29	15 (FP)	44
	8+ days -ve	5 (FN)	15	20
	Total	34	30	64

4. cut-off = 0.5^(b), sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	26	10 (FP)	36
	8+ days -ve	9 (FN)	19	28
	Total	35	29	64

(b) This particular cut-off point produces test results which are reasonably consistent with the clinician's assessment of urgency.

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	23	9 (FP)	32
	8+ days -ve	11 (FN)	21	32
	Total	34	30	64

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	22	7 (FP)	29
	8+ days -ve	13 (FN)	22	35
	Total	35	29	64

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	15	3 (FP)	18
	8+ days -ve	19 (FN)	27	46
	Total	34	30	64

Note: FP = false positive, FN = false negative

Assuming cut-off = 0.5 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	38	32 (FP)	70
	8+ days -ve	1 (FN)	5	6
	Total	39	37	76

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	38	22 (FP)	60
	8+ days -ve	4 (FN)	12	16
	Total	42	34	76

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	34	18 (FP)	52
	8+ days -ve	6 (FN)	18	24
	Total	40	36	76

4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	31	12 (FP)	43
	8+ days -ve	10 (FN)	23	33
	Total	41	35	76

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	28	10 (FP)	38
	8+ days -ve	13 (FN)	25	38
	Total	41	35	76

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	26	8 (FP)	34
	8+ days -ve	15 (FN)	27	42
	Total	41	35	76

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	18	4 (FP)	21
	8+ days -ve	23 (FN)	32	55
	Total	41	35	76

Note: FP = false positive, FN = false negative

Assuming cut-off = 0.6 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	43	36 (FP)	79
	8+ days -ve	1 (FN)	5	6
	Total	44	41	85

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	43	25 (FP)	67
	8+ days -ve	4 (FN)	13	18
	Total	47	38	85

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	38	20 (FP)	58
	8+ days -ve	7 (FN)	20	27
	Total	45	40	85

4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	34	14 (FP)	48
	8+ days -ve	12 (FN)	25	37
	Total	46	39	85

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	31	11 (FP)	42
	8+ days -ve	15 (FN)	28	43
	Total	46	39	85

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	29	9 (FP)	38
	8+ days -ve	17 (FN)	30	47
	Total	46	39	85

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	20	4 (FP)	24
	8+ days -ve	26 (FN)	35	61
	Total	46	39	85

Note: FP = false positive, FN = false negative

Assuming cut-off = 0.7 for emergency model 1:

1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	46	40 (FP)	86
	8+ days -ve	2 (FN)	5	7
	Total	48	45	93

2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	47	27 (FP)	74
	8+ days -ve	4 (FN)	15	19
	Total	51	42	93

3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	41	23 (FP)	64
	8+ days -ve	8 (FN)	21	29
	Total	49	44	93

4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	38	15 (FP)	53
	8+ days -ve	12 (FN)	28	40
	Total	50	43	93

5. cut-off = 0.55, sensitivity = 0.67, specificity = 0.71, PV+ = 0.73, PV- = 0.65

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	34	12 (FP)	46
	8+ days -ve	16 (FN)	31	47
	Total	50	43	93

6. cut-off = 0.6, sensitivity = 0.63, specificity = 0.77, PV+ = 0.76, PV- = 0.64

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	31	10 (FP)	41
	8+ days -ve	19 (FN)	33	52
	Total	50	43	93

7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		2-7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	2-7 days +ve	22	4 (FP)	26
	8+ days -ve	28 (FN)	39	67
	Total	50	43	93

Note: FP = false positive, FN = false negative

Emergency model 3

1. cut-off = 0.2, sensitivity = 1.00, specificity = 0.00

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	71	29 (FP)	100
	8+ days -ve	0 (FN)	0	0
	Total	71	29	100

2. cut-off = 0.3, sensitivity = 0.99, specificity = 0.04

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	70	28 (FP)	98
	8+ days -ve	1 (FN)	1	2
	Total	71	29	100

3. cut-off = 0.4, sensitivity = 0.93, specificity = 0.24

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	66	22 (FP)	88
	8+ days -ve	5 (FN)	7	12
	Total	71	29	100

4. cut-off = 0.5, sensitivity = 0.89, specificity = 0.40

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	63	17 (FP)	80
	8+ days -ve	8 (FN)	12	20
	Total	71	29	100

5. cut-off = 0.7, sensitivity = 0.66, specificity = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	47	8 (FP)	55
	8+ days -ve	24 (FN)	21	45
	Total	71	29	100

6. cut-off = 0.8, sensitivity = 0.49, specificity = 0.87

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	34	4	39
	8+ days -ve	36 (FN)	25	61
	Total	71	29	100

7. cut-off = 0.9, sensitivity = 0.49, specificity = 0.87

		Clinician urgency (clinical assessment of urgency)		Total
		≤7 days (+ve)	8+ days (-ve)	
Test result (based on predictor variables)	≤7 days +ve	18	1 (FP)	19
	8+ days -ve	53 (FN)	28	81
	Total	71	29	100

Note: FP = false positive, FN = false negative

Appendix A2: Screening questions from emergency models

These are the series of questions identified to assist in discriminating between those able to wait longer than 1 week, those who should be seen within 2–7 days and those who should be seen within 48 hours. Note that the responses given in the ‘Response’ boxes are only an example.

Emergency models 1 and 2

	Response
<p>In the last week, have you had...</p> <ul style="list-style-type: none"> • pain in teeth with cold food or fluids • pain in jaw when opening mouth wide • shooting pain in face or cheeks • bleeding gums • a broken filling • a loose tooth • a toothache • pain in teeth with hot food/fluids • pain which is worse in the middle of the day 	<input type="text" value="Yes"/> <input type="text" value="Yes"/> <input type="text" value="No"/> <input type="text" value="No"/> <input type="text" value="No"/> <input type="text" value="Yes"/> <input type="text" value="No"/> <input type="text" value="No"/>
<p>During the last week, how often has pain, discomfort or other problems with your teeth, mouth or dentures caused you to have...</p> <ul style="list-style-type: none"> • difficulty sleeping 	<input type="text" value="Very often"/>
<p>During the last week, how often have you...</p> <ul style="list-style-type: none"> • worried about the health of your teeth or mouth • worried about the appearance of your teeth or mouth 	<input type="text" value="Very often"/> <input type="text" value="Sometimes"/>
<p>Dental Anxiety Scale (DAS)</p> <ul style="list-style-type: none"> • Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? • Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel? • Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel? • Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel? 	<input type="text" value="I would be a little uneasy about it"/> <input type="text" value="A little uneasy"/> <input type="text" value="Tense"/> <input type="text" value="A little uneasy"/>
<p>URGENCY: <48 hours</p>	

Note: If a patient gave these responses to the questions it is predicted that they would require care within 48 hours (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

It is suggested that the questions identified for emergency models 1 and 2 be combined so that all the questions are asked of patients when they ring up for an emergency appointment. One of the benefits of this approach is that patients will not be able to memorise questions or give what they believe are desirable responses to ensure receiving care sooner, since there are too many response permutations to the 16 questions. Also, care is determined based on the pattern of responses so there would be too many response combinations for the patient to consider.

Emergency model 3

	Response
In the last week, have you had... <ul style="list-style-type: none"> • a toothache • pain which is worse in the middle of the day • shooting pain in face or cheeks • sore gums • bleeding gums • changes in ability to taste • a broken filling • a loose tooth 	No
	No
	No
	No
	No
	No
	No
	No
During the last week, how often has pain, discomfort or other problems with your teeth, mouth or dentures caused you to have... <ul style="list-style-type: none"> • difficulty sleeping 	Never
During the last week, how often have you... <ul style="list-style-type: none"> • worried about the appearance of your teeth or mouth 	Never
URGENCY: 8+ days	

Note: Responding 'No' or 'Never' to all the above questions places the patient in the urgency category of 8+ days (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

Appendix A3: Emergency dental care questionnaire



Patient ID

RELATIVE NEEDS INDEX STUDY

Emergency Dental Care

A study of the need for dental care.

Conducted by:

Social and Preventive Dentistry
The University of Adelaide
AUSTRALIA 5005

Relative Needs Index Study

RESPONSES RECORDED MUST BE THOSE OF THE PATIENT.

1 Please indicate your ■ date of birth:
day month year

■ sex: Male ₁ Female ₂

2 Were you born in Australia? Yes ₁ No ₂

If No, (a) in what country were you born?

country

(b) in which year did you first arrive in Australia to live?

year

3 Are you of Aboriginal and/or Torres Strait Islander origin? No ₁
Yes, Aboriginal ₂
Yes, Torres Strait Islander ₃

4 What is the postcode of the suburb/area you live in?

5 Which language do you **mainly** speak at home? (Please tick one box)

English	<input type="checkbox"/> ₁	Mandarin	<input type="checkbox"/> ₆
Italian	<input type="checkbox"/> ₂	Arabic	<input type="checkbox"/> ₇
Greek	<input type="checkbox"/> ₃	Russian	<input type="checkbox"/> ₈
Cantonese	<input type="checkbox"/> ₄	German	<input type="checkbox"/> ₉
Vietnamese	<input type="checkbox"/> ₅	Other (please specify)	<input type="checkbox"/> ₁₀

6 Australia's population is made up of many ethnic communities or groups.

With which community or group do you **mainly** identify?

(State only one, eg. Italian. If no ethnic identity, write "none").

7 How old were you when you left school? *(Please tick one box)*

- Did not go to school 1
- 14 years or younger 2
- 15 years 3
- 16 years 4
- 17 years 5
- 18 years 6
- 19 years or older 7

8 What is the highest level of education you have attained? *(Please tick one box)*

- Primary School 1
- Some secondary school 2
- Completed secondary school 3
- Some University, higher education 4
- Completed a University, higher education course 5
- Some TAFE, CAE or vocational course 6
- Completed TAFE, CAE or vocational course 7
- Other 8
- Don't know 9

9 (a) Do you have

- Pensioner concession card (full entitlement)? 1
- Pensioner concession card (part entitlement)? 2
- Health care card? 3
- Veterans Affairs Card? 4
- Commonwealth Seniors Health Card? 5

(b) How long have you had your concession card?

- Pensioner concession card (full entitlement)
- Pensioner concession card (part entitlement)
- Health care card
- Veterans Affairs card
- Commonwealth Seniors Health card

-
- 10** (a) Do you have private dental insurance? Yes 1 → **Go to (b)**
No 2 → **Go to Q11**

Q10 continued on next page

(b) How long have you had private dental insurance?

- | | | | |
|---------------------------------|----------------------------|------------------------------|----------------------------|
| Less than 6 months | <input type="checkbox"/> 1 | 2 years to less than 3 years | <input type="checkbox"/> 4 |
| 6 months to less than 12 months | <input type="checkbox"/> 2 | 3 years to less than 5 years | <input type="checkbox"/> 5 |
| 1 year to less than 2 years | <input type="checkbox"/> 3 | 5 years or more | <input type="checkbox"/> 6 |

11 In the last week, what dental problem has caused you to seek dental care?

- | | | | |
|----------------------|----------------------------|---------------------------------|-----------------------------|
| Toothache | <input type="checkbox"/> 1 | Sore gums | <input type="checkbox"/> 9 |
| Broken/lost filling | <input type="checkbox"/> 2 | Ulcer/s | <input type="checkbox"/> 10 |
| Broken tooth | <input type="checkbox"/> 3 | Accident/incident | <input type="checkbox"/> 11 |
| Need a filling | <input type="checkbox"/> 4 | Loose denture/s | <input type="checkbox"/> 12 |
| Bleeding gum/teeth | <input type="checkbox"/> 5 | Broken denture/s | <input type="checkbox"/> 13 |
| Wisdom teeth | <input type="checkbox"/> 6 | Need new denture/s | <input type="checkbox"/> 14 |
| Need tooth extracted | <input type="checkbox"/> 7 | Headache | <input type="checkbox"/> 15 |
| Swelling | <input type="checkbox"/> 8 | Other (<i>please specify</i>) | <input type="checkbox"/> 16 |

12 In the last week, have you had the following problems?

- | | | | | | | |
|---|-----|----------------------------|----|----------------------------|----|----------------------------|
| (a) toothache | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (b) pain in teeth with hot foods or fluids | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (c) pain in teeth with cold foods or fluids | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (d) pain in teeth with sweet foods | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (e) pain in jaw while chewing | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (f) pain in jaw when opening mouth wide | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (g) pain which is worse in the middle of the day | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (h) pain at night | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (i) pain in front of ear | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (j) burning sensation in tongue or other parts of mouth | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (k) shooting pain in face or cheeks | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | | |
| (l) pain or discomfort from denture | Yes | <input type="checkbox"/> 1 | No | <input type="checkbox"/> 2 | NA | <input type="checkbox"/> 3 |

13 In the last week, have you had the following problems?

- | | | | | | | |
|---|-----|--------------------------|---|----|--------------------------|---|
| (a) mouth ulcers | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (b) cold sores | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (c) sore gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (d) bleeding gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (e) swelling on gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (f) bad breath | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (g) dryness of mouth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (h) unpleasant taste | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (i) changes in ability to taste | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (j) clicking/grating noise in jaw joint | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (k) swelling of your face or neck | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (l) a lost filling | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (m) a lost crown | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (n) a broken filling | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (o) a broken crown | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (p) a loose tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (q) a cracked tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (r) high temperature | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |

14 In the last week, have you

- | | | | | | | |
|--|-----|--------------------------|---|----|--------------------------|---|
| (a) chipped a tooth? | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (b) broken a tooth? | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (c) noticed any visible pink areas on the tooth as a result of a broken tooth? | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (d) broken or chipped a tooth as a result of an accident? | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |

15 In the last week, have you experienced pain as a result of problems with your teeth, mouth or dentures?

Yes 1
No 2 → **Go to Q16**

Q15 continued on next page

(a) If Yes, is this pain

an ache? 1

a throbbing pain? 2

a dull pain? 3

a sharp pain? 4

a burning pain? 5

a shooting pain? 6

(b) Is this pain

constant? 1

intermittent? 2

increasing? 3

decreasing? 4

(c) How long have you had this problem?

(d) Have you taken any medication to relieve this pain?

Yes

1

→ Go to (e), (f) & (g)

No

2

→ Go to Q16

(e) If Yes, what medication have you taken?

(f) Please state the dosage used.

(g) How often did you use this medication to relieve pain or discomfort in your teeth or mouth?

Once per day 1

Twice per day 2

Three to four times per day 3

Five to six times per day 4

Six or more times per day 5

16 What category best describes your teeth? (Please tick one box)

Natural teeth only 1

→ Go to Q18

Natural teeth and upper denture only 2

→ Go to Q17

Natural teeth and lower denture only 3

→ Go to Q17

Both upper and lower dentures with some natural teeth 4

→ Go to Q17

17 (a) How long ago did you receive your first denture(s)?

Upper denture

Lower denture

(b) How long have you had the denture(s) you wear now?

Upper denture

Lower denture

18 (a) Have you ever had a tooth extracted?

Yes ₁ → **Go to (b), (c) & (d)**

No ₂ → **Go to Q20**

(b) If Yes, why? (eg. wisdom tooth, decay, orthodontic etc)

(c) If Yes, how long has it been since your last extraction?

(d) How many teeth have you had extracted in the past 2 years?

(Number)

19 Have you had a tooth extracted in the last week?

Yes ₁ → **Go to (a)**

No ₂ → **Go to Q20**

(a) If Yes, have you experienced any bleeding?

Yes ₁ → **Go to (b)**

No ₂ → **Go to Q20**

(b) How often have you had to spit out blood?

Very Often ₁

Fairly Often ₂

Sometimes ₃

Hardly ever ₄

Not at all ₅

20 What is your usual reason for visiting the dentist?

For a regular check-up ₁

For an occasional check-up ₂

When in discomfort/pain ₃

When something needs to be fixed ₄

21 How long has it been since your last dental visit? *(Please tick one box)*

- | | | | | | |
|--------------------------------|--------------------------|---|------------------------------|--------------------------|---|
| Less than 12 months | <input type="checkbox"/> | 1 | 3 years to less than 5 years | <input type="checkbox"/> | 4 |
| 12 months to less than 2 years | <input type="checkbox"/> | 2 | 5 years or more | <input type="checkbox"/> | 5 |
| 2 years to less than 3 years | <input type="checkbox"/> | 3 | Never | <input type="checkbox"/> | 6 |
- **Go to Q26**

22 Where was your last dental visit? *(Please tick one box)*

- | | | |
|--|--------------------------|---|
| Private practice | <input type="checkbox"/> | 1 |
| Public hospital/clinic | <input type="checkbox"/> | 2 |
| School Dental Service | <input type="checkbox"/> | 3 |
| Dental technician | <input type="checkbox"/> | 4 |
| Health Fund | <input type="checkbox"/> | 5 |
| Prison, corrective/detention institution | <input type="checkbox"/> | 6 |
| Other | <input type="checkbox"/> | 7 |
| Don't know | <input type="checkbox"/> | 8 |

23 How often do you usually go to the dentist? *(Please tick one box)*

- | | | | | | |
|--------------------------|--------------------------|---|----------------------|--------------------------|---|
| More than 2 times a year | <input type="checkbox"/> | 1 | Once every 2 years | <input type="checkbox"/> | 4 |
| Two times a year | <input type="checkbox"/> | 2 | Once every 5 years | <input type="checkbox"/> | 5 |
| Once a year | <input type="checkbox"/> | 3 | Less often than that | <input type="checkbox"/> | 6 |

24 In which country was your last dental visit? *(Please tick one box)*

- | | | |
|-------------------------------|--------------------------|---|
| Australia | <input type="checkbox"/> | 1 |
| Other <i>(please specify)</i> | <input type="checkbox"/> | 2 |

25 What dental treatment did you receive at your last dental visit/s? *(Please tick one or more boxes)*

- | | | | | | |
|---------------------|--------------------------|---|---|--------------------------|----|
| None | <input type="checkbox"/> | 1 | Gum Treatment | <input type="checkbox"/> | 8 |
| Check-up | <input type="checkbox"/> | 2 | Teeth straightened/braces | <input type="checkbox"/> | 9 |
| Dental filling | <input type="checkbox"/> | 3 | New or replacement dentures | <input type="checkbox"/> | 10 |
| Amalgam replacement | <input type="checkbox"/> | 4 | Teeth cleaned | <input type="checkbox"/> | 11 |
| Root canal filling | <input type="checkbox"/> | 5 | Whitening/bleaching | <input type="checkbox"/> | 12 |
| Crown | <input type="checkbox"/> | 6 | Denture repair | <input type="checkbox"/> | 13 |
| Tooth extracted | <input type="checkbox"/> | 7 | Other treatment <i>(please specify)</i> | <input type="checkbox"/> | 14 |

26 Do you think that dental treatments can help make your teeth and mouth more healthy? *(Please tick one box)*

- Yes/absolutely 1
 Probably/sometimes 2
 No 3
 Don't know 4

For Q27 to Q29 please *circle* one number in each line to indicate the patient's level of agreement or disagreement with each statement.

27 During the last week, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to ...

	All the time	Very often	Fairly often	Some-times	Never	
have difficulty sleeping?	1	2	3	4	5	
stay home more than usual?	1	2	3	4	5	
stay in bed more than usual?	1	2	3	4	5	
take time off work?	1	2	3	4	5	NA

Q27 continued on next page

	All the time	Very often	Fairly often	Some-times	Never
be unable to do household chores?	1	2	3	4	5
avoid your usual leisure activities?	1	2	3	4	5

28 During the last week, how often have you worried about ...

	All the time	Very often	Fairly often	Some-times	Never
the appearance of your teeth or mouth?	1	2	3	4	5
the health of your teeth or mouth?	1	2	3	4	5

29

	Very Good	Good	Fair	Poor	Very poor
How would you rate your general health?	1	2	3	4	5
How would you rate your oral health?	1	2	3	4	5

-
- 30** (a) Do you take any regular medication? Yes ₁ → **Go to (b)**
No ₂ → **Go to Q31**
- (b) Was this medication recommended by a health care provider? Yes ₁
No ₂
-

- 31** Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? *(Please tick one box)*
- I would look forward to it as a reasonably enjoyable experience ₁
I wouldn't care one way or the other ₂
I would be a little uneasy about it ₃
I would be afraid that it would be unpleasant and painful ₄
I would be very frightened of what the dentist might do ₅
-

- 32** Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel?
(Please tick one box)
- Relaxed ₁
A little uneasy ₂
Tense ₃
Anxious ₄
So anxious that I sometimes break out in a sweat or almost feel physically sick ₅
-

- 33** Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel? *(Please tick one box)*
- Relaxed ₁
A little uneasy ₂
Tense ₃
Anxious ₄
So anxious that I sometimes break out in a sweat or almost feel physically sick ₅
-

- 34** Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel? *(Please tick one box)*
- Relaxed ₁
A little uneasy ₂
Tense ₃
Anxious ₄
So anxious that I sometimes break out in a sweat or almost feel physically sick ₅

35 How characteristic of you are the following statements? *(Please circle one of the numbers in each line)*

	Uncharacteristic of me			Characteristic of me		
	very	rather	somewhat	somewhat	rather	very
I am quick to express an opinion when it comes to my dental health care needs.	1	2	3	4	5	6
I usually think my needs are not as important as other people's needs.	1	2	3	4	5	6
If treatment is not to my satisfaction, I let the dentist know I am not happy.	1	2	3	4	5	6
If the service received is not to my satisfaction, I complain to dental staff.	1	2	3	4	5	6

36 Was this interview done by proxy? Yes ₁ No ₂

INTERVIEWER'S COMMENTS

Thank you for your co-operation and time in answering this questionnaire.

Appendix B1: General model results using various cut-off values

General model 1

1. cut-off = 0.2, sensitivity = 1.00, specificity = 0.004

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	58	41 (FP)	99
	7+ months -ve	0 (FN)	1	1
	Total	58	42	100

2. cut-off = 0.4, sensitivity = 0.85, specificity = 0.46

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	49	23 (FP)	72
	7+ months -ve	9 (FN)	19	28
	Total	58	42	100

3. cut-off = 0.5, sensitivity = 0.77, specificity = 0.63

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	45	16 (FP)	61
	7+ months -ve	13 (FN)	26	39
	Total	58	42	100

4. cut-off = 0.57, sensitivity = 0.71, specificity = 0.73

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	41	11 (FP)	52
	7+ months -ve	17 (FN)	31	48
	Total	58	42	100

5. cut-off = 0.6, sensitivity = 0.67, specificity = 0.76

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	39	10 (FP)	49
	7+ months -ve	19 (FN)	32	51
Total		58	42	100

6. cut-off = 0.7, sensitivity = 0.51, specificity = 0.87

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	30	5 (FP)	35
	7+ months -ve	28 (FN)	37	65
Total		58	42	100

7. cut-off = 0.8, sensitivity = 0.34, specificity = 0.94

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	20	3 (FP)	23
	7+ months -ve	38 (FN)	39	77
Total		58	42	100

8. cut-off = 0.9, sensitivity = 0.15, specificity = 0.98

		Clinician urgency (clinical assessment of urgency)		Total
		≤6 months (+ve)	7+ months (-ve)	
Test result (based on predictor variables)	≤6 months +ve	9	1 (FP)	10
	7+ months -ve	49 (FN)	41	90
Total		58	42	100

Note: FP = false positive, FN = false negative

General model 2

1. cut-off = 0.1, sensitivity = 1.00, specificity = 0.03

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	40	58 (FP)	98
	4+ months -ve	0 (FN)	2	2
	Total	40	60	100

2. cut-off = 0.2, sensitivity = 0.92, specificity = 0.32

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	37	41 (FP)	78
	4+ months -ve	3 (FN)	19	22
	Total	40	60	100

3. cut-off = 0.3, sensitivity = 0.78, specificity = 0.58

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	31	25 (FP)	56
	4+ months -ve	9 (FN)	35	44
	Total	40	60	100

4. cut-off = 0.4, sensitivity = 0.63, specificity = 0.74

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	25	16 (FP)	41
	4+ months -ve	15 (FN)	44	59
	Total	40	60	100

5. cut-off = 0.5, sensitivity = 0.50, specificity = 0.85

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	20	9 (FP)	29
	4+ months -ve	20 (FN)	51	71
	Total	40	60	100

6. cut-off = 0.6, sensitivity = 0.40, specificity = 0.92

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	16	5 (FP)	21
	4+ months -ve	24 (FN)	55	79
	Total	40	60	100

7. cut-off = 0.7, sensitivity = 0.27, specificity = 0.96

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	11	2 (FP)	13
	4+ months -ve	29 (FN)	58	87
	Total	40	60	100

8. cut-off = 0.8, sensitivity = 0.16, specificity = 0.99

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	6	1 (FP)	7
	4+ months -ve	34 (FN)	59	93
	Total	40	60	100

9. cut-off = 0.9, sensitivity = 0.05, specificity = 1.00

		Clinician urgency (clinical assessment of urgency)		Total
		≤3 months (+ve)	4+ months (-ve)	
Test result (based on predictor variables)	≤3 months +ve	2	0 (FP)	2
	4+ months -ve	38 (FN)	60	98
	Total	40	60	100

Note: FP = false positive, FN = false negative

Appendix B2: Screening questions from general models

General model 1

These are the series of questions identified to assist in discriminating between those patients able to wait longer than 7+ months and those who should be seen within 6 months. Note that the responses given in the 'Response' boxes are only an example.

If a patient gave these responses to the questions it is predicted that they would require care within 6 months (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

	Response
In the last four weeks, have you had...	
• a toothache	Yes
• pain in teeth with hot food or fluids	No
• pain in teeth with cold food or fluids	Yes
• pain in teeth with sweet foods	No
• pain in jaw while chewing	Yes
• pain in jaw when opening mouth wide	No
• pain in front of ear	No
• burning sensation in tongue/mouth	No
• shooting pain in face or cheeks	No
• pain or discomfort from denture	No
During the past year...	
• have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	Never
• have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?	Never
• have you had a painful aching in your mouth?	Hardly ever
• have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	Occasionally
• have you been self conscious because of your teeth, mouth or dentures?	Never
• have you felt tense because of problems with your teeth, mouth or dentures?	Never
• has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	Never
• have you had to interrupt meals because of problems with your teeth, mouth or dentures?	Never
• have you found it difficult to relax because of problems with your teeth, mouth or dentures?	Never
• have you been a bit embarrassed because of problems with your teeth, mouth or dentures?	Never
• have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	Never
• have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?	Never
• have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?	Never
• have you been totally unable to function because of problems with your teeth, mouth or dentures?	Never
What is your usual reason for visiting the dentist?	Check-up/Problem
How long has it been since your last dental visit?	1-<3 years
Do you smoke tobacco?	No
URGENCY: LE 6 months	

Appendix B3: General dental care questionnaire



Patient ID

RELATIVE NEEDS INDEX STUDY

General Dental Care

A study of the need for dental care.

Conducted by:

Social and Preventive Dentistry
The University of Adelaide
AUSTRALIA 5005

Relative Needs Index Study

RESPONSES RECORDED MUST BE THOSE OF THE PATIENT.

1 Please indicate your ■ date of birth:
day month year

■ sex: Male ₁ Female ₂

2 Were you born in Australia? Yes ₁ No ₂

If No, (a) in what country were you born?

country

(b) in which year did you first arrive in Australia to live?

year

3 Are you of Aboriginal and/or Torres Strait Islander origin? No ₁
Yes, Aboriginal ₂
Yes, Torres Strait Islander ₃

4 What is the postcode of the suburb/area you live in?

5 Which language do you **mainly** speak at home? (Please tick one box)

English	<input type="checkbox"/> ₁	Mandarin	<input type="checkbox"/> ₆
Italian	<input type="checkbox"/> ₂	Arabic	<input type="checkbox"/> ₇
Greek	<input type="checkbox"/> ₃	Russian	<input type="checkbox"/> ₈
Cantonese	<input type="checkbox"/> ₄	German	<input type="checkbox"/> ₉
Vietnamese	<input type="checkbox"/> ₅	Other (please specify)	<input type="checkbox"/> ₁₀

6 Australia's population is made up of many ethnic communities or groups.
With which community or group do you **mainly** identify?

(State only one, eg. Italian. If no ethnic identity, write "none").

7 Which of the following best describes where you live? *(Please tick one box)*

- House/flat/unit 1
- Caravan 2
- Boarding house/hostel/refuge/rehabilitation 3
- Group home 4
- Institution 5
- Aged care facility *(incl. Nursing home, aged care hostel)* 6
- Retirement village 7
- Other *(please specify)* 8

8 Which of the following best describes the household in which you live? *(Please tick one box)*

- With spouse/partner only 1
- With spouse/partner and child/ren 2
- With parents 3
- By self 4
- With my child/ren only 5
- Share with other adults 6
- Other *(please specify)* 7

9 How old were you when you left school? *(Please tick one box)*

- Did not go to school 1
- 14 years or younger 2
- 15 years 3
- 16 years 4
- 17 years 5
- 18 years 6
- 19 years or older 7

10 What is the highest level of education you have attained? *(Please tick one box)*

- Primary School 1
- Some secondary school 2
- Completed secondary school 3
- Some University, higher education 4
- Completed a University, higher education course 5
- Some TAFE, CAE or vocational course 6
- Completed TAFE, CAE or vocational course 7
- Other 8
- Don't know 9

11 What is your usual/previous occupation?

12 (a) Do you have

- Pensioner concession card (full entitlement)? ₁
- Pensioner concession card (part entitlement)? ₂
- Health care card? ₃
- Veterans Affairs Card? ₄
- Commonwealth Seniors Health Card? ₅

(b) How long have you had your concession card(s)?

- Pensioner concession card (full entitlement)
- Pensioner concession card (part entitlement)
- Health care card
- Veterans Affairs card
- Commonwealth Seniors Health card

13 (a) Do you have private dental insurance? Yes ₁ → **Go to (b)**
No ₂ → **Go to Q14**

(b) How long have you had private dental insurance?

- Less than 6 months ₁ 2 years to less than 3 years ₄
- 6 months to less than 12 months ₂ 3 years to less than 5 years ₅
- 1 year to less than 2 years ₃ 5 years or more ₆

14 Are you usually able to

- (a) chew a piece of fresh carrot? Yes ₁ No ₂
- (b) chew boiled vegetables? Yes ₁ No ₂
- (c) chew fresh lettuce salad? Yes ₁ No ₂
- (d) chew firm foods such as steaks or dried apricots? Yes ₁ No ₂
- (e) bite off and chew a piece of whole fresh apple? Yes ₁ No ₂
- (f) chew hamburger? Yes ₁ No ₂

15 (a) How often do you add sugar to your food (eg. cereal, sauces etc)?

Never	<input type="checkbox"/>	1	} →	How many teaspoons of sugar do you add to your food?	<input type="text"/>
Rarely	<input type="checkbox"/>	2			
Sometimes	<input type="checkbox"/>	3			
Often/always	<input type="checkbox"/>	4			

(b) How often do you add sugar to your drink (eg. tea, coffee)?

Never	<input type="checkbox"/>	1	} →	How many teaspoons of sugar do you add to your drink?	<input type="text"/>
Rarely	<input type="checkbox"/>	2			
Sometimes	<input type="checkbox"/>	3			
Often/always	<input type="checkbox"/>	4			

(c) How many times did you have a dessert or sweet snack yesterday?

(d) How many times did you have a sweet drink yesterday (eg. juice, non-diet soft drink, tea, coffee)?

16 Thinking about problems with your teeth or mouth,

(a) do you ever have difficulty pronouncing any words?	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2
(b) do you ever have difficulty speaking clearly?	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2
(c) do you ever have difficulty making yourself understood?	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2

17 In the last four weeks, have you had the following problems?

(a) toothache	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(b) pain in teeth with hot foods or fluids	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(c) pain in teeth with cold foods or fluids	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(d) pain in teeth with sweet foods	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(e) pain in jaw while chewing	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(f) pain in jaw when opening mouth wide	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(g) pain which is worse in the middle of the day	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(h) pain at night	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(i) pain in front of ear	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(j) burning sensation in tongue or other parts of mouth	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(k) shooting pain in face or cheeks	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2			
(l) pain or discomfort from denture	Yes	<input type="checkbox"/>	1	No	<input type="checkbox"/>	2	NA	<input type="checkbox"/>	3

18 In the last four weeks, have you had the following problems?

- | | | | | | | |
|---|-----|--------------------------|---|----|--------------------------|---|
| (a) mouth ulcers | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (b) cold sores | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (c) sore gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (d) bleeding gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (e) swelling on gums | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (f) bad breath | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (g) dryness of mouth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (h) unpleasant taste | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (i) changes in ability to taste | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (j) clicking/grating noise in jaw joint | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (k) swelling of your face or neck | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (l) a lost filling | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (m) a lost crown | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (n) a broken filling | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (o) a broken crown | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (p) a loose tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (q) a chipped tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (r) a cracked tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (s) a broken tooth from an accident | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (t) visible pink areas on the tooth as a result of a broken tooth | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |
| (u) high temperature | Yes | <input type="checkbox"/> | 1 | No | <input type="checkbox"/> | 2 |

19 What category best describes your teeth? *(Please tick one box)*

- | | | | | |
|---|--------------------------|---|---|-----------|
| Natural teeth only | <input type="checkbox"/> | 1 | → | Go to Q21 |
| Natural teeth and upper denture only | <input type="checkbox"/> | 2 | → | Go to Q20 |
| Natural teeth and lower denture only | <input type="checkbox"/> | 3 | → | Go to Q20 |
| Both upper and lower dentures with some natural teeth | <input type="checkbox"/> | 4 | → | Go to Q20 |

20 (a) How long ago did you receive your first denture(s)?

Upper denture

Lower denture

Q20 continued on next page

(b) How long have you had the denture(s) you wear now? Upper denture

Lower denture

21 What dental treatment do you think you currently need? (Please tick one or more boxes)

- | | | | | | |
|---------------------|--------------------------|---|----------------------------------|--------------------------|----|
| None | <input type="checkbox"/> | 1 | Gum Treatment | <input type="checkbox"/> | 8 |
| Check-up | <input type="checkbox"/> | 2 | Teeth straightened/braces | <input type="checkbox"/> | 9 |
| Dental filling | <input type="checkbox"/> | 3 | New or replacement dentures | <input type="checkbox"/> | 10 |
| Amalgam replacement | <input type="checkbox"/> | 4 | Teeth cleaned | <input type="checkbox"/> | 11 |
| Root canal filling | <input type="checkbox"/> | 5 | Whitening/bleaching | <input type="checkbox"/> | 12 |
| Crown | <input type="checkbox"/> | 6 | Denture repair | <input type="checkbox"/> | 13 |
| Tooth extracted | <input type="checkbox"/> | 7 | Other treatment (please specify) | <input type="checkbox"/> | 14 |
-

22 (a) Have you ever had a tooth extracted? Yes 1 → Go to (b), (c) & (d)
 No 2 → Go to Q23

(b) If Yes, why? (eg. wisdom tooth, decay, orthodontic etc)

(c) How long has it been since your last extraction?

(d) How many teeth have you had extracted in the past 2 years?
 (Number)

23 What is your usual reason for visiting the dentist?

- | | | |
|----------------------------------|--------------------------|---|
| For a regular check-up | <input type="checkbox"/> | 1 |
| For an occasional check-up | <input type="checkbox"/> | 2 |
| When in discomfort/pain | <input type="checkbox"/> | 3 |
| When something needs to be fixed | <input type="checkbox"/> | 4 |

24 How long has it been since your last dental visit? (Please tick one box)

- | | | | | | |
|--------------------------------|--------------------------|---|------------------------------|--------------------------|---------------|
| Less than 12 months | <input type="checkbox"/> | 1 | 3 years to less than 5 years | <input type="checkbox"/> | 4 |
| 12 months to less than 2 years | <input type="checkbox"/> | 2 | 5 years or more | <input type="checkbox"/> | 5 |
| 2 years to less than 3 years | <input type="checkbox"/> | 3 | Never | <input type="checkbox"/> | 6 → Go to Q29 |

25 Where was your last dental visit? *(Please tick one box)*

- | | | |
|--|--------------------------|---|
| Private practice | <input type="checkbox"/> | 1 |
| Public hospital/clinic | <input type="checkbox"/> | 2 |
| School Dental Service | <input type="checkbox"/> | 3 |
| Dental technician | <input type="checkbox"/> | 4 |
| Health Fund | <input type="checkbox"/> | 5 |
| Prison, corrective/detention institution | <input type="checkbox"/> | 6 |
| Other | <input type="checkbox"/> | 7 |
| Don't know | <input type="checkbox"/> | 8 |

26 How often do you usually go to the dentist? *(Please tick one box)*

- | | | | | | |
|--------------------------|--------------------------|---|----------------------|--------------------------|---|
| More than 2 times a year | <input type="checkbox"/> | 1 | Once every 2 years | <input type="checkbox"/> | 4 |
| Two times a year | <input type="checkbox"/> | 2 | Once every 5 years | <input type="checkbox"/> | 5 |
| Once a year | <input type="checkbox"/> | 3 | Less often than that | <input type="checkbox"/> | 6 |

27 In which country was your last dental visit? *(Please tick one box)*

- | | | |
|-------------------------------|--------------------------|---|
| Australia | <input type="checkbox"/> | 1 |
| Other <i>(please specify)</i> | <input type="checkbox"/> | 2 |
-

28 What dental treatment did you receive at your last dental visit/s? *(Please tick one or more boxes)*

- | | | | | | |
|---------------------|--------------------------|---|---|--------------------------|----|
| None | <input type="checkbox"/> | 1 | Gum Treatment | <input type="checkbox"/> | 8 |
| Check-up | <input type="checkbox"/> | 2 | Teeth straightened/braces | <input type="checkbox"/> | 9 |
| Dental filling | <input type="checkbox"/> | 3 | New or replacement dentures | <input type="checkbox"/> | 10 |
| Amalgam replacement | <input type="checkbox"/> | 4 | Teeth cleaned | <input type="checkbox"/> | 11 |
| Root canal filling | <input type="checkbox"/> | 5 | Whitening/bleaching | <input type="checkbox"/> | 12 |
| Crown | <input type="checkbox"/> | 6 | Denture repair | <input type="checkbox"/> | 13 |
| Tooth extracted | <input type="checkbox"/> | 7 | Other treatment <i>(please specify)</i> | <input type="checkbox"/> | 14 |
-

29 Do you think that dental treatments can help make your teeth and mouth more healthy? *(Please tick one box)*

- | | | |
|--------------------|--------------------------|---|
| Yes/absolutely | <input type="checkbox"/> | 1 |
| Probably/sometimes | <input type="checkbox"/> | 2 |
| No | <input type="checkbox"/> | 3 |
| Don't know | <input type="checkbox"/> | 4 |

For Q30 to Q35, please *circle* one number in each line to indicate the patient's level of agreement or disagreement with each statement.

30 Thinking about your dental health over the last year, how often ...

	All the time	Very often	Fairly often	Some-times	Never
have you been prevented from eating foods you would like to eat?	1	2	3	4	5
have you found your enjoyment of food is less than it used to be?	1	2	3	4	5
did it take you longer to finish a meal than other people?	1	2	3	4	5
have you found your taste for salt to have increased?	1	2	3	4	5
did you avoid eating with other people because of problems with chewing?	1	2	3	4	5
were you embarrassed by the appearance or health of your teeth or mouth?	1	2	3	4	5
did you avoid laughing or smiling?	1	2	3	4	5
did you avoid conversation with others?	1	2	3	4	5

31 During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to ...

	All the time	Very often	Fairly often	Some-times	Never	
have difficulty sleeping?	1	2	3	4	5	
stay home more than usual?	1	2	3	4	5	
stay in bed more than usual?	1	2	3	4	5	
take time off work?	1	2	3	4	5	NA
be unable to do household chores?	1	2	3	4	5	
avoid your usual leisure activities?	1	2	3	4	5	

32 During the past year, how often have you worried about ...

	All the time	Very often	Fairly often	Some-times	Never
the appearance of your teeth or mouth?	1	2	3	4	5
the health of your teeth or mouth?	1	2	3	4	5

33 During the past year,	All the time	Very often	Fairly often	Sometimes	Never
	1	2	3	4	5
how often did you use medication to relieve pain or discomfort in your teeth or mouth?					

34	Very Good	Good	Fair	Poor	Very Poor
	1	2	3	4	5
How would you rate your general health?					
How would you rate your oral health?					

35 During the past year ...	Very often	Fairly often	Occasionally	Hardly ever	Never
	1	2	3	4	5
have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?					
have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?					
have you had a painful aching in your mouth?					
have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?					
have you been self conscious because of your teeth, mouth or dentures?					
have you felt tense because of problems with your teeth, mouth or dentures?					
has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?					
have you had to interrupt meals because of problems with your teeth, mouth or dentures?					
have you found it difficult to relax because of problems with your teeth, mouth or dentures?					
have you been a bit embarrassed because of problems with your teeth, mouth or dentures?					
have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?					
have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?					
have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?					
have you been totally unable to function because of problems with your teeth, mouth or dentures?					

36 Have you sought medical care in the last 6 months? Yes ₁
No ₂

37 (a) Do you take any regular medication? Yes ₁ → **Go to (b)**
No ₂ → **Go to Q38**

(b) Was this medication recommended by a health care provider? Yes ₁
No ₂

38 Do you
(a) have diabetes? Yes ₁
No ₂

(b) Do you smoke tobacco? Yes ₁
No ₂
Occasionally ₃

39 Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? *(Please tick one box)*

I would look forward to it as a reasonably enjoyable experience	<input type="checkbox"/> ₁
I wouldn't care one way or the other	<input type="checkbox"/> ₂
I would be a little uneasy about it	<input type="checkbox"/> ₃
I would be afraid that it would be unpleasant and painful	<input type="checkbox"/> ₄
I would be very frightened of what the dentist might do	<input type="checkbox"/> ₅

40 Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel?
(Please tick one box)

Relaxed	<input type="checkbox"/> ₁
A little uneasy	<input type="checkbox"/> ₂
Tense	<input type="checkbox"/> ₃
Anxious	<input type="checkbox"/> ₄
So anxious that I sometimes break out in a sweat or almost feel physically sick	<input type="checkbox"/> ₅

41 Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel?
(Please tick one box)

Relaxed	<input type="checkbox"/> ₁
A little uneasy	<input type="checkbox"/> ₂
Tense	<input type="checkbox"/> ₃
Anxious	<input type="checkbox"/> ₄
So anxious that I sometimes break out in a sweat or almost feel physically sick	<input type="checkbox"/> ₅

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