THE NEW ZEALAND MEDICAL JOURNAL

Vol 114 No 1142 Journal of the New Zealand Medical Association 26 October 2001

ISSN 0028 8446

Twice monthly except December & January

THE NEW ZEALAND MEDICAL JOURNAL

Established 1887 - Journal of the New Zealand Medical Association

Twice monthly except December & January ISSN 0028 8446

Information for authors

Guidelines for authors are in accordance with the Uniform Requirements for Manuscripts submitted to Biomedical Journals. Full details are printed in NZ Med J 1997; 110: 9-17, Med Educ 1999; 33: 66-78 and are on the NZ Medical Association website – www.nzma.org.nz. Authors should be aware of the broad general readership of the Journal. Brevity and clear expression are essential. Most papers should be 2200 words or less, the maximum being 3000 words and 30 references. For papers accepted for publication which exceed three printed pages (around 3,000 words) there will be a page charge of $450 plus GST for each printed page. Letters should not exceed 400 words and ten references. Case reports must be no longer than 600 words, with up to six references and no more than one Figure or Table. Requirements for letters, obituaries and editorials are on the website. All material submitted to the Journal is assumed to be sent to it exclusively unless otherwise stated.

In, or with your covering letter, the following is required:

1. Each author must give a signed personal statement of agreement to publish the paper or letter.
2. One (or more) author must state: "I (we) accept full responsibility for the conduct of the study, had access to the data, and controlled the decision to publish".
3. Authors must state whether potential conflicts of interest do or do not exist.
4. All sources of funding must be stated explicitly and this information will be published with the paper.

The paper: Papers are to be written in English and typewritten in double spacing on white A4 paper with a 25 mm margin at each side. Send three copies of the paper. Wherever possible, the article should also be submitted on a 3.5-inch disk. Although Word 5.1 (or later version) is the program of choice, other word-processing programs are acceptable. Organise the paper as follows:

Title page – the title should be brief without abbreviations. Authors' names, with only one first name and no degrees should be accompanied by position and workplace at the time of the study. Corresponding author details with phone, fax and email should be given, and the text word count noted.

Abstract page – this must not exceed 200 words and should describe the core of the paper's message, including essential numerical data. Use four headings: Aims, Methods, Results, Conclusions.

Body of the paper – there should be a brief introduction (no heading) followed by sections for Methods, Results, Discussion, Acknowledgements and Correspondence.

References – in the text use superscript numbers for each reference. Titles of journals are abbreviated according to the style used by Index Medicus for articles in journals the format is: Braatvedt GD. Outcome of managing impotence in clinical practice. NZ Med J 1999; 112: 272-4. For book chapters the format is: Marks P. Hypertension. In: Baker J, editor. Cardiovascular disease. 3rd ed. Oxford: Oxford University Press; 1998. p567-95. Note all authors where there are four or less; for five or more authors note only the first three followed by 'et al'. Personal communications and unpublished data should also be cited as such in the text.

Tables should be on separate sheets with self-explanatory captions. Footnote symbols must be used in a set sequence (* † ‡ § || ¶ ** †† ‡‡ etc).

Figures must be glossy prints or high quality computer printouts. Since these are likely to be reduced in size when printed, use large type and approximately twice column size for the figure.

The Journal does not hold itself responsible for statements made by any contributors. Statements or opinions expressed in the Journal reflect the views of the author(s) and do not reflect official policy of the New Zealand Medical Association unless so stated.

Addresses

Editorial: All editorial correspondence is sent to Professor Nicholls, c/o Department of Medicine, Christchurch Hospital, PO Box 4345 Christchurch, New Zealand. Telephone (03) 364 1116; Facsimile (03) 364 1115; email barbara.griffin@chmeds.ac.nz

Advertising: All correspondence is to be sent to the Advertising Manager, Print Advertising, 83-91 Captain Springs Road, PO Box 13 128 Onehunga, Auckland. Telephone (09) 634-4982; Facsimile (09) 634-4951; email printad.auck@xtra.co.nz or PO Box 27194, Upper Willis Street, Wellington. Telephone (04) 801-6187; Facsimile (04) 801-6261; email printad.wgtn@xtra.co.nz

Circulation: All correspondence about circulation, subscriptions, change of address and missing numbers is sent to Chief Executive Officer, New Zealand Medical Association, PO Box 156, Wellington. Telephone (04) 472-4741; Facsimile (04) 471-0838. email nzmedjnl@nzma.org.nz

Publisher: The Journal is published by Southern Colour Print, PO Box 920, Dunedin. Telephone (03) 455-0554; Facsimile (03) 455-0303.

Subscriptions: New Zealand – standard mail NZ$255.15, fastpost NZ$272.25 (GST incl); **overseas surface mail** NZ$280.00, **overseas airmail –** South Pacific/Australia NZ$340.00; America/Asia/India/Europe NZ$420.00; Africa/Middle East NZ$490.00. All subscription enquiries to NZ Medical Association, as for Circulation above.

THE NEW ZEALAND MEDICAL JOURNAL

26 October 2001
Volume 114
No 1142

EDITORIALS

Medical education: investment or cost?

This issue of the Journal contains three papers and an editorial on medical student debt. They highlight the fact that those contemplating a career in medicine are faced with a serious financial hurdle. This might be of little consequence to members of upper income families but will increasingly give rise to caution for the larger number of students from middle and lower income backgrounds. Although we know of no in-depth analysis, it seems likely that there is already a selection process for our future doctors based on family income. Is it desirable that doctors in future will be recruited increasingly from upper income families?

For those who do enter medical schools and accumulate a sizeable debt, what are the likely consequences? The papers in the Journal give rise to disquiet. Many young doctors will leave New Zealand to recoup their debt overseas. Of these, there is a good chance that the 'best' or most promising will be snapped up and not return. Many who return will be tempted to enter high paying specialties avoiding, especially, general practice, particularly in rural areas. It is inevitable that many will leave the country feeling aggrieved, even angry. These feelings may well tip the balance between whether or not they return to work in New Zealand. In earlier years, young doctors who left these shores (whether for clinical experience, to travel, or to undertake research), left with a warm feeling for the country which had provided a 'free' education. Factors such as these made it acceptable, even comfortable, for them to receive a relatively low salary upon their return to New Zealand.

The current attitude of our politicians to student fees is myopic. It is almost as if the country is trying to rid itself selectively of its brightest and best – at least those from middle and low income families. History is, of course, replete with examples of political short-sightedness when it comes to treatment of the most talented. Especially graphic and tragic was Germany in the 1920s – 40s where the regime in power forced the exodus of many top scientists. Some of these became leaders of scientific communities in their adopted countries and were pivotal in the development of, for example, penicillin and atomic energy.[1] Is New Zealand doomed to rediscover the folly of maltreating its brightest?

New Zealand government investment in university education, already low at 0.80% of GDP in 1991, fell to 0.66% in 1999 (discussion paper submitted to University of Otago Council, June 12th, 2001). Our politicians seem unable or unwilling to recognise the seriousness of the issue. Even University Vice Chancellors, while vocalising the problems, have demonstrated lack of empathy by accepting a greater than 40% wage rise.[2]

One practical problem is that the pay-off for investing 'seriously' in education is not realised until many years hence –beyond the time horizons of most politicians and the three year electoral term. Education of our future doctors (and the funding of tertiary education in general) needs urgent review.

No doubt most of our current medical practitioners graduated from New Zealand medical schools with little or no debt. Yet the voice of the medical profession has, with few exceptions, been eerily quiet. Perhaps it is time that we, through the New Zealand Medical Association, the Universities, our Specialty Colleges and the Association of Salaried Medical Specialists, force a rethink of tertiary fees structure for the good of those who will ultimately repay medical student debts – the patients.

The Editors

1. Medewar J, Pyke D. Hitler's gift. New York: Arcade Publishing; 2000.
2. Ross T. Pay boosters for varsity heads. The Press, 2001 July 23.

Medical student debt and evidence-based politics

Richard Pole, ***Medical Student, University of Otago and Political Science Student, University of Canterbury, Christchurch.***

This issue of the New Zealand Medical Journal contains three articles that herald the establishment of a new epidemic in Aotearoa New Zealand: medical student debt.

Demographics. At this stage medical student debt seems to exclusively affect medical students. Within this cohort are groups with increased risk. For instance, medical student debt for the average female will certainly have a greatly protracted natural history in contrast to the average male. Women have a tendency to work part-time and in lower paid specialties. This decreases their income, and means that female doctors will have more difficulty in paying back student loans.[1]

As is the case with all diseases in New Zealand worth their salt, medical student debt affects Maori and Pacific Islanders more than other New Zealanders, with Maori and Pacific Islanders predicting much greater levels of debt.[2] This is consistent with evidence from overseas, which has shown that "students from under-represented minorities were more likely to have accumulated debt than other students, and their debt loads were higher".[3]

Unfortunately, there is also reason to suspect that in the long term medical student debt will affect all New Zealanders who wish to have access to affordable medical care from New Zealand trained practitioners. This will be due to these practitioners passing on the exorbitant cost of their education to their 'clients'. Especially at risk of this co-morbidity are those who already experience financial barriers to accessing healthcare, including Maori and Pacific Islanders, youth and those of lower socio-economic status.

Aetiology. Medical student debt is caused by borrowing money to facilitate participation in the New Zealand medical education system.[4] It is not caused, as initially thought by some investigators, by borrowing money to finance overseas holidays, excessive consumption of beer, or speculation in the lucrative New Zealand sharemarket.

Pathogenesis. Over the past decade New Zealand public policy has become increasingly neoliberal in persuasion. This ideology has been used by successive governments to justify 'user-pays' myopia. Universities are now underfunded to the extent that medical students are required to contribute more than 30% of the cost of their medical education. Medical student debt is caused by the corruption of 'user pays', and its replacement with the sanitised version: 'user borrows'. Signing off yearly loans of $10 000 for course fees has become habitual for New Zealand medical students. Borrowing money to pay rent, and to buy Weetbix, is also a necessity for the majority – a fact that distinguishes tertiary students from any other group in New Zealand society. In addition, textbooks, stethoscopes and 'reasonable standards of dress' all cost money.

The majority of medical students have probably never owned a house, or a business, and therefore probably entertain a degree of naïvety as to the true cost of the financial commitment they are making to their education. It is ironic that an investment in a medical education in New Zealand may no longer be considered a 'smart' financial investment.

Symptoms. Medical student debt manifests as academic mortgages of up to $120 000.[4] As it stands, medical student debt is a contributor to a national student debt figure of more than $4 billion.

Stress is an associated symptom: the frequency of medical students worrying about their debt is positively correlated to their level of medical student debt.[4] This is not good news for a profession that is over-represented in terms of depression, alcoholism and divorce.

Another palpable symptom is the loss of any sense of loyalty that New Zealand medical students feel toward the New Zealand health system. This manifests as an associated preference to practice medicine overseas.[2,5] It is predicted therefore that Australian citizenship will increasingly be a marker of medical student debt amongst New Zealand medical graduates.

Also alarming is the potential for medical student debt to influence the afflicted student's career choice. In America, "[medical] students who had very large debts were less likely to choose primary care specialties".[3] In New Zealand, a career in general practice is first choice for only 15% of current medical students.[2,5] Furthermore it seems that in New Zealand more current medical students would choose a career outside the field of medicine, than would choose to work in psychiatry, public health or pathology.[5] These statistics do not correlate with a public health sector that is serious about preventive health and primary care.

Investigations. Yes please, these are required STAT. And it would be helpful if the task of investigating medical student debt was not left up to the medical students themselves. Medical students are very busy, and have other things to worry about (for instance: lectures, patients, pathology, part time work, their level of debt, etc). The establishment of the Health Workforce Advisory Committee is welcomed; and the recommendations of the Education and Science Select Committee's inquiry into fees, loans and allowances and the overall funding of tertiary education are eagerly awaited.

Management. It is imperative to note from the outset that the correct management of medical student debt will not involve further increases in university fees. The cost of attending medical school in New Zealand must be decreased.

It is also important to note that a sensible antidote to the problem of medical student debt can be found within the confines of the 'user pays' dogma. All that is required is an honest application of this neoliberal principle to the context of the New Zealand health system. That is, who is the 'user' of medical education? Is it the medical student? Or in fact, are the 'users' the countless patients who in ten years time will be consuming the health resources provided by the doctor? This interpretation would lead to a significant recalibration of the cost of the medical degree that is met by the medical student. There is a strong argument for the end-user (the taxpayer) meeting the whole cost of medical education.

Prognosis. Continuation of the status quo is untenable. The developing public health disaster that is medical student debt is now squarely in the hands of the country's policy-makers. These political practitioners would be well advised to follow a 'best practice' approach. Evidence-based medicine is the paradigm that underlies the modern practice of medicine. The key assumption of evidence-based medicine is that the most ethical practice is to employ treatments that have proven efficacy. The corollary is that "with interventions for which high-quality evidence clearly shows lack of efficacy, evidence-based medicine provides a process that appropriately leads to the discarding of the intervention".[6]

The philosophy of evidence-based medicine should be translated to the art and practice of politics. With respect to the data contained within this issue of the Journal, evidence-based politics would surely conclude that the policy of burdening medical students with the cost of their education has a proven lack of efficacy. The diligent practitioner of evidence-based politics would be forced to discard this particular intervention. To do otherwise would be unethical.

The opinions presented here are exclusively those of the author.

Correspondence. Richard Pole, C/- Christchurch School of Medicine, PO Box 4345, Christchurch. Email: rpole@chmeds.ac.nz

1. Poole P. Room for more women in clinical specialties. NZ Med J 2000; 113: 105-7.
2. O'Grady G, Fitzjohn J. Debt on graduation, expected place of practice and career aspirations of Auckland Medical School students. NZ Med J 2001; 114: 467-9.
3. Bland CJ, Meurer LN, Maldonado G. Determinants of primary care specialty choice: a non-statistical meta-analysis of the literature. Acad Med 1995; 70: 620-41.
4. Gill D, Palmer C, Mulder R, Wilkinson T. Medical student debt at the Christchurch School of Medicine. The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) survey of medical students pilot study. Results Part I. NZ Med J 2001; 114: 461-4.
5. Gill D, Palmer C, Mulder R, Wilkinson T. Medical student career intentions at the Christchurch School of Medicine. The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) survey of medical students pilot study. Results Part II. NZ Med J 2001; 114: 464-7.
6. Culpepper L, Gilbert TT. Evidence and ethics. Lancet 1999; 353: 829-31.

ORIGINAL ARTICLES

Medical student debt at the Christchurch School of Medicine. *The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) survey of medical students* pilot study. Results Part I.

Denzil Gill, *Trainee Intern;* **Claire Palmer**, *Trainee Intern;* **Roger Mulder**, *Associate Professor, Department of Psychological Medicine;* **Tim Wilkinson**, *Associate Dean (Undergraduate Education), Christchurch School of Medicine and Health Sciences, Christchurch.*

Abstract

Aims. To determine the level and sources of medical student debt at the Christchurch School of Medicine.

Methods. A questionnaire, *The New Zealand Wellbeing, Intentions, Debt, and Experiences (WIDE) Survey of Medical Students*, was developed and administered to all 204 medical students at the Christchurch School of Medicine and Health Sciences. Included were questions on student demographics, sources and levels of debt, parental financial support, and student perceptions of their debt.

Results. The response rate was 88%. International students, whose debt was with an overseas government, and students with mortgages were excluded from the data analysis. The combined total debt for the remaining 165 students was $7 775 000 with $6 290 000 (81%) owed to the Government Students Loans scheme. One quarter of 6th year medical students had a debt over $83 250, 50% had a debt over $70 000, and 75% had a debt over $50 000. Student allowances were inaccessible to 64% of 4th and 5th year students and part-time employment during term-time was common. Lack of funds was reported to impair full participation in the medical course.

Conclusion. The majority of medical students at the Christchurch School of Medicine accumulate high levels of debt, mainly through the Government Student Loans scheme, during their medical training.

NZ Med J 2001; 114: 461-4

Medical students, and other tertiary students in New Zealand, must contribute to the cost of their tertiary education through the payment of tuition fees. Tuition fees are charged by the tertiary institutions to overcome shortfalls in Government funding of education. Basic undergraduate medical training in this country is taught through the University of Otago or the University of Auckland and consists of a six-year course made up of three predominantly pre-clinical years followed by three predominantly clinical years. Students currently studying medicine through these institutions pay approximately $9500 per annum in tuition fees. The entire amount of these tuition fees as well as some living expenses and course-related costs can be borrowed from the Government Student Loans (GSL) scheme. Over the six years of a medical course a medical student can potentially amass a large educational debt that must be repaid after graduation. We are concerned about the effect this might have on the general accessibility of the medical course to individuals, particularly those from lower socio-economic backgrounds. It also has serious implications regarding the retention of medical graduates in New Zealand, their choice of speciality, their location of practice and the ongoing provision of affordable health care in this country.

While there has been much speculation and rhetoric surrounding the impact of tertiary education debt in New Zealand there has also been a paucity of data showing levels of debt, student attitudes towards debt and the impact of debt on career decisions.

The New Zealand Wellbeing, Intentions, Debt, and Experiences (WIDE) Survey of Medical Students is a questionnaire-based survey developed by medical students in collaboration with academic staff at the University of Otago's Christchurch School of Medicine and Health Sciences (CSM). The aim of the survey is to collect comprehensive information on a range of subjects relevant to medical students in New Zealand including sources and levels of medical student debt, and factors influencing medical student career decisions. Following the development of the questionnaire and prior to the start of the nation-wide survey, a pilot study was performed on 4th, 5th, and 6th year medical students training at the CSM. The results from the full nation-wide survey are not expected for several months. We report here data from the pilot study at the CSM.

Methods

Questionnaire Development. *The New Zealand WIDE Survey of Medical Students* is a questionnaire-based survey that we developed to collect comprehensive information on a range of topics relevant to New Zealand medical students. Topics covered in the survey include: medical student demographics; student debt; career intentions and factors influencing career choice; student health and wellbeing including mental health, and drug and alcohol consumption; and student experiences during medical training. Questions relating to demographic data were worded in a similar way to questions from the New Zealand Census questionnaire. Some other questions were taken directly, or adapted from, previous studies carried out in New Zealand including the 1999 Otago University Medical Students Association survey of medical student debt (unpublished), the 1996 Otago University Medical School Department of Psychological Medicine study 'Is Medical School Hazardous to Your Health?'(unpublished), and the Christchurch Health and Development Study.[1] A copy of the Alcohol Use Disorders Identification Test (AUDIT) was included in the questionnaire.[2] Questions on student experiences at medical school were based on overseas studies.[3-6] The survey questionnaire was developed in consultation with the medical student associations of New Zealand and Auckland University, and Wellington, Christchurch and Otago Schools. The investigators sought input from Maori medical student representatives at the CSM and approval was obtained from the University of Otago Ethics Committee. A biostatistician reviewed the content and format of the questionnaire and the questionnaire was pre-tested on 20 volunteers to ensure clarity and face validity.

Pilot study. Prior to initiation of a nation-wide survey of all medical students studying in New Zealand, a pilot study was conducted at the CSM from September to October 2000. Students were asked in advance to collect information on levels of debt from all sources. Participation was voluntary and the survey was administered and completed by class groups during a specifically allocated one-hour period. To preserve anonymity participants deposited completed questionnaires into a box. Simultaneously, student names were recorded on a separate register so that absentees could be followed up. The names of any students who indicated that they did not wish to participate in the survey were also noted so that they would not be approached again.

Data analysis. The raw data from the questionnaires was entered into a spreadsheet database by one of the investigators and no other person has had access to the individual questionnaires. The questionnaires remain anonymous and no attempt to identify students based on information disclosed in the questionnaire can be made. Basic descriptive and statistical analyses were performed and the results tabulated. Statistical comparison of debt by different categories was by analysis of variance.

Results

Surveys were completed by 179 of 204 medical students studying at the CSM in 2000 (88%). The response rates for the individual years were: 4th year 94%, 5th year 86%, and 6th year 84%.

Demographic data. Of the respondents 50.3% were male and 49.7% were female, ages 17-40 (average 23.6) years. 85% were New Zealand citizens, 9% were permanent residents, and 6% were international students mainly sponsored by the Malaysian government. New Zealand European (71%) was the most common ethnicity, followed by Chinese (15%), Malay (6%), New Zealand Maori (3%), Indian (1%), and 7% (other). The majority (76.5%) reported coming from an urban background. Most (73%) were raised in a community of over 30 000 people with 55% coming from a community of over 100 000 people. Flatting was the most common living arrangement (70%), 21% lived with their parents, 5% were in their own home, and the remainder were boarding or in a hostel. 89% of respondents had never been married, 6% were married, and the remainder were divorced or in a de facto relationship. Estimated total annual parental or caregiver income was less than $10 000 in 5%, between $10 000 and $40 000 in 24%, between $40 000 and $100 000 in 48%, over $100 000 in 23%. One or both parents had a tertiary qualification for 68%, while 11% had one or both parents practising medicine.

Debt levels. The debts of ten international students sponsored by an overseas government were excluded from the following analysis. Of the remaining 169 respondents, 78% reported having a debt with the GSL scheme, 62% were in overdraft with a bank, 34% owed money on credit cards, 31% had a loan with The Medical Assurance Society (MAS), 30% had borrowed from family or whanau, 5% had a bank loan and 2% had a mortgage.

Table 1 shows the total and GSL debt levels. In order to protect individual privacy and to avoid misrepresentation of debt levels, the debts of students with mortgages have been excluded. The combined total debt from all sources for the remaining 165 respondents was $7 775 000 with $6 290 000 (81%) in the form of GSL debt. Debt accumulated through study prior to medical school totalled $592 000 or 8% of total debt. Debt levels increase as students move through medical school such that 4th year students had the lowest combined total debt and combined GSL debt, $1 838 000 and $1 543 000 respectively, followed by 5th year students with $2 733 000 and $2 060 000 respectively. Students in their final (6th) year of study had the largest combined total debt of $3 204 000 and combined GSL debt of $2 687 000. Table 2 shows the distribution of debt among medical students in each year at the CSM. For 6th year students about to graduate, 6% of students recorded no debt while 9% had a debt in excess of $100 000: the maximum recorded debt for an individual student in this group being $120 000. The median total debt level rose from $34 500 for 4th year students, to $52 000 for 5th year students, and $70 000 for 6th year students. 75% of 6th year students reported having total debts in excess of $50 000.

The use of GSL money is shown in Table 3. This was used mainly to pay for tuition fees (98%), living expenses (81%) and course costs (83%). 19% had used the GSL scheme to purchase or maintain a vehicle, 6% to purchase a computer, while 17% had funded course-related travel, and 18% had funded non-course-related travel using the GSL scheme.

Table 1. Total debt levels and debt with the Government Student Loans scheme.

	Total debt from all sources*	Debt with GSL† scheme	GSL debt as percentage of total debt
6th Year (n=53)	$3 204 000	$2 687 000	84%
5th Year (n=54)	$2 733 000	$2 060 000	75%
4th Year (n=58)	$1 838 000	$1 543 000	84%
All Students (n=165)	$7 775 000	$6 290 000	81%

*Debt levels for students with home mortgages have not been included. †GSL=Government Student Loan.

Table 2. Distribution of total debt levels.

Total debt level	4th Year (n=58) %	5th Year (n=54) %	6th Year (n=53) %
$0	17	11	6
$1 - $24 999	26	6	11
$25 000 - $49 999	28	30	8
$50 000 - $74 999	26	35	32
$75 000 - $99 999	3	11	34
≥$100 000	0	7	9
Minimum	$0	$0	$0
1st Quartile	$10 000	$30 500	$50 000
Median	$34 500	$52 000	$70 000
3rd Quartile	$51 500	$70 000	$83 250
Maximum	$79 000	$114 000	$120 000
Average	$31 690	$50 611	$61 615

Table 3. Medical student expenditure of Government Student Loan funds.

	Proportion of respondents (n=133)
Tuition fees	130 (98%)
Living expenses	108 (81%)
Course costs	111 (83%)
Vehicle	25 (19%)
Computer	8 (6%)
Course-related travel	23 (17%)
Non-course-related travel	24 (18%)
Other	2 (2%)

Financial support. Access to financial support while studying at medical school to offset student debt was examined. All students in their 6th year of medical training, with the exception of students sponsored by an overseas government, receive a training grant to assist with tuition fees and living expenses. Other students can apply for a student allowance administered through Work and Income New Zealand. These allowances are means-tested on parental income for students 25 years of age or younger. Only 34% of 4th and 5th year students receive a full or partial student allowance, with the remaining 66% receiving no allowance.

31% of 4th year students and 15% of 5th year students were employed in part-time work during term time, working on average seven hours per week. The maximum work time undertaken by a medical student during term time was 20 hours per week. Most students had difficulty accurately quantifying their income generated from work undertaken during term time or holiday breaks and as we did not consider these data to be reliable, we have excluded them from analysis.

Students in all years reported receiving varying degrees of financial support from their parents. 9% of students had all of their fees and living expenses paid for by parents, while 31% received no financial assistance from parents. 33% received a financial contribution from parents to cover some of their fees only or some of their living expenses only. The remaining 27% received some other financial assistance with, for example, parents paying for all of their fees but no living expenses, or all living costs and only some of their fees. Students not receiving a student allowance, or not having adequate financial support from parents are forced to borrow money. As well as borrowing from the GSL scheme, medical students can access loans privately through organisations such as MAS. 31% of students reported having a loan with the MAS to fund living expenses (49%), non-course-related travel (47%), a vehicle (32%), course costs (30%), course-related travel (26%), a computer (13%) and tuition fees (9%).

Opinions on debt. 90% of respondents felt it appropriate that students contribute towards the cost of their education through tuition fees, however 82% felt that the amount paid currently was too high. 79% felt that there should be a universal student allowance available to all tertiary students.

Impact of debt. 46% of students reported lack of money never impaired full participation in the medical course. Participation was impaired rarely for 31%, sometimes for 21%, and often for 2%. Sufficient money to pay for any course-related costs such as textbooks and equipment was available to 34%, while 64% felt they could pay for the basics but would buy more if they were able, and 2% felt that they could not afford to pay for basic course-related costs.

Frequency of worrying about debt (Table 4) was never (20%), rarely (10%), sometimes (34%), often (30%), and always (5%). There was a significant correlation between the average debt level for 6th year students about to graduate and the frequency with which they worry about their debt. The average debt for 6th year students who 'never' worried (14%) was $2500, while the average debt for 6th year students who 'always' worried (7%) was $86 750 ($p<0.001$). The impact that debt levels have on influencing decisions relating to careers in medicine is discussed in the subsequent paper.[7]

Table 4. How often medical students worry about their student debt.

	All students (%)	6th Year students (%)	6th Year students average debt
Never	20	14	$2 500
Rarely	10	10	$43 833
Sometimes	34	36	$65 944
Often	30	33	$74 947
Always	5	7	$86 750
			p<0.001 (ANOVA)

Discussion

This pilot study has provided logistic information and has shown that the questionnaire has good face validity and is acceptable to the target population. We avoided using a mail-out survey, preferring instead to run a census-style format with emphasis on protecting anonymity while retaining the ability to identify non-respondents. Its success was partly contingent on time being spent educating the students as to the purpose of the survey and enlisting their support. We are pleased with the response rates and believe the results portray an accurate picture of issues relating to medical student debt at one medical school. It must, however, be remembered that students are not randomly allocated to undertake their clinical training at the CSM and therefore the data from this pilot study should not be taken as indicative of the New Zealand medical students in general. Also, because of this, we have not examined the relationships between student demographic data and debt, preferring to leave such an analysis to the national survey.

As there was a 12% non-response rate and we have chosen to exclude the debts of those students with mortgages the total debt levels reported here underestimate the true value of total debt. Nonetheless, a combined total debt for 165 medical students of $7 775 000, the majority of which lies with the GSL scheme, is alarmingly high. Debt accumulates throughout medical school and the median debt of $70 000 for students about to graduate from the CSM confirms that obtaining a medical education in New Zealand has become expensive to the individual. The prospect of graduating with such a debt may already be deterring able students from considering medicine as a career.

The median debt level for 6th year students at the CSM is considerably higher than the $26 000 previously reported for final year students at the Auckland University Medical School and must be interpreted appropriately.[8] In 1999, at the time of the Auckland study, there was a large discrepancy in tuition fees charged between the Universities of Auckland and Otago. This occurred because the former had retained a single flat-fee across all faculties for longer than the University of Otago who earlier moved to a tiered fees schedule. The demise of the flat fees scheme at Auckland University has seen a rapid increase in tuition fees for medical students there and it is expected that the difference in median debt levels for students graduating from the two universities will soon disappear.

Concern that students are misappropriating GSL scheme money substantially appears unfounded. The vast majority of students are using GSL money to pay tuition fees, living expenses and course-related costs. For students to use GSL money for other purposes requires them to have access to sufficient funds to cover tuition costs and living costs from other sources such as parents, holiday work or other lending institutions. We know from previous work that, on average, a medical student would not earn enough through holiday work to cover 50% of current fees, without considering living expenses.[8]

It is concerning to find that only one third of 4th and 5th year students have access to full or partial student allowances. Parental income presumably makes the remaining two thirds of students ineligible. However, as we show in this study, only 9% of students receive full financial support from parents. It appears, therefore, that most medical students are forced to accumulate a large GSL debt, work part-time during term, and/or borrow from other lending institutions to cover the shortfall. We are concerned that term-time employment, during what is a time consuming and demanding course, may have a detrimental effect on study.

The majority of students support a universal tertiary student allowance to help offset living costs during study at university. We suggest that the current allowance system is failing to meet student needs and lack of access to sufficient funds places unnecessary pressure on students. Certainly over half of students report that their full participation in the medical course has been impaired at some time through lack of access to money, and inability of students to afford textbooks and other course materials places strain on institutional resources. This comes at a time when university faculties and libraries are being pressured to make cutbacks due to budget shortages.

The personal impact of high student debt is difficult to measure. Worry is a subjective emotion but could impact significantly on the learning experience. The demonstration

of a significant correlation between high levels of debt and time spent worrying about debt, is hardly surprising. However, this does represent the first publication of data showing a negative impact of debt on students in this country. A similar correlation has been demonstrated amongst dental students in the United Kingdom where those with higher debts were significantly more likely to report an adverse effect on their studies due to concerns about debt and the need to find work.[9] It was also suggested that worry about debt may affect concentration, motivation and commitment, and possibly contribute to poor health or depression.

Issues relating to student fees and debt are complex and poorly understood due to a lack of useful data and we hope that this paper will generate informed discussion. In simple terms, it is our opinion that high student debt levels arise because under-funding of tertiary education is being passed directly on to students through high tuition fees. The effects are not yet fully apparent but data from this pilot study suggest they could be significant. Students do not have the ability to earn sufficient funds during holidays and parents are unable to provide support to cover high tuition fees along with living expenses. This is further compounded by an inability to access student allowances. Consequently students are forced to borrow large sums to complete medical training.

If student fees and debts continue to rise, is there a risk that medicine will become a career not for the able, but for those willing to accept a burden of debt or who are affluent enough to afford it? Does a level of debt exist above which training in medicine is no longer economically justifiable to the individual? We suggest it is time that an analysis was undertaken to determine the value of a medical degree, not just in monetary terms but also in the context of the health needs of our society. It is time to consider what represents a reasonable level of debt for students to take on, and what represents a burden of debt which impacts negatively on the individual and society in general.

Acknowledgments. We thank Professor Andrew Hornblow, Professor John Campbell and Dr Elizabeth Wells for advice and encouragement, and the medical students at the CSM and around New Zealand who have supported this study.

Correspondence. Dr Tim Wilkinson, Christchurch School of Medicine and Health Sciences, Christchurch. Fax: (03) 337 7975; email: tim.wilkinson@chmeds.ac.nz

1. Fergusson DM, Woodward LJ, Horwood LJ. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early childhood. Psychol Med 2000; 30: 23-39.
2. Saunders JB, Aasland OG, Babor TF et al. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption – II. Addiction 1993; 88: 791-804.
3. Richman JA, Flaherty JA, Rospenda KM, Christensen ML. Mental health consequences and correlates of reported medical student abuse. JAMA 1992; 267: 692-4.
4. Silver HK, Glicken AD. Medical student abuse. JAMA 1990; 263: 527-32.
5. Wolf TM, Randall HM, Von Almen K, Tynes LL. Perceived mistreatment and attitude change by graduating medical students: a retrospective study. Med Educ 1991; 25: 182-90.
6. Harnett Sheehan K, Sheehan DV, White K et al. A pilot study of medical student 'abuse': student perceptions of mistreatment and misconduct in medical school. JAMA 1990; 263: 533-7.
7. Gill D, Palmer C, Mulder R, Wilkinson T. Medical student career intentions at the Christchurch School of Medicine. The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) Survey of Medical Students pilot study results. Part II. NZ Med J 2001; 114: 464-7.
8. Collins MG. Medical students and debt: a survey of medical students at the School of Medicine, University of Auckland. NZ Med J 1999; 112: 123-6.
9. Hoad-Reddick G, Heath JR, Loughnane P et al. Student debt: an inevitable problem? Br Dent J 1996; 181: 276-8.

Medical student career intentions at the Christchurch School of Medicine. *The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) survey of medical students* pilot study. Results Part II.

Denzil Gill, *Trainee Intern;* **Claire Palmer**, *Trainee Intern;* **Roger Mulder**, *Associate Professor, Department of Psychological Medicine;* **Tim Wilkinson**, *Associate Dean (Undergraduate Education), Christchurch School of Medicine and Health Sciences, Christchurch.*

Abstract

Aims. To record career preferences for medical students at the Christchurch School of Medicine and Health Sciences and investigate factors, including student debt, that might influence career decisions.

Methods. A questionnaire, *The New Zealand Wellbeing, Intentions, Debt, and Experiences (WIDE) Survey of Medical Students*, was developed and administered to all 204 medical students at the Christchurch School of Medicine and Health Sciences. The survey included questions relating to preferred career intentions and factors influencing career decisions, including the decision to leave New Zealand to practise medicine.

Results. The response rate was 88%. 80% intend to practise medicine in New Zealand immediately after graduation, however 82% indicated that they would leave within two years of graduation. Financial opportunities overseas and level of debt were the strongest motivating factors to leave. Repayments towards student loans and increased salaries were factors that might retain people in New Zealand. Medical and surgical specialities were the most popular career choices. Personal interest was the strongest motivator for career choice. Practising in a rural community was not popular.

Conclusion. Debt is one of a number of important factors influencing medical student career decisions including the decision to leave New Zealand. Initiatives addressing debt may be useful in retaining medical graduates in this country.

NZ Med J 2001; 114: 465-7

Graduating with a medical degree provides access to a large number of career pathways created by increasing specialisation of medical practice. The factors influencing career choice are complex. Intrinsic factors, such as the interests and experiences of the individual, mix with extrinsic factors such as economic rewards and lifestyle considerations. Career considerations begin early during undergraduate medical training and are influenced by role models and educational experiences.[1,2] High levels of debt accumulated during basic medical training may discourage people from pursuing less lucrative areas of medicine.[3,4] This is of particular concern for New Zealand at a time when there is a shortage of medical practitioners in a number of areas including rural general practice.

Debt accumulated while studying towards a tertiary qualification is also widely touted as contributing to the emigration of graduates in many professional areas. This 'brain-drain' includes loss to overseas countries of New Zealand-trained medical practitioners. Gaining registration as a medical practitioner is most easily achieved by practising in New Zealand or Australia in the first year after graduation. Thereafter, medical graduates have traditionally left New Zealand to travel and gain experience before returning to practise for the bulk of their career. There is, however, increasing concern that medical graduates are leaving New Zealand earlier and staying away longer, or indefinitely, and that this decision is being driven by high debt levels. Emigration of medical graduates has potentially negative consequences for ongoing provision of affordable and accessible health care in this country, and may result in increasing reliance on overseas trained doctors.

There has been no attempt to quantify the impact of educational debt on shaping the choice of career of New Zealand medical students who are a relatively small, easily defined population, which is expected to amass a large debt during the long, expensive undergraduate course. *The New Zealand Wellbeing, Intentions, Debt, and Experiences (WIDE) Survey of Medical Students* is a questionnaire-based survey developed to collect comprehensive information on a range of subjects relevant to medical students in New Zealand.[5] We present results from a pilot study conducted at the Christchurch School of Medicine and Health Sciences (CSM).

Methods

A detailed description of the topics covered, and the development and administration of *The New Zealand WIDE Survey of Medical Students* was given in the preceding paper.[5] Statistical analysis of debt by different categories was by analysis of variance.

Results

Surveys were completed by 179 of 204 medical students studying at the CSM in 2000 (88%). The response rates for the individual years were 4th year 94%, 5th year 86% and 6th year 84%. The previous paper included information on demographic characteristics, and debt levels of survey participants.[5]

Emigration intentions after graduation. Table 1 shows the country in which students intend to practise medicine immediately after graduation and for the bulk of their career. The majority (80%) indicated they would remain in New Zealand immediately after graduation, 9% would practise in Australia, 5% would practise in Malaysia, 1% would move to the United Kingdom and 5% were undecided. 46% of students indicated that they wanted to practise in New Zealand for the bulk of their medical career. 7% will practise long-term in Australia, 6% in Malaysia, 4% in the United Kingdom, and 4% in another country. A large proportion (34%) had not decided the preferred country of practice for the bulk of their career.

Table 2 shows how soon after graduation students intend to leave New Zealand to practise medicine. 15%indicated that they would leave immediately, 47% would leave at the end of one year, and a further 20% would leave at the end of two years, with 11% of students remaining undecided. Overall 82% indicated they would leave New Zealand within two

years of graduation. While not statistically significant, in this pilot study, there was a clear trend for students with higher debt levels to indicate that they would leave New Zealand earlier ($p<0.15$).

Table 1. Students' preferred country of practise immediately after graduation, and for the bulk of their career.

Preferred country of practise medicine	Immediately after graduation (%)	Bulk of medical career (%)
New Zealand	80	46
Australia	9	7
Malaysia	5	6
United Kingdom	1	4
Canada	0	1
USA	0	1
Pacific Islands	0	1
Other	0	1
Undecided	5	34

Table 2. The length of time after graduation when medical students are considering leaving New Zealand to practise medicine.

Time following graduation	Respondents (%)
Immediately	15
1 year	47
2 years	20
3 years	3
4 years	0
5 years	1
>5 years	2
Undecided	11
Never	1

Using a 5-point scale, students were asked to indicate how strong a number of factors were in motivating them to leave New Zealand to practise medicine. The percentage of students reporting each factor as 'very important and a strong motivator to leave New Zealand' were: financial opportunities overseas (44%), level of debt (40%), working conditions overseas (36%), overseas travel (32%), job or training opportunities overseas (24%), family considerations (13%), returning to home country (7%), and research opportunities (3%). When these factors were compared to the average debt levels for 6th year students at the CSM, students with higher debts were found to be significantly more likely to indicate that their level of debt was a very important factor strongly motivating them to leave New Zealand ($p<0.001$). Students with higher debts were also significantly more likely to be motivated to leave New Zealand to pursue financial opportunities overseas ($p<0.05$).

The use of incentives to retain New Zealand-trained graduates in this country has been touted as one solution to postgraduate emigration. Using a 5-point scale, students were asked to indicate how strong a number of factors would be as an incentive to remain in New Zealand. The percentage of students reporting each factor as 'very important and a strong incentive to stay in New Zealand' were: student loan repayments (45%), increased salaries (43%), training opportunities (36%), shorter working hours (34%), bonded training (21%), increased morale in hospitals (19%) and increased spending on healthcare (15%). There was a significant correlation between level of debt for a 6th year student and contributions towards loan repayments being regarded as a strong motivator to remain in New Zealand ($p<0.01$).

Career intentions. Table 3 shows the career intentions for medical students at the CSM. Students were asked to nominate their top three career choices in order of preference from a list of options. First choice careers were an internal medicine speciality (25%), a surgical speciality (22%), general practice (16%), paediatrics (10%), emergency medicine (9%), and obstetrics and gynaecology (5%). A career outside of medicine was the first choice for 3% with the same proportion preferring a career in radiology, or anaesthesia and intensive care. Only 1% of students indicated that their first choice of medical career would be psychiatry, public health, or research. No student indicated a career intention in academic medicine/teaching, pathology, or management as their first choice. Of note 11% of students indicated a career outside of medicine as one of their three choices overall. Although not statistically significant, there was a worrying trend for 6th year students with higher debts to exclude general practice from their top three choices. Students who excluded general practice as a career choice had an average debt of $66 429 while those who included general practice had an average debt of $59 292 ($p<0.29$).

Table 3. Career intentions.

Career	1st choice (%)	2nd choice (%)	3rd choice (%)	Overall (%)
Internal Medicine	25	21	9	55
Surgery	22	9	5	35
General Practice	16	15	17	47
Paediatrics	10	9	14	32
Emergency Medicine	9	14	12	35
Obstetrics and Gynaecology	5	9	5	18
Radiology	3	6	4	13
Anaesthesia or Intensive Care	3	5	7	14
Career outside of Medicine	3	2	7	11
Psychiatry	1	2	4	7
Public Health	1	2	4	6
Research	1	2	3	6
Academic/Teaching	0	3	7	10
Pathology	0	1	1	2
Management	0	1	1	2

Using a 5-point scale, students were asked to indicate how strong a number of factors were in influencing their choice of career. The percentage reporting each factor as 'very important and a strong influence on their career choice' were: interest (75%), lifestyle options (42%), family (29%), intellectual challenge (28%), financial opportunities (23%), level of debt (16%) and prestige (6%). Practising medicine in a rural New Zealand community was not a popular career choice. The majority (59%) indicated that it was unlikely (35%) or that they would definitely not (24%) practise in a rural New Zealand community. Only 1% of students indicated that they would definitely practise in a rural community, while 10% indicated that it was likely that they would practise in a rural community. The remainder (29%) were undecided. The stated likelihood of practising in a rural community was not related to level of debt.

Discussion

Speculation has existed for some time as to the contribution of high student debt levels to the emigration of junior doctors from New Zealand.[6] Graduates from New Zealand medical schools can undertake their post-graduation 'probationary' year to gain registration, in either New Zealand or Australia. 15% of students in this study indicated that they will leave the country immediately after graduation without gaining registration here. However, the majority have indicated they intend to begin their working medical career in New Zealand. Of more concern is the fact that 82% intend to be practising medicine overseas within two

years of graduation and less than half are confident that they intend to practise in New Zealand for the bulk of their career. Not only does this represent a huge loss of New Zealand-trained doctors, but also the loss of an enormous amount of taxpayer dollars spent on training that cannot be recouped through services. Regrettably absence of historical data for comparison means we are unable to comment as to whether these figures represent a change in the pattern of medical graduate emigration since the arrival of student fees and loans.

The decision to leave is multifactorial and could easily change over time. However, financial opportunities overseas are clearly playing a major role in luring people from this country. We provide the first clear evidence that those medical students with higher debts are significantly more motivated to leave the country because of their debt and would leave to pursue financial opportunities. Retention of New Zealand medical graduates is clearly a significant problem that needs to be addressed.[7] Not surprisingly repayments towards student loans and higher salaries were identified as incentives that would motivate students to stay in New Zealand after graduation. Loan repayment incentives would need to be of a significant size since the median CSM 6th year student debt of $70 000 would be expected to earn around $4900 in interest alone in the first year after graduation. Such an initiative has recently been announced by Grey Hospital (West Coast, South Island) where a significant lump sum will be paid directly off the student loan of a medical graduate in return for nine months continuous service.

Bonded training[7] is another incentive scheme proposed as a means for retaining medical practitioners (submission by Christchurch Medical Students Association to the Education and Science Committee; 2000). In our study only 21% of students felt that this would be a strong motivator for them to stay in New Zealand, however the example of bonded training given in the survey questionnaire was 'a scholarship towards fees in exchange for a guarantee of work for a set number of years in a particular hospital after graduation'. A bonded training scheme could take many different forms, but ideally developed through consultation with medical students and medical graduates. Bonded training might alleviate difficulties that some smaller provincial hospitals have in attracting and retaining medical staff.

The decision pathway leading a medical student to a particular career is complex and poorly understood. It is reassuring to find that personal interest is a strong motivating factor influencing career choice for three quarters of students at the CSM. Similar results were reported in the United States.[8] Studies investigating the effect of debt on career decision-making have yielded mixed results. Some show level of debt to have no effect on career choice, while others have found that students with high debt are significantly less likely to choose specialities such as general practice.[3,4,8-11] Asking whether or not level of debt influences career choice is too simplistic. Instead, it appears more appropriate to consider the conditions and context in which debt becomes a strong motivator influencing the career decisions of an individual. Studies employing a multivariate analysis have demonstrated complex relationships between debt and career choices.[8-10] Our study has shown that for 16% of students, level of debt is a strong motivator influencing their career choice. In this pilot study we have not attempted to look at covariates, such as demographic data and debt levels, of those students who have identified level of debt as a strong motivator. We believe there is a risk of producing misinformation with such an analysis on a study of this size. However, this will clearly be an area of interest when the nation-wide study is analysed.

It is known that students start considering career decisions early in their medical training and that role models, both positive and negative, have a significant impact.[1,2] A number of areas, for example psychiatry, pathology, and public health, are unpopular with students and clearly this has serious implications for maintaining the future provision of services in these areas. Workforce planners would be wise to start looking at the reasons behind this unpopularity. General practitioners account for around 40% of the medical workforce but only 16% of students at the CSM have identified general practice as their first choice of career. A large number listed general practice as their second or third choice, although these views may well change over time.

Working in a rural New Zealand community is also an unpopular career choice. New Zealand is currently faced with a shortage of general practitioners particularly in rural communities. We suggest that barriers and incentives for these decisions should be explored. This is particularly important for female students who are already underrepresented in almost all clinical specialities and for whom there is a need for increased exposure to appropriate role models.[12]

This paper represents the first attempt to quantify and discuss some of the issues involved in career choices of New Zealand medical students. While we intend to publish an in depth analysis based on the nation-wide survey of medical students, we hope this paper facilitates informed discussion on these important matters.

Acknowledgements. We thank Professor Andrew Hornblow, Professor John Campbell and Dr Elizabeth Wells for their advice and encouragement, and the medical students at the CSM and around New Zealand who have supported this study.

Correspondence. Dr Tim Wilkinson, Christchurch School of Medicine and Health Sciences, Christchurch. Fax: (03) 337 7975; email: tim.wilkinson@chmeds.ac.nz

1. Babbott D, Baldwin DC Jr, Jolly P, William DJ. The stability of early speciality preferences among US medical school graduates in 1983. JAMA 1988; 259: 1970-5.
2. Osborn E. Factors influencing students' choices of primary care or other specialities. Acad Med 1993; 68: 572-4.
3. Rosenthal MP, Diamond JJ, Rabinowitz HK et al. Influence of income, hours worked, and loan repayment on medical students' decision to pursue a primary care career. JAMA 1994; 271: 914-7.
4. Rosenthal MP, Marquette PA, Diamond JJ. Trends along the debt-income axis: implications for medical students' selections of family practice careers. Acad Med 1996; 71: 675-7.
5. Gill D, Palmer C, Mulder R, Wilkinson T. Medical student debt at the Christchurch School of Medicine. The New Zealand Wellbeing, Intentions, Debt and Experiences (WIDE) Survey of Medical Students pilot study results part I. NZ Med J 2001; 114: 461-4.
6. Gill D, Quinn V, Palmer C. Medical student debt. NZ Med J 1999; 112: 302.
7. Brownlie BEW. Retention of junior medical officers. NZ Med J 2000; 113: 404.
8. Kassebaum DG, Szenas MA, Schuchert MK. Determinants of the generalist career intentions of 1995 graduating medical students. Acad Med 1996; 71: 197-209.
9. Kassler WJ, Wartman SA, Silliman RA. Why medical students choose primary care careers. Acad Med 1991; 66: 41-3.
10. Colquitt WL, Zeh MC, Killian CD, Cultice JM. Effect of debt on US medical school graduates preferences for family medicine, general internal medicine, and general pediatrics. Acad Med 1996; 71: 399-411.
11. Sparr IL, Pryor KC, Simon W. Effect of debt level on the residency preferences of graduating medical students. Acad Med 1993; 68: 570-2.
12. Poole PJ. Room for more women in clinical specialities. NZ Med J 2000; 113: 105-7.

Debt on graduation, expected place of practice, and career aspirations of Auckland Medical School students

Gregory O'Grady, ***Medical Student, University of Auckland, Auckland;*** **Julie Fitzjohn,** ***Trainee Intern, University of Otago, Dunedin.***

Abstract

Aims. To determine the debt level that current Auckland medical students expect to graduate with, and evaluate this debt in the context of their career aspirations and intended place of practice.

Methods. Simple check-box and fill-in-the-blank surveys were distributed to Auckland University medical students in Years 1 through to 5 during their second week of scheduled lectures in March 2000. Students were asked to provide demographic details, then complete sections on debt and career aspirations.

Results. 70% of Auckland medical students participated. Average expected debt was between $60 000 to $70 000. Predicted size of graduation debt was significantly related with plans to practice medicine overseas, and this trend was especially strong among females. In addition, Maori and Polynesian students bear a disproportionate level of the student debt burden compared to Pakeha and Asian groups. 77% of students indicated a preference for working in private or hospital specialty work.

Conclusions. Student debt will have major effects on the composition of the New Zealand medical workforce over coming years. More attention must be paid to the national picture of medical student indebtedness if adequate workforce planning is to be possible.

NZ Med J 2001; 114: 468-70

The large burden of debt faced by young medical graduates in New Zealand has been predicted to have major social and medical workforce implications for New Zealand.[1] This burden is commonly held to be a driving force behind junior doctors striking for improved pay and working conditions, and increasing numbers emigrating in search of greater remuneration.

High debt levels have also been hypothesised to decrease the number of medical students interested in specialities with lower remuneration.[1] Certainly, American research indicates that this is a probable effect.[2]

The effects of changing workplace preferences in a generation of graduating students could extend well beyond junior doctor years, and the full impact would not be felt for some time.

This study aimed to ascertain the level of debt that current Auckland medical students expect to graduate with, and attempted to place this debt in the context of career aspirations and intended place of practice.

Methods

A survey of current Auckland School of Medicine undergraduate students was conducted in the second week of the University's academic year (2000). Surveys were distributed to students in Years 1 through to 5 during regularly scheduled lectures. Trainee Interns (sixth year medical students) were not surveyed due to a tight timeframe and clinical placements. International full fee-paying students were excluded.

The surveys took the form of simple check box and fill-in-the-blank questions. Students were asked to provide demographic information, including sex, ethnic grouping, country of birth, country of high school attendance (majority and final year), and route of entry into the medical school. Students then completed sections on debt and career plans post-graduation. For the debt projections, students were instructed to assume tuition fees and living costs remained constant. Expected debt size was asked for in groupings of $10 000, and what proportion would be borrowed under the student loan scheme. They were then asked likely career ambition, as a selection of: general practice; hospital-based specialty; privately-based specialty; research/academic; health management; or other. A further series of questions asked where they expected to undertake further house-surgeon/registrar training and practice, as a selection of: only overseas; mainly overseas; mainly in New Zealand; or only in New Zealand.

Statistical analyses were performed using SPSS. p-values of <0.05 were regarded as statistically significant.

Results

Response rate. There were 407 respondents, representing approximately 70% of the Auckland medical student body (excluding international students) (Table 1). 249 (61.2%) respondents were of New Zealand European/Pakeha ethnicity, 27 (6.63%) Maori or Pacific Island, 90 (22.1%) Asian, 40 (9.8%) Other, and 1 unspecified. Not all students answered all questions in the survey.

Table 1. Response rate by year of study.

Year of study	Number of respondents	Approximate response rate
Year One	64	73%
Year Two	113	80%
Year Three	94	75%
Year Four*	40	34%
Year Five	96	90%
TOTAL†	407	70%

Due to a tight timeframe and clinical placements, *one group of fourth year students only and †no sixth year students were able to be sampled.

Expected debt on graduation. Median projected debt range was $60 000 to $69 999, with 8.9% of students expecting debts of greater than $100 000 (Figure 1). 58.1% of students in the pre-clinical years (Years 1-3) estimated total debt in excess of $60 000, compared with 36.0% (p<0.001) of those in the second half of the degree program, who initially paid lower fees. Most students (79.4%) indicated that 60% or more of their estimated debt would be in the form of Student Loan.

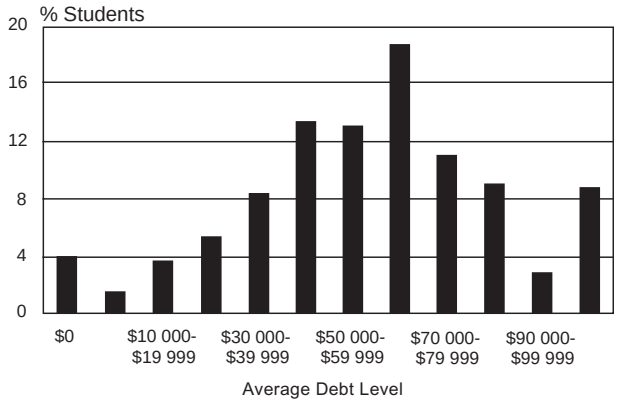

Figure 1. Average debt level expected on graduation.

Likelihood of practicing overseas. 103 of 398 students (25.8%) expected to practice mainly or only overseas. Likelihood of practising overseas was significantly related to size of debt (p=0.035) with 31.3% of students with debt of $60 000 or more planning to mainly or only practice overseas on graduation, compared with 20.3% of those with debts of less than $60 000. (Figure 2).

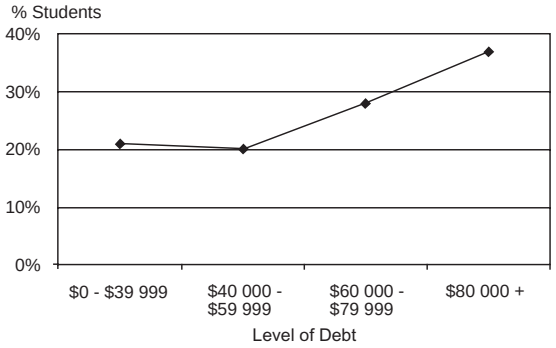

Figure 2. Level of debt versus percentage of students expecting to practice overseas (p=0.035).

Approximately the same proportion of males and females expected to practice overseas. However, women showed a statistically significant trend to being more likely to practice overseas in relation to their debt size (p=0.002), while males did not (p=0.56) (Table 2).

Ethnicity and Debt. Maori and Pacific Island students in this study were significantly more likely than all other ethnic groups, (70.4% compared to 49.3%) to estimate a loan exceeding $60 000 (p=0.035). Besides Maori and Pacific Island students, 51.0% of New Zealand European/Pakeha students expected debts greater than $60 000, compared to 40.0% of Asians and 60.0% of other ethnic groupings (Figure 3).

Debt and career aspiration. No relationship was demonstrated between size of loan and career aspiration. However, very few medical students demonstrated interest in the generally lower paid careers such as general practice (13.6%) and research/academia (2.8%), compared to hospital/private practice (77.0%). 6.5% recorded interest in other medical careers (Figure 4).

Discussion

Auckland medical students currently expect to graduate from medical school with an average debt of $60 000 to $70 000. Expected debt was more likely to be in excess of $60 000 among pre-clinical students. Maori and Polynesian students are bearing a disproportionate level of the student debt burden when compared to Pakeha and Asian groups. The predicted size of graduation debt was positively correlated with plans to practice medicine overseas, with women owing high debt having a strong preference towards servicing this overseas. 77.0% of students indicated a preference for working in private or hospital specialty work.

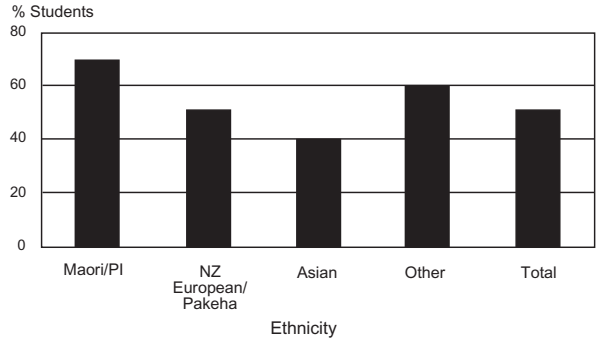

Figure 3. Students with a debt greater than $60 000. p heterogeneity = 0.02.

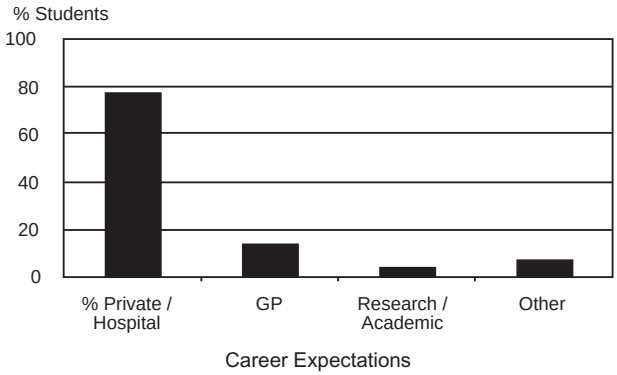

Figure 4. Career aspirations of medical students.

Interpretation of these data requires some caution. Whilst the study achieved a representative sampling of Auckland medical students, they make up less than half of all medical students in New Zealand. Our cohort are not, therefore, necessarily representative of New Zealand medical students as a whole. Furthermore, this study reports student expectation, rather than actual outcome, at and after graduation. It is possible that some students may have under or overestimated the financial commitments of their course. Students were also asked to assume that fee levels remained constant, whereas in reality this is uncertain. Furthermore, and especially for pre-clinical students, it is possible that student attitudes to type and place of practice may be influenced later in their course of study or after their graduation.

This study replaces speculation with fact regarding the negative consequences that a high debt burden is having on the New Zealand health workforce. Collins reported early in 1999 that the average debt for Auckland medical students was $25 000.[3] The increase in debt levels in this study is due

Table 2. Loan vs expectation to practice overseas (by sex).

Predicted size of loan – females only*	N	% to practice overseas	Predicted size of loan – males only*	N	% to practice overseas
$0-$39 999	52	19.2%	$0-39 999	40	22.5%
$40 000-$59 999	60	13.3%	$40 000-$59 999	45	28.9%
$60 000-$79 999	64	25.0%	$60 000-$79 999	56	30.4%
$80 000+	45	44.4%	$80 000+	36	27.8%
Total	221	24.4%	Total	177	27.7%

*p trend females students: p=0.002; male students: p=0.56.

principally to the approximately 300% increase in medical course fees at the Auckland School of Medicine from 1998 to 2000. Otago medical students have been paying fees at similarly high levels (around $10 000 per year) since the early 1990s.

This study has confirmed popular opinion regarding high debt driving the 'brain drain', a major contributor to the current medical workforce crisis. Fears that the student loan scheme adversely affects women greater than men[4,5] are also validated. This is especially disconcerting given that greater than 50% of the present intake is female. It is possible that publicity at Auckland Medical School regarding special issues facing women in medicine may have contributed to this strong trend.

The high debt burden on Maori and Pacific Island students is born out by the figures in this study. It has been suggested that this is to have a negative effect on the provision of health for Maori and Polynesian communities.[1]

Provision of good quality care in the community is also threatened by the fact that only 13.6% of Auckland medical students have indicated a desire to work in primary care. Experience suggests the proportion of a medical class normally expected to proceed to general practice is approximately one third. It appears that the vast majority of Auckland medical students would prefer to work in specialties, where the level of remuneration is generally perceived to be greater.

This study clearly shows that student debt will have major effects on the composition of the New Zealand medical workforce over coming years.

More attention must be paid to the national picture of medical student indebtedness if adequate workforce planning is to be possible. Planning would be further assisted by an adequate evaluation of the levels and effect of debt after graduation. Further major unanswered questions relate to how the financial stress of high debt levels affects the welfare and wellbeing of medical students. There is a poverty of such data available. A greater understanding of the full effects of high fees and debt on medical students and graduates is needed.

Acknowledgments. We thank Richard Pole, President NZMSA, for comments on the draft, and those staff of the Faculty of Medical and Health Sciences at Auckland University who assisted in the preparation of this manuscript. Administration of the survey was assisted by the AUMSA executive, particularly past presidents Celine Fris and Yezdi Mistry and we thank Auckland Medical students who participated.

Correspondence. Gregory O'Grady, Faculty of Medicine and Health Sciences, University of Auckland, Private Bag 92019, Auckland. Fax (09) 358 3467; email: gog@xtra.co.nz

1. Mackay P. Medical student debt – de facto workforce planning. NZMA Newsletter, 1999. 25 June.
2. Bland CJ, Meurer CN, Maldono G. Determinants of primary care specialty choice: a non-statistical meta-analysis of the literature. Acad Med 1995; 70: 620-41.
3. Collins MG. Medical students and debt: a survey of students at the School of Medicine, University of Auckland. NZ Med J 1999; 112: 123-6.
4. Poole PJ. Room for more women in clinical specialties. NZ Med J 2000; 113: 105-7.
5. Tracey M. Women in general practice in New Zealand. NZ Med J 1999; 112: 50-2.

Smoke gets in your eyes: smoking and visual impairment in New Zealand

Graham A Wilson, *Ophthalmology Fellow, Royal Victoria Hospital, Belfast, Northern Ireland;* **Amanda P Field,** *Optometrist, Rangiora Optometrists, North Canterbury;* **Nick Wilson,** *Public Health Physician, Wellington.*

Abstract

Aim. To estimate the burden of visual impairment attributable to smoking in New Zealand.

Methods. Review of Medline-indexed literature on the relationship between smoking and eye disease and use of relevant New Zealand morbidity and smoking prevalence data.

Results. The international literature indicates there is strong evidence that smoking is a major cause of eye disease and blindness – particularly for cataracts and age-related macular degeneration (AMD). Using the most relevant international risk estimates, we estimated that 1335 people who are registered blind in New Zealand have AMD attributable to current and past smoking (26.8% of all AMD cases in the 55 years plus age-group). It was also estimated that 31 of the registered cases of visual impairment due to cataract and 396 hospitalisations for cataract surgery per year, are attributable to smoking. While subject to various methodological limitations, these estimates are probably under-estimates of the true burden of eye disease attributable to smoking.

Conclusions. Smoking is a major cause of untreatable visual impairment and also a significant reason for cataract surgery in New Zealand. There is a need for more intensive tobacco control activities in New Zealand.

NZ Med J 2001; 114: 471-4

While there has been substantial work on the impact of smoking on health in New Zealand,[1] there has been no assessment of the burden of visual impairment attributable to smoking in this country. This is despite such work having been undertaken in Australia.[2]

Methods

A Medline search using key words 'smoking', 'tobacco', 'macular', 'cataract', 'ophthalmology', and 'New Zealand' was undertaken for the years 1966 to October 2000. Anonymous blind registration data for all New Zealand as at October 2000 was obtained from the Royal New Zealand Foundation for the Blind (RNZFB). Those registered with the RNZFB have acuity tests of no better than 6/24 using the 'best' eye with corrective lenses. Data on rates of cataract surgery were obtained[3] along with smoking prevalence data from the 1996 Census.

Results

Age-related macular degeneration (AMD) and smoking. The results from six large population studies in four different countries all indicate that smoking is significantly associated with an increased risk of AMD (Table 1). Furthermore, these studies indicate a lower risk for former smokers compared to current smokers and some show a dose response relationship with pack-years smoked. A cross sectional study of 1000 people also identified smoking as a risk factor for AMD[4] but one study of only 430 people did not.[5] All of the case-control studies identified (of those involving over 50 cases), show that smoking is a significant risk factor for AMD.[6-8] A review by Solberg et al[9] suggests that smoking contributes to AMD by increasing oxidative stress and lipid peroxidation as well as by reducing plasma levels of antioxidants.

To estimate the impact of smoking on AMD in New Zealand, we used the Australian data in Table 1, on the grounds that the population in Australia is more similar to that of New Zealand than for the other countries in which studies have been done. For example, in terms of the tobacco consumption per adult and per smoker, New Zealand is much closer to the Australian pattern than the USA or the Netherlands.[1]

Of the 4984 New Zealanders registered blind with AMD in the 55 year and over age-group, it was estimated that 1335 cases (26.8%) were attributable to smoking (Table 2). The great majority of this population (90.4%) have AMD in both eyes and hence are seriously disabled. Of those with AMD from smoking, 65.6% are women.

Cataracts and smoking. The six largest population studies examining the relationship between smoking and cataracts have all shown significant associations (Table 1). The other smaller population studies identified also showed a significant relationship between smoking and risk of cataract.[10-13] Furthermore, two case-control studies have also shown this relationship[14,15] but another one did not.[16] The association between smoking and cataracts has also been found among people with type II diabetes.[17] In general these studies on smoking and risk of cataract indicate that the risk is greatest for heavier smokers, current smokers and those who had smoked more cigarettes and for a longer duration.

Smoking probably induces cataract formation through oxidative damage and heavy metal accumulation in the lens.[9] While some smoking-related damage to the lens may be reversible, smoking cessation reduces the risk of cataract primarily by limiting the total dose-related damage to the lens.[18]

To estimate the impact of smoking on cataracts in New Zealand, we used the most conservative results out of the two Australian studies (ie, that for the Blue Mountains Eye study - Table 1). This was on the grounds that the epidemiology of cataracts is more likely to be similar between these two countries than between New Zealand and the USA or France (ie Australia has a more similar smoking pattern and similarly high levels of incident ultraviolet light). The risk estimate from the Blue Mountains study is also more conservative than those from the two largest US studies and the French study detailed in Table 1.

Of the 326 New Zealanders registered blind with cataracts in the 55 year and over age-group, it was estimated that 31 (9.5%) were visually impaired due to smoking (Table 2). Most of this population (60%) have cataracts in both eyes and hence are seriously disabled. Furthermore, there were an estimated 396 hospitalisations for cataract surgery in public hospitals in 1996/1997 (13.1% of all the operations estimated to be for nuclear and posterior subscapular cataracts).

Discussion

The international literature indicates that there is strong evidence that smoking is a major cause of eye disease and

Table 1. Results of major studies that examined the association between smoking and age-related (AMD) or cataracts.

Population/ setting (reference)	Risk associated with smoking (relative to never smoking)		Comments
	Odds ratio (OR) or relative risk (RR)	95% confidence interval	
Age-related macular degeneration			
6174 adults (Rotterdam, The Netherlands)[22]	6.6	2.8 to 15.9	For current smokers. Former smokers had a 3.2-fold increased risk of neovascular AMD. The data also indicated a dose response relationship.
3654 adults (Blue Mountains, Australia)[23]	3.9	2.1 to 7.4	For current smokers and late AMD. Having ever smoked was also significantly associated with late AMD (OR = 1.8).
2196 adults (Sete, France)[24]	3.6	1.1 to 12.4	For current smokers. For former smokers OR = 3.2. Some evidence for a dose response gradient. The risk of late AMD remained increased until 20 years after cessation of smoking.
4771 adults (Beaver Dam, Wisconsin, USA)[25]	2.5 (females) 3.3 (males)	1.0 to 6.2 1.0 to 10.5	For current smokers.
21 157 male physicians (USA)[26]	2.5	1.6 to 3.8	For current smokers (20+ cigarettes/day). Prospective cohort study.
31 843 women (multistate, USA)[27]	2.4	1.4 to 4.0	For current smokers (25+ cigarettes/day). Prospective cohort study with 12 years of follow-up. Also considered former smokers (RR = 2.0).
Cataracts			
17 824 male physicians (USA)[28]	2.2	1.5 to 3.4 (p<0.001)	Nuclear cataracts (current smokers). Prospective cohort study. For posterior subcapsular (PSC) cataracts RR = 3.2.
4503 adults (Victoria, Australia)[29]	1.9	1.5 to 2.4	Nuclear cataracts (smoked for >30 years compared to non-smokers or smoked <=30 years).
2468 adutls (Sete, France)[30]	1.9	1.0 to 3.7	Nuclear cataracts (current smokers).
50 828 nurses (multistate, USA)[31]	1.6	1.2 to 2.3 (p for trend = 0.02)	Age-related cataract extraction (smokers of at least 65 pack years). Prospective cohort study. For PSC cataracts RR = 2.6.
3654 adults (Blue Mountains, Australia)[19]	1.3	1.1 to 1.6	Nuclear cataracts (ever cigarette smokers). For PSC cataracts OR = 1.3.
4926 adults (Beaver Dam, Wisconsin, USA)[32]	1.1	1.0 to 1.1	Nuclear cataracts (for 10 pact-years of smoking). For PSC cataracts OR = 1.1.

blindness – particularly cataracts and AMD. Using the most relevant international risk estimates and New Zealand morbidity and smoking prevalence data, this analysis estimated that 1335 people who are registered blind in New Zealand have AMD attributable to current and past smoking (26.8% of all AMD cases in the 55 plus age-group). It was also estimated that 31 registered cases of visual impairment due to cataract and 396 hospitalisations for cataract surgery per year are attributable to smoking. Of particular concern is that most visual impairment attributable to smoking is untreatable. The only proven treatments for AMD are laser photocoagulation and photodynamic therapy but these are only used in a minority of patients. These treatments are largely limited to stabilising the condition and preventing further loss of vision.

This study is a first attempt to estimate the impact of smoking on eye disease and visual impairment in New Zealand. It is however, limited by its reliance on risk estimates from population studies in Australia (which has slightly different patterns of smoking and exposure to other potential risk factors such as ultraviolet light). While, these studies produced odds ratios that were adjusted for potential confounders and effect modifiers, residual confounding may still exist eg, for alcohol and cataracts.[19] Furthermore, these studies have not produced age-group specific odds ratios which might have allowed for more precise calculations in Table 2. Nevertheless, our analysis probably substantially underestimates the burden of eye disease from smoking for the following reasons. First, some visually impaired people in New Zealand may not be registered with the RNZFB. For example, membership of Maori and Pacific peoples has increased by 14% in 2000 and is expected to increase further as a result of the new development of dedicated services to these communities. While the Foundation maintains an up-to-date and accurate database, it is still dependent on voluntary referral from health professionals. Also of note, is that the definition of blindness used by the Foundation (visual acuity of no better than 6/24 using the best eye) is not as restrictive as that used by the World Health Organization (ie less than 3/60 in the best eye). Second, the analysis only

Table 2. Estimates of age-related macular degeneration (AMD), cataracts, and cataract surgery attributable to smoking in New Zealand.*

Sex, Age (years)	No. of cases (AMD, cataracts†/ cataract surgery)	Smoking pravalence‡		Estimated risk of AMD or cataracts in smokers compared with never smokers (odds ratio)§		Attributable risk (in former + current smokers)**	Cases of visual impairment from smoking††
		Former	Current	Former	Current		
Age-related macular degeneration							
F 55-59	16	22.3%	18.0%	1.2	5.6	49.6%	8
F 60-69	69	24.8%	14.9%	1.2	5.6	45.4%	31
F 70-79	690	24.2%	9.1%	1.2	5.6	34.1%	235
F 80+	3007	17.4%	4.3%	1.2	5.6	19.9%	598
M 55-59	8	36.2%	21.8%	1.6	3.1	49.2%	4
M 60-69	39	44.8%	19.2%	1.6	3.1	49.9%	19
M 70-79	288	53.7%	11.9%	1.6	3.1	44.4%	128
M 80+	867	49.6%	7.1%	1.6	3.1	35.9%	311
Total	4984						1335
Cataracts							
F 55-59	6	22.3%	18.0%	1.3	1.3	11.4%	1
F 60-69	8	24.8%	14.9%	1.3	1.3	11.2%	1
F 70-79	43	24.2%	9.1%	1.3	1.3	9.4%	4
F 80+	181	17.4%	4.3%	1.3	1.3	6.2%	11
M 55-59	3	36.2%	21.8%	1.3	1.3	15.9%	0
M 60-69	9	44.8%	19.2%	1.3	1.3	17.3%	2
M 70-79	21	53.7%	11.9%	1.3	1.3	17.3%	4
M 80+	55	49.6%	7.1%	1.3	1.3	15.0%	8
Total	326						31
Cataract surgery hospitalisations (public hospitals)							
M+F 55+	3016	33.3%	13.9%	1.4	1.1	13.1%	396

*Registered cases from the national database of the Royal New Zealand Foundation for the Blind. Of these individuals, 60.4% have cataracts in both eyes. Cataract surgery rates were for public hospitalisations in a one year period 1996/1997[3] – a total of 6615 hospitalisations of which 45.6% were assumed to be nuclear or posterior subcapsular cataracts (see the next note). †Based on the Australian data it was assumed that 45.6% of cataracts were nuclear or posterior subcapsular with the rest being cortical.[19] ‡Smoking prevalence rates from the 1996 Census (data from Statistics New Zealand 1997). It was conservatively assumed that the population registered with the RNZFB had the same age-specific and gender-specific smoking rates as the rest of the NZ population. §Based on the data on cataracts[19] and AMD[2] from the Blue Mountains Eye Study in Australia. These studies have not produced age-group specific odds ratios which might have allowed for more precise calculation. **Calculated using the standard formular for determining attributable risk (AR). AR = (smoking prevalence) x (odds ratio – 1)/[(smoking prevalence) x (odds ratio – 1) + 1]. ††Calculated from the numbers of registered cases multiplied by percentage attributable risk.

considered cataract surgery in public hospitals in the period for which data were available (1996/1997) – despite the fact that a substantial amount of cataract surgery occurs in the private sector and rates in the public sector have recently increased. Indeed, we estimate that the total number of cataract operations in the country is more likely to be around 10 000 per year. This would suggest that there are around 600 hospitalisations for cataract surgery per year that are attributable to smoking. Third, this work did not consider the impact of smoking on all the other eye conditions for which there is evidence of an association with smoking. The review by Solberg et al[9] indicates that these conditions include retinal ischaemia, anterior ischaemic optic neuropathy, and Graves ophthalmopathy. Smoking is also the direct cause of tobacco-alcohol amblyopia and the infants of smoking mothers are at increased risk of strabismus.

The major implication for policy makers is that the burden of eye disease from smoking provides yet another reason to intensify proven tobacco control interventions such as tobacco taxation and restricting smoking in public places.

The lack of information about eye disease and smoking in the public arena represents yet another failing of the tobacco industry to warn consumers about the consequences of using its products. Given this corporate failure, the provision of this information by health authorities is critical (as has recently been recommended for Australia[2]). "Smoking is a major cause of blindness" and "smoking causes untreatable blindness" are possible messages. Future mass media campaigns to promote smoking cessation could also include information on smoking and blindness, given that blindness is a relatively feared condition by the public.[20]

There is extremely good evidence that brief advice from a health professional increases smoking quit rates.[21] Therefore ophthalmologists, general practitioners, optometrists and other health workers should enhance their efforts to warn patients that smoking can cause blindness and recommend smoking cessation (eg, use of the national Quitline service and nicotine replacement therapy). Vascular events in the eye result in dramatic, sudden and permanent loss of vision and occur more commonly in smokers. When advising of the risks of a similar event occurring in the fellow eye, health professionals can inform the patient of the increased risk of blindness if they continue to smoke. This type of highly personalised risk information is likely to be particularly effective in prompting quitting attempts. Hospitals and other healthcare service providers should also consider providing intensive smoking cessation services to those at the greater risk of smoking-related eye disease – eg, people with diabetes who smoke and middle-aged and older smokers.

Finally, it is desirable that risk factor data for AMD and cataracts are systematically collected and analysed in at least one New Zealand setting. This would help further clarify the role of smoking in eye disease along with identifying other possible risk factors. To minimise the cost of such a study, risk factor data could be collected as part of a routine patient management information system for eye patients attending a large hospital.

Acknowledgements. We are very grateful for the assistance of Mrs D Field, Dr Mark Elder and Clare Salmond. We also thank the Royal New Zealand Foundation for the Blind and Rebecca Thomson for supplying data and helpful comments.

Correspondence. Dr Graham Wilson, c/- Dr Nick Wilson, 367A Karori Road, Karori, Wellington. Fax: (04) 476 3646; email: nwilson@actrix.gen.nz

1. Cancer Society of New Zealand. Tobacco statistics 2000. Wellington: Cancer Society of New Zealand; 2000.
2. Mitchell P, Chapman S, Smith W. Smoking is a major cause of blindness: A new cigarette pack warning? Med J Aust 1999; 171: 173-4.
3. Ministry of Health. Purchasing for your health 1996/1997. Wellington: Ministry of Health, 1998.
4. Vinding T, Appleyard M, Nyboe J, Jensen G. Risk factor analysis for atrophic and exudative age-related macular degeneration. An epidemiological study of 1000 aged individuals. Acta Ophthalmol (Copenh) 1992; 70: 66-72.
5. Pauleikhoff D, Wormald RP, Wright L et al. Macular disease in the elderly population. Ger J Ophthalmol 1992; 1: 12-5.
6. Tamakoshi A, Yuzawa M, Matsui M et al. Smoking and neovascular form of age related macular degeneration in late middle aged males: findings from a case-control study in Japan. Research Committee on Chorioretinal Degenerations. Br J Ophthalmol 1997; 81: 901-4.
7. The Eye Disease Case-Control Study Group. Risk factors for neovascular age-related macular degeneration. Arch Ophthalmol 1992; 110: 1701-8.
8. Hyman LG, Lilienfeld AM, Ferris FL 3rd, Fine SL. Senile macular degeneration: a case-control study. Am J Epidemiol 1983; 118: 213-27.
9. Solberg Y, Rosner M, Belkin M. The association between cigarette smoking and ocular diseases. Surv Ophthalmol 1998; 42: 535-47.
10. Hiller R, Sperduto RD, Podgor MJ et al. Cigarette smoking and the risk of development of lens opacities. The Framingham studies. Arch Ophthalmol 1997; 115: 1113-8.
11. Leske MC, Chylack LT Jr, He Q et al. Risk factors for nuclear opalescence in a longitudinal study. LSC Group. Longitudinal study of cataract. Am J Epidemiol 1998; 147: 36-41.
12. West S, Munoz B, Schein OD et al. Cigarette smoking and risk for progression of nuclear opacities. Arch Ophthalmol 1995; 113: 1377-80.
13. Flaye DE, Sullivan KN, Cullinan TR et al. Cataracts and cigarette smoking. The City Eye Study. Eye 1989; 3: 379-84.
14. Leske MC, Chylack LT, Wu SY. The Lens Opacities Case-Control Study. Risk factors for cataract. Arch Ophthalmol 1991; 109: 244-51.
15. Harding JJ, van Heyningen R. Drugs, including alcohol, that act as risk factors for cataract, and possible protection against cataract by aspirin-like analgesics and cyclopenthiazide. Br J Ophthalmol 1988; 72: 809-14.
16. Phillips CI, Clayton RM, Cuthbert J et al. Human cataract risk factors: significance of abstention from, and high consumption of, ethanol (U-curve) and non-significance of smoking. Ophthalmic Res 1996; 28: 237-47.
17. Klein BEK, Klein R, Linton KL, Franke T. Prevalence of cataracts in a population-based study of persons with diabetes mellitus. Ophthalmology 1985; 92: 1191-6.
18. Christen WG, Glynn RJ, Ajani UA et al. Smoking cessation and risk of age-related cataract in men. JAMA 2000; 284: 713-6.
19. Cumming RG, Mitchell P. Alcohol, smoking, and cataracts: the Blue Mountains Eye Study. Arch Ophthalmol 1997; 115: 1296-303.
20. Borland R, Donaghue N, Hill D. Illnesses that Australians most feared in 1986 and 1993. Aust J Public Health 1994; 18: 366-9.
21. Fiore MC, Bailey WC, Cohen SJ et al. Treating tobacco use and dependence. Clinical Practice Guideline. Rockville, MD: US Department of Health and Human Services; 2000.
22. Vingerling JR, Hofman A, Grobbee DE, de Jong PT. Age-related macular degeneration and smoking. The Rotterdam Study. Arch Ophthalmol 1996; 114: 1193-6.
23. Smith W, Mitchell P, Leeder SR. Smoking and age-related maculopathy: The Blue Mountains Eye Study. Arch Ophthalmol 1996; 114: 1518-23.
24. Delcourt C, Diaz JL, Ponton-Sanchez A, Papoz L. Smoking and age-related macular degeneration. The POLA Study. Arch Ophthalmol 1998; 116: 1031-5.
25. Klein R, Klein BE, Linton KL, DeMets DL. The Beaver Dam Eye Study: the relation of age-related maculopathy to smoking. Am J Epidemiol 1993; 137: 190-200.
26. Christen WG, Glynn RJ, Manson JE et al. A prospective study of cigarette smoking and risk of age-related macular degeneration in men. JAMA 1996; 276: 1147-51.
27. Seddon JM, Willet WC, Speizer FE, Hankinson SE. A prospective study of cigarette smoking and age-related macular degeneration in women. JAMA 1996; 276: 1141-6.
28. Christen WG, Manson JE, Seddon JM et al. A prospective study of cigarette smoking and risk of cataract in men. JAMA 1992; 268: 989-93.
29. McCarty CA, Nanjan MB, Taylor HR. Attributable risk estimates for cataract to prioritize medical and public health action. Invest Ophthalmol Vis Sci 2000; 41: 3720-5.
30. Delcourt C, Cristol JP, Tessier F et al. Risk factors for cortical, nuclear, and posterior subcapsular cataracts: the POLA study. Am J Epidemiol 2000; 151: 497-504.
31. Hankinson SE, Willet WC, Colditz et al. A prospective study of cigarette smoking and risk of cataract surgery in women. JAMA 1992; 268: 994-8.
32. Klein BEK, Klein R, Linton KL, Franke T. Cigarette smoking and lens opacities: The Beaver Dam Eye Study. Am J Prev Med 1993; 9: 27-30.

The prevalence of faecal incontinence and constipation in a general New Zealand population; a postal survey

AC Lynch, ***Advanced Trainee in General Surgery;*** **BR Dobbs,** ***Scientific Officer, Department of Surgery, Christchurch Hospital;*** **J Keating,** ***Colorectal Surgeon and Senior Lecturer, Department of Surgery, Wellington Hospital, Wellington;*** **FA Frizelle,** ***Professor of Colorectal Surgery, Colorectal Unit, Department of Surgery, Christchurch Hospital, Christchurch.***

Abstract

Aims. To determine the prevalence of constipation and faecal incontinence in the community.

Methods. A 20-question multi-field postal questionnaire was sent to 1500 adults (over 18 years) randomly selected from the electoral roll in the Canterbury region. Questions detailed frequency of bowel function, time spent at the toilet, incidence and severity of faecal incontinence, constipation, and the effect of disordered bowel function.

Results. Of 1500 questionnaires, 717 (48%) were returned (male: female 388:329). The median age was 46 years (range 18-70). 24 (4%) had self-reported gastrointestinal disease. There was a median frequency of seven bowel motions per week (BM/wk) (range 1 to 70) with 89% having between two motions a day and one every two days. Faecal incontinence affected lifestyle in 58 (8.1%). Incontinence of solid stool at least once a month occurred in 70 (9.8%), of liquid stool in 91 (12.7%), of gas in 459 (64%), while 12 (2%) regularly wore a pad. Those with self-reported gastrointestinal disease had a significantly higher ($p<0.05$) bowel motion frequency (17 vs 7 BM/wk) and median faecal incontinence score (2.5 vs 0). Laxatives were used by 4.9% of the population, while 26.2% increased fibre to avoid constipation.

Conclusions. The normal frequency of bowel motions (± 2SD) was 2-17 per week. Faecal incontinence affecting life style affected 8.1%, while constipation requiring regular laxative use affected 4.9% of people. There is acceptance in the community that a moderate degree of bowel dysfunction is normal. Stool frequency and faecal incontinence scores can be used to predict those most likely to have organic gastrointestinal disease.

NZ Med J 2001; 114: 474-7

The prevalence of faecal incontinence and constipation in the general population of New Zealand is unknown.[1,2] Studies previously undertaken in New Zealand have looked at specific subgroups: incontinence in the elderly[1] and incontinence and constipation amongst irritable bowel sufferers.[2] Neither of these groups could be said to be representative of the community as a whole. Many overseas studies have focused on high-risk groups such as the elderly or those living in nursing homes[3-5] or used study designs that may under- or over-estimate prevalence.[6,7] Overseas general population studies are not necessarily applicable to New Zealand for reasons of genetic diversity, environmental, cultural and lifestyle issues.

Arriving at a definition for a normal bowel habit has been difficult. Medical practitioners make assumptions as to what constitutes normal bowel function based on what patients tell them, what they read and their own experience. Patients also have an expectation as to what is normal for them. A knowledge of the range of bowel function in the healthy general population is of clinical value when assessing

individual patients and is useful as a benchmark in comparative studies. The prevalence of faecal incontinence and constipation may help define the need for health resources to tackle these problems.

The aim of this study was to determine the prevalence and degree of faecal incontinence and constipation in the general population in the Canterbury region.

Methods

A twenty-question multifield questionnaire (copy available by contacting the authors) detailing daily bowel habit was posted to 1500 randomly selected individuals from the Canterbury region between Timaru and Kaikoura. The number 1500 was decided upon after reviewing previous studies and in recognition of the poor response rates that typify such surveys. Questionnaire recipients were randomly selected from the electoral roll and stratified for age by decade to mirror the age distribution of the general population aged eighteen years and over.

The questionnaire required retrospective recall and included a standardised assessment of faecal incontinence,[8] and questions on: frequency of stool, gas/stool discrimination, time spent at defecation, need for laxatives, use of extra fibre or constipating agents, previous bowel or anorectal surgery, and whether their bowel function was 'normal'. We did not ask why they thought it normal or abnormal.

The Southern Regional Health Authority Ethics Committee approved the study. Non-parametric statistical analysis was undertaken with medians being compared by using the Mann-Whitney test.

Results

Of the 1500 questionnaires sent, 717 (48%) were returned. Of these, 388 (54%) respondents were male and 329 (46%) female. The median age was 45 years. The age and gender of the non-responders was not significantly ($p>0.05$) different from those who responded.

Frequency of stool. Frequency of stool ranged from 1-70 bowel motions per week (BM/wk). The median was seven BM/wk with 77% of respondents having between one and two bowel motions per day. Of the 655 respondents (91%) who felt that their bowel function was normal, median bowel motion frequency was seven BM/wk (range 1-70). Of the respondents without self-reported gastrointestinal disease the mean frequency of bowel motions (±2SD) equated to 2 and 17 BM/wk (Table1).

Table 1. Bowel motion frequency vs self-description of bowel function as normal or abnormal.

	'Normal' Bowel Function	'Abnormal' Bowel Function	Total
Male (number)	366	22	388
Median Bowel motions/week	7 BM/wk	16 BM/wk	7 BM/wk
range	4-42	3-70	3-70
Female (number)	289	40	329
Median Bowel motions/week	7 BM/wk	5 BM/wk	7 BM/wk
range	3-70	1-70	1-70
Number	655	62	717
Median Bowel motion/week	7 BM/wk	7 BM/wk	7 BM/wk
range	3-70	1-70	1-70

Incontinence score. Incontinence was scored according to a commonly accepted system[8] (Table 2). Scores could range between 0 (perfect continence) and 20 (complete incontinence). Respondents with scores of three or more are considered to have a significant problem. The overall median score was one (range 0 to 13). There were 118 (17%) with a score of three or greater (51 female, 67 male, mean age 45.1 years). In this group, only 26 (22%) felt that their bowel function was abnormal.

The inability to delay defecation (urgency) was a problem with increasing incontinence score. Of the 118 people with incontinence scores greater than three, 61% were not able to delay defecation at least fifteen minutes, 28% were able to hold on a few minutes only, and 11% needed to go immediately.

Gas/liquid discrimination. Gas or liquid discrimination was not a problem in 85.2% of respondents. Of the remainder, 10.5% occasionally had trouble, 3% often had trouble and 1% never could tell the difference. Median incontinence scores for those who never have a problem with gas/liquid discrimination is 1 vs 3 for those who sometimes or always are unable to tell.

Time spent in toilet. The time spent at the toilet for 92% of respondents was less than fifteen minutes a day, while 7% spend 15-30 minutes and 1% spend more than 30 minutes per day. There was no difference between males and females. The 8% of respondents spending longer than fifteen minutes had increased stool frequency (median 16 BM/wk) and incontinence scores (median 2) Eleven of the 24 people (46%) reporting bowel pathology spend more than fifteen minutes at the toilet per day.

Laxative use. The prevalence of laxative use was 4.7% (Table 3). The median age of laxative users tended to be older than that of the whole population (53 years, range 31-68). Bowel function was self-reported as abnormal in 15 (44%) of this group, including 22 women and 12 men. Frequency was five BM/wk (range 1-14) for occasional laxative users and seven BM/wk for regular users. Median incontinence score was 2 (range 0-11) for occasional users and regular users (range 0-13).

Extra dietary fibre. Extra fibre was taken by 26% of respondents (97 female, 92 male – Table 3). The median age was 50 years (range 18-69), median incontinence score 2 (range 0-13) and median frequency was eight BM/wk (range 1-70) with no significant gender difference ($p>0.05$).

Use of a constipating agent. A constipating agent was used by eleven respondents (6 female, 5 male – Table 3). Their median age was 53 years (range 32-60). Ten out of eleven described their bowel function as abnormal: two had Crohn's disease, one coeliac disease and one a previous sphincterotomy. Median frequency was 20 BM/wk (range 7-70) and the median incontinence score was eight (range 3-13).

Gastrointestinal disease. Gastrointestinal disorders or previous colorectal surgery was reported by 24 respondents (11:13 male:female – Table 4). Median age was 52 years (range 30-69). Median frequency was seventeen BM/wk (range 6-50), and the median incontinence score was 2.5 (range 0-10). However, only ten of the 24 respondents felt that their bowel function was abnormal.

Impact of everyday activities. Incontinence did not impact on the every day activities of 92% of respondents, while it did occasionally in 4.6%, sometimes 2.1%, and 1.5% often. The median incontinence score for those who sometimes, often or always have everyday activities affected by incontinence was eight (range 4-13) vs 0 (range 0-11) for those who never or occasionally had their everyday activities affected.

Discussion

This study was undertaken to describe the prevalence of faecal incontinence and constipation in the general population of New Zealand, using a postal questionnaire. The low response rate (47.8%) was similar to that of other studies of this nature.[7,9,10] Bowel dysfunction may be less of a problem than suggested by the present study as those who responded almost certainly were motivated to do so by their bowel-related problems. However, responders were not significantly different in age and gender from non-responders. Another aspect that will have skewed the results would be that the data were based on retrospective recall. Two people reported that they passed 70 BM/wk before they answered the questionnaire which suggests a 'guesstimation' in answering some questions.

Table 2. Continence grading scores.

Type of incontinence	Frequency of incontinence: Never Score=0	Rarely <1/month Score=1	Sometimes >1/month, <1/month Score=2	Usually >1/week, <1/day Score=3	Always >1/day Score=4
Solid	647	39	20	8	3
Liquid	626	53	30	5	3
Gas	258	206	199	44	10
Wears pad	702	9	2	1	0
Lifestyle alteration	659	33	15	10	0

The numbers given indicate the number of respondents experiencing different levels of incontinence and the frequency with which this occurred. Not every respondent answered every question. A faecal incontinence score for each patient was determined by addition of the score on the frequency of incontinence (X axis) for each the five types of incontinence (Y axis). Range of scores possible, 0 to 20.

Table 3. Type of described pattern of stool and use of fibre, laxatives and constipating agents.

	Loose/watery	Soft/firm	Hard
Number	15 F/18 M	286 F/356 M	28 F/13 M
	5%	90%	5%
Mean age (years)	48	46	43
Abnormal function	20	28	13
BM/week	17	10	7.5
Incontinence score	4.1	1.4	2.0
Laxative use	0	27	7
Fibre	10	166	13
Constipating agent	6	5	0

Table 4. Prevalence of gastrointestinal disease and colorectal procedures in sample population.

Disease/Procedure	Number
Crohn's Disease	3
Ulcerative colitis	1
Coelic Disease	1
Chronic Pancreatitis	1
Diverticular Disease	1
Haemorrhoids or Haemorrhoidectomy	10
Colostomoy	1
Rectocoele	2 (1 repaired)
Colectomy	2 (1 sigmoid, 1 left hemicolectomy)
Anal Fissure or Anal Stretch	2
Total	24 (4%)

There was considerable variability in what is tolerated as normal in the community. The mean ± 2SD should account for just over 95% of the normal population, which in this study would account for the passage of between 2-17 BM/wk. Those who considered themselves to have normal bowel habit had lower bowel motion frequency and faecal incontinence scores than those who considered they had abnormal bowel habit. Those with self-reported gastrointestinal disease had the highest stool frequency and faecal incontinence scores. This suggests what has probably been accepted by most practitioners already, that patients with abnormal stool frequency outside the range suggested above and high faecal incontinence scores should be investigated for the presence of gastrointestinal disease.

Faecal incontinence of at least a moderate degree was found in 8.1% of respondents. Overseas reports have put the rate at 0.17-5.3%.[1,3,6,11] A report from the UK found a community prevalence of 4.2% for men and 1.7% for women, who were aged between 15-64 years, and 10.9% men and 13.3% women who were 65 years or older.[11] The prevalence of faecal incontinence is higher in specific groups, such as in nursing homes where the reported range is from 10-17%,[1,4,5] and in hospitalised elderly (13-47%).[12,13]

A recent study of the general population in Australia found the prevalence of faecal incontinence to be 15%, as assessed by a postal questionnaire.[10] This is substantially higher than previous population studies. An important factor in determining prevalence is the definition of incontinence used. Faecal incontinence is usually assessed with a graduated scale (such as the Cleveland Clinic Faecal Incontinence Score,[8] used in the present study) where a particular point has to be decided on to indicate that the problem is significant. This point is not consistent between studies. The Australian study[10] included incontinence of flatus, which most other studies, including the present one, do not. The Australian prevalence of faecal incontinence falls to 9.2% when incontinence of flatus is excluded, a figure similar to that in the present study.

The question of whether incontinence of flatus should be included is a vexed issue. Many studies have neglected incontinence of flatus but it is recognised as a significant problem by patients, though it would rarely be an indication for surgery. The Australian study[10] found that 5.8% of their study population had this as an isolated problem at least once a month, compared with 7.5% in our study. Another community-based study that did include incontinence of flatus estimated a rate of 1.32%.[6] This low frequency might relate to study design, in which a telephone interview asked about the status of other household members. Information provided by insurers was the basis for another study so that only people presenting for treatment of incontinence were included.[7] This most likely represents only a small proportion of patients with these symptoms.

Faecal incontinence can be personally and socially incapacitating. It has such a social stigma that patients are often unwilling to seek help, and doctors are reluctant to inquire about it. When patients do seek help, medical practitioners are often at a loss to know how to investigate or manage the problem.[14-16] This unpredictability and social embarrassment can lead to self-imposed social isolation. In recent years there have been significant developments in the management of faecal incontinence with improved results. Newer methods of investigation include anorectal manometry, pudendal nerve latencies, and EMG's, endorectal ultrasound as well as anal sphincter MRIs. These have helped in the diagnosis of specific problems.[16-18] Constipating and bulking drug treatments, biofeedback, anterior sphincteroplasty and antegrade colonic enemas (ACE) are readily available in New Zealand in specialist centres, and prove adequate for most patients. Modern treatment techniques such as dynamic anal graciloplasty and the artificial sphincter are available in a very limited way in New Zealand. However, only a small number of patients nationwide require such interventions.

Constipation is often regarded as a trivial symptom, but it can be a major disability. Constipation means different things

to different people, and the term has been shown to be ambiguous and misleading.[19] To some it implies stools that are infrequent and hard, while to others it refers to prolonged and repeated attempts at defecation, and even the need for digital assistance. Attention has been drawn to the importance of stool weight and transit time,[20] but these parameters are difficult to assess, so stool frequency remains a common guide.[21]

We have used stool frequency as a guide, but we also looked at other aspects that may be associated with constipation. Almost a third of those surveyed took something to keep their bowel motions regular and 4.7% used laxatives to treat constipation. A surprising 26% took extra dietary fibre to avoid constipation. Those who used laxatives regularly were older and had fewer bowel motions per week.

Diet, gender, age and the presence of disease[9,22-24] influence the frequency of bowel motion. Studies from the 1960's established normal values for stool frequency as thrice daily to three times a week. These studies, however, were in predominantly elderly patients, and results were not stratified by age. Amongst recent studies, one from Germany found that mean stool frequency was 1.02/day, with 95% of the studied normal population having between two stools per day and one every two days, and becoming less frequent with age.[9] The present study has defined the normal range of bowel motions to be 2-17BM/wk. This is very similar to results from the studies noted above.

Widespread beliefs that everyone should have a bowel motion at least once a day may have helped contribute to overuse and abuse of laxatives.[25] We found that 4.9% of the study population used laxatives and these subjects had a lower frequency of bowel motions per week.

Constipation should be considered not just as frequency problem but as a problem of difficulty with defecation.[26] It is important that the physician defines what the patient is complaining of. A common definition for research purposes is "the reduced frequency of defecation and/or a difficult bowel action in more than 25% of attempts".[26] While it is easy to understand when a patient is describing a difficulty with defecation, it is not always easy to determine the cause, nor to predictably achieve success in management. Defining the underlying pathophysiology objectively is necessary for identification of patients amenable to surgical or medical intervention. The great majority of patients (90%+) do not need surgery for constipation and can be managed quite adequately by diet and lifestyle changes, medications, and biofeedback.[27]

It is clear from our study that faecal incontinence and constipation are common in our community, and are not confined to the elderly. Most treatment is simple, non-surgical and available in New Zealand.

Correspondence. Professor Frank A Frizelle, Colorectal Unit, Department of Surgery, Christchurch Hospital, Riccarton Ave, Chrisctuhurch. Fax (03) 3640 352; email: frankf@cdhb.govt.nz

1. Campbell AJ, Reinken J, McCosh. Incontinence in the elderly; prevalence and prognosis. Age Ageing 1985; 14: 65-70.
2. Welch GW, Pomare EW. Functional gastrointestinal symptoms in a Wellington community sample. NZ Med J 1990; 103: 418-20.
3. Talley NJ, O'Keefe EA, Zinmeister AR, Melton LJ. Prevalence of gastrointestinal symptoms in the elderly: a population based study. Gastroenterology 1992; 102: 895-901.
4. Donald IP, Smith RG, Cruikshank JG et al. A study of constipation in the elderly living at home. Gerontology 1985; 31: 112-8.
5. Kok ALM, Voorhorst FJ, Burger CW et al. Urinary and faecal incontinence in community-residing elderly women. Age Ageing 1992; 21: 211-5.
6. Nelson R, Norton N, Cautley E, Furner S. Community-based prevalence of anal incontinence. JAMA 1995; 274: 559-61.
7. Drossman DA, Sandler RS, Madeline Broom C, McKee DC. Urgency and faecal soiling in people with bowel dysfunction. Dig Dis Sci 1986; 31: 1221-5.
8. Kuijpers HC. Fecal Incontinence. In: Wexner SD, Vernava AM, editors. Clinical decision making in colorectal surgery. New York: Igaku-Shoin; 1995. p 107-112.
9. Giebel GD, Mennigen R, Burde C. Attitude at stool: what is the norm? Coloproctology 1985; 17: 99-104.
10. Lam TCF, Kennedy ML, Chen FC et al. Prevalence of faecal incontinence: obstetric and constipation related risk factors: a population-based study. Colorectal Dis 1999; 1: 197-203.
11. Thomas TM, Egan M, Walgrove A, Meade TW. The prevalence of faecal and double incontinence. Community Med 1984; 6: 216-20.
12. Capewell AE, Primrose WR, MacIntre C. Nursing dependency in registered nursing homes and long term care wards in Edinburgh. BMJ 1986; 292: 1719-21.
13. Tobin GW, Brocklehurst JC. Faecal incontinence in residential homes for the elderly: prevalence, aetiology and management. Age and Ageing 1986; 15: 41-6.
14. Madoff RD, Williams JG, Caushaj PF. Fecal incontinence. N Engl J Med 1992; 326: 1002-7.
15. Jorge JMN, Wexner SD. Etiology and management of fecal incontinence. Dis Colon Rectum 1993; 36: 77-97.
16. Vaizey CJ, Kamm MA, Nicholls RJ. Recent advances in the surgical treatment of faecal incontinence. Br J Surg 1998; 85: 596-603.
17. Farouk R, Bartolo DC. The clinical contribution of integrated laboratory and ambulatory anorectal physiology assessment in faecal incontinence. Int J Colorectal Dis 1993; 8: 60-5.
18. Farouk R, Bartolo DC. The use of enoluminal ultrasound in the assessment of patients with faecal incontinence. J Royal Coll Surg Edin 1994; 39: 312-8.
19. Frizelle FA, Dominguez JD, McCall JL, Santoro GA. Surgical treatment of constipation. Int J Surg Sci 1995; 2: 100-6.
20. Burkitt DP, Walker AR, Painter NS. Effect of dietary fibre on stools and transit times, and its role in the causation of disease. Lancet 1972; II: 1408-12.
21. Talley NJ, Weaver AL, Zinsmeister AR, Melton LJ. Functional constipation and outlet delay; a population-based study. Gastroenterology 1993; 105: 781-90.
22. Drossman DA, Li Z, Andruzzi E et al. US householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. Dig Dis Sci 1993; 38: 1569-80.
23. Campbell AJ, Busby WJ, Horwath CC. Factors associated with constipation in a community based sample of people aged 70 years and over. J Epidemiol Community Health 1993; 47: 23-6.
24. Conell AM, Hilton C, Irvine G et al. Variation of bowel habit in two populations. BMJ 1965; 2: 1095-9.
25. American Society of Colon and Rectal Surgeons. Constipation; questions and answers. Patient information. Arlington Heights II: American Society of Colon and Rectal Surgeons; 1994.
26. Probert CSJ, Emmett PM, Cripps HA, Heaton KW. Evidence for the ambiguity of the term constipation: the role of irritable bowel syndrome. Gut 1994; 35: 1455-8.
27. Surrenti E, Rath DM, Pemberton JH, Camilleri M. Audit of constipation in a tertiary referral gastroenterology practice. Am J Gastroenterol 1995; 90: 1471-5.

MOLECULE-TO-MALADY

Stem cells and neurodegenerative diseases

Bronwen Connor, *Lecturer, Division of Pharmacology;* Willeke MC van Roon-Mom, *Assistant Research Fellow, Division of Anatomy with Radiology;* Maurice A Curtis, *PhD student, Division of Anatomy with Radiology;* Michael Dragunow, *Professor of Pharmacology, Division of Pharmacology;* Richard LM Faull, *Professor of Anatomy, Division of Anatomy with Radiology, Faculty of Medical and Health Sciences, Auckland University, Auckland.*

NZ Med J 2001; 114: 477-9

The Promise of Stem Cell Research

A particularly exciting and novel development in the treatment of neurodegenerative diseases is the suggestion from both animal and human studies that cell transplantation offers the potential of effective future treatment for neurodegenerative disorders such as epilepsy, Parkinson's disease, Huntington's disease and Alzheimer's disease. In recent years, the transplantation of cells into the diseased human brain has emerged from the realm of the theoretical to that of the practical. Grafts of embryonic cells have been shown to partially restore some neurochemical deficits and to ameliorate behavioural and locomotor impairment in animal

models of these diseases.[1-6] In humans, patients with idiopathic and 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced Parkinson's disease have shown remarkable improvements following human fetal neural transplants.[7-9] However, the use of human fetal embryonic tissue for cell transplantation therapy in neurodegenerative diseases is associated with major problems. The scarcity of this material is compounded by practical issues such as the age of the donor, viability, contamination and heterogeneity of tissue as well as overwhelming ethical and moral concerns.

Worldwide attention is presently focused on the potential use of 'stem cells' as an alternative source of tissue for cell transplantation and brain repair. The announcement that stem cells can be obtained from aborted human fetuses or from spare embryos from *in vitro* fertilization procedures has been met with both enthusiasm and opposition. Less controversial, and probably more notable, is the recent demonstration that stem cells can be obtained from adult brain tissue, raising the exciting possibility that these cells can be exploited to generate cells for autologous brain cell transplants. Furthermore, a recent report showing that human bone marrow stromal cells can differentiate into neurons[10] raises the possibility of obtaining an easily accessible renewable source of material for autologous transplantation.

The Use of Neural Stem Cells in Brain Repair

We are interested in the use of 'neural' stem cells for the treatment of neurodegenerative diseases.

What Exactly is a Neural Stem Cell? The term 'neural stem cell' is used loosely to describe cells that can generate brain cells or are derived from the central nervous system, have some capacity for self-renewal, and can give rise to cells other than themselves through asymmetric cell division.[11] Neural stem cells exist in both the developing mammalian central nervous system and the adult central nervous system of mammals, including man.[12,13] Neural stem cells can also be derived from more primitive cells that have the capacity to generate neural stem cells and stem cells of other tissues (Figure 1). Embryonic (pluripotent) stem cells are obtained from blastocytes (fertilized eggs) and this is currently the stem cell type being proposed for use in a wide variety of commercial and clinical applications. Most stem cells can be categorized as multipotential and only make cells that have a particular function. Usually between the stem cell and its final cell type is an intermediate population of committed progenitors with limited proliferative capacity and a restricted fate.

The Role of Neural Stem Cells in the Adult Brain. The use of adult stem cells in cell transplantation therapy could obviate the need to use stem cells derived from human embryos or human fetal tissue. At present, there are no legal or ethical concerns regarding research with adult stem cells. Furthermore, adult stem cells derived directly from the patient would reduce the likelihood that the transplanted cells will be rejected.

Stem cells have been identified and isolated from specific regions of the brain; (i) the subventricular zone (SVZ) lining the lateral ventricles and adjacent to the region of the basal ganglia affected in Huntington's and Parkinson's disease, and; (ii) the subgranular zone (SGZ) in the hippocampus, the region of the brain which is primarily affected in Alzheimer's disease and temporal lobe epilepsy. The stem cells located in these regions have been shown to multiply and form new replacement neurons for adjacent brain structures. In this regard it is especially exciting that stem cells located in these regions are found immediately adjacent to the basal ganglia and hippocampus that are respectively the areas of primary degeneration in Huntington's and Parkinson's disease, and in Alzheimer's disease and epilepsy. Indeed, there is increasing evidence that one function of stem cells in the adult brain may be to generate new cells in response to brain injury or disease. When the brain is injured, it may try to 'repair' itself with its own population of stem cells but, for most injuries that come to clinical attention, this repair process is restricted by the number of available stem cells and may even be counter-acted by a growth-inhibitory environment, especially in the adult brain. In order to investigate whether neurodegenerative conditions do stimulate stem cells in the adult brain to try and repair the area of injury, we are investigating the presence of stem cells in the human brain in Huntington's disease, Parkinson's disease, Alzheimer's disease and epilepsy. In several cases of advanced Huntington's disease, our preliminary studies have shown an increase in the number of putative stem cells in the SVZ compared to age-matched normal human brains suggesting that there is an injury-induced increase in the number of stem cells. However, this increase in stem cell proliferation is ultimately insufficient to compensate for the progressive cell loss observed in the Huntington's diseased brain. If this potential for cell replacement by the brain could be augmented pharmacologically then compensation may increase to a point where neuronal cell loss is slowed and even perhaps clinical improvement observed.

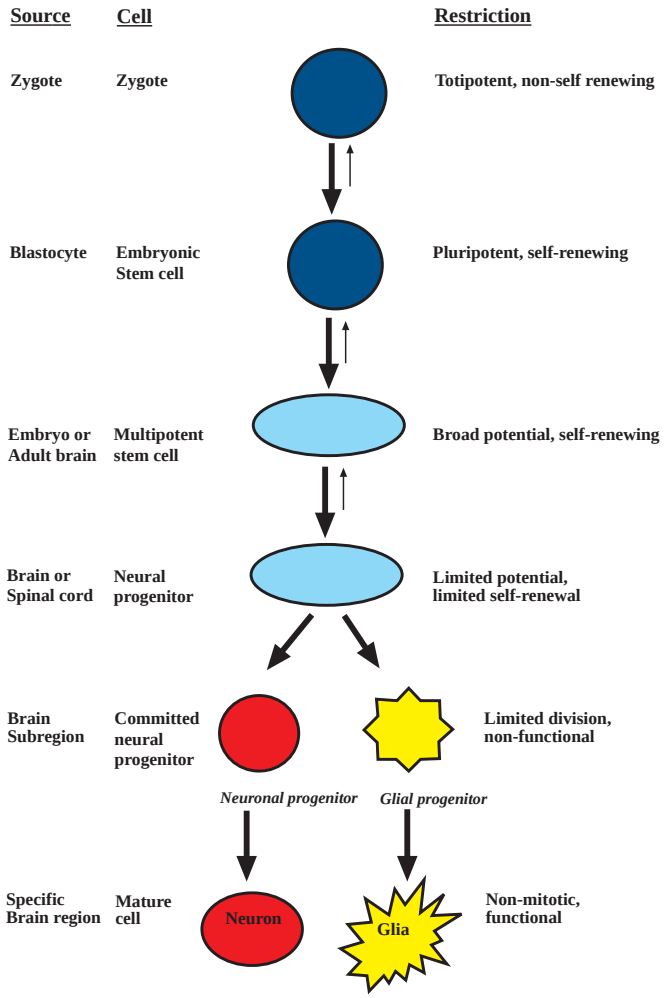

Figure 1. A schematic diagram demonstrating the different classes of mammalian stem cells.

Finally, recent studies suggest that neurogenesis is not merely a compensatory response to brain injury, but may play a

fundamental role in how our brains function. Shors et al[14] demonstrated that neurogenesis was involved in trace memory formation, and this may explain recent MRI studies showing that hippocampal volume in humans is associated with navigation experience.[15]

The Clinical Potential of Neural Stem Cells

Given that most neurodegenerative diseases affect specific cell populations, an ideal source of material for transplantation would be an expandable cell source that could be instructed to completely assume the desired cell type upon maturation. This would provide a valuable strategy for the repair of certain neurodegenerative disorders. Stem cells have the ability to achieve this.

Neural stem cells have been successfully transplanted into the normal adult mammalian brain where they form mature cells.[16-18] As with transplanted fetal neurons, neural stem cells transplanted into the lesioned rat brain have been observed to 'replace' lost brain cells and reduce lesion-induced behavioural impairment.[19-21] They appear to integrate into the brain after transplantation, possibly allowing for literal cell replacement; this makes them a potentially better source for cell transplantation therapy than human fetal embryonic neurons.

Whether stem cells take on the exact function of the cells they replace remains to be determined, but the answer will be the foundation on which therapeutic strategies are built. Transplanted stem cells may need to be genetically and/or pharmacologically engineered to direct them to the appropriate cell phenotype, or more likely, the cells that integrate into a particular region of the brain may need to be 'nurtured' by neighbouring cells in order to be functionally integrated into the neural circuitry. Alternatively, the delivery of factors that act to stimulate neural stem cells to repair the injured or diseased brain may have clinical potential in the treatment of neurodegenerative diseases. At present however, we do not know which soluble and intracellular factors will promote neural stem cells to grow and multiply to make mature, adult brain cells. We have some evidence to suggest that transcription factors are pivotal in this process.[22] In addition, growth factors, such as insulin-like growth factor-1,[23] brain-derived neurotrophic factor,[24] transforming growth factor-α,[25] fibroblast growth factor-2[26] and members of the Ephrin family[27] have been observed to promote the proliferation and differentiation of stem cells. Just as important are studies investigating the pathways controlling astrocytogenesis since much of the failure of cell transplantation in the brain may be due to the formation of astrocytes rather than new neurons.

Pharmaceuticals may also regulate neurogenesis in the adult brain. For example, recent studies suggest that lithium carbonate, commonly used to treat manic-depression, can promote neurogenesis in the brain[28] and increase grey matter volume after chronic (four weeks) use in humans with bipolar mood disorder.[29] Other antidepressants such as prozac also regulate neural stem cell production.[30]

In conclusion, the exciting possibility that the human brain has the potential, just like other organs of the human body, to repair itself is dramatically changing attitudes towards the treatment of neurodegenerative diseases. The era of the stem cell is upon us; hopefully we will no longer have to accept that the diagnosis of a neurodegenerative disease heralds an unremitting, inevitable clinical decline for the patient.

Correspondence. Professor R Faull, Anatomy with Radiology, Faculty of Medical and Health Sciences, The University of Auckland, Private Bag 92019, Auckland. Fax: (09) 373 7484; email: rlm.faull@auckland.ac.nz

1. Faull RLM, Waldvogel HJ, Nicholson LFB et al. Huntington's disease and neural transplantation: $GABA_A$ receptor changes in the basal ganglia in Huntington's disease in the human brain and in the quinolinic acid lesioned rat model of the disease following fetal neuron transplants. In: Tracey DJ, editor. Neurotransmitters in the human brain. New York: Plenium Press; 1995. p 173-97.
2. Chrisholm AH. Fetal tissue transplantation for the treatment of Parkinson's disease: a review of the literature. J Neurosci Neurosurg 1996; 28: 329-38.
3. Lindvall O. Update on fetal transplantation: the Swedish experience. Mov Dis 1998; 13: 83-7.
4. Olanow CW, Freeman TB, Kordower JH. Neural transplantation as a therapy for Parkinson's disease. Adv Neurol 1997; 74: 249-69.
5. Deckel AW, Robinson RG, Coyle JT, Sanberg PR. Reversal of long-term locomotor abnormalities in the kainic acid model of Huntington's disease by day 18 fetal striatal implants. Euro J Pharmacol 1983; 93: 287-8.
6. Isacson O, Dunnett SB, Bjorklund A. Graft-induced behavioral recover in an animal model of Huntington's disease. Proc Natl Acad Sci USA 1986; 83: 2728-32.
7. Freed CR, Greene PE, Breeze RE et al. Transplantation of embryonic dopamine neurons for severe Parkinson's disease. N Engl J Med 2001; 344: 710-9.
8. Spencer DD, Robbins RJ, Naftolin F et al. Unilateral transplantation of human fetal mesencephalic tissue into the caudate nucleus of patients with Parkinson's disease. N Engl J Med 1992; 327: 1541-8.
9. Widner H, Tetrud J, Rehncrona S et al. Bilateral fetal mesencephalic grafting in two patients with Parkinsonism induced by 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP). N Engl J Med 1992; 327: 1556-63.
10. Woodbury D, Schwarz EJ, Prockop DJ, Black IB. Adult rat and human bone marrow stromal cells differentiate into neurons. J Neurosci Res 2000; 61: 364-70.
11. Gage FH. Mammalian neural stem cells. Science 2000; 287: 1433-8.
12. Gould E, Reeves AJ, Graziano MSA, Gross CG. Neurogenesis in the neocortex of adult primates. Science 1999; 286: 548-52.
13. Eriksson PS, Perfilieva E, Bjork-Eriksson T et al. Neurogenesis in the adult human hippocampus. Nat Med 1998;4:1313-7.
14. Shors TJ, Miesegaes G, Beylin A et al. Neurogenesis in the adult is involved in the formation of trace memories. Nature 2001;410:372-5.
15. Maguire EA, Gadian DG, Johnsrude IS et al. Navigation-related structural change in the hippocampi of taxi drivers. Proc Natl Acad Sci USA 2000; 97: 4398-403.
16. Zigova T, Pencea V, Betarbet R et al. Neuronal progenitor cells of the neonatal subventricular zone differentiate and disperse following transplantation into the adult rat striatum. Cell Transplant 1998; 7: 137-56.
17. Herrera DG, Garcia-Verdugo JM, Alvarez-Buylla A. Adult-derived neural precursors transplanted into multiple regions in adult brain. Ann Neurol 1999; 46: 867-77.
18. Fricker RA, Carpenter MK, Winkler C et al. Site-specific migration and neuronal differentiation of human neural progenitor cells after transplantation in the adult rat brain. J Neurosci 1999; 19: 5990-6005.
19. Studer L, Tabar V, McKay RDG. Transplantation of expanded mesencephalic precursors leads to recovery in Parkinsonian rats. Nat Neurosci 1998; 1: 290-5.
20. Svendsen CN, Caldwell MA, Shen J et al. Long-term survival of human central nervous system progenitor cells transplanted into a rat model of Parkinson's disease. Exp Neurol 1997; 148: 135-46.
21. Armstrong RJ, Watts C, Svendsen CN et al. Survival, neuronal differentiation and fiber outgrowth of propagated human precursor grafts in an animal model of Huntington's disease. Cell Transplant 2000; 9: 55-64.
22. Young D, Lawlor PA, Leone P et al. Environmental enrichment inhibits spontaneous apoptosis, prevents seizures and is neuroprotective. Nat Med 1999; 5: 448-53.
23. Aberg MAI, Berg ND, Hedbacker H et al. Peripheral infusion of IGF-I selectively induces neurogenesis in the adult rat hippocampus. J Neurosci 2000; 20: 2896-903.
24. Pincus DW, Keyoung M, Harrison-Restelli C et al. Fibroblast growth factor-2/Brain-derived neurotrophic factor-associated maturation of new neurons generated from adult human subependymal cells. Ann Neurol 1998; 43: 576-85.
25. Fallon J, Reid S, Kinyamu R et al. In vivo induction of massive proliferation, directed migration and differentiation of neural cells in the adult mammalian brain. Proc Natl Acad Sci USA 2000; 97: 14686-91.
26. Yoshimura S, Takagi Y, Harada J et al. FGF-2 regulation of neurogenesis in adult hippocampus after brain injury. Proc Natl Acad Sci USA 2001; 98: 5874-9.
27. Stuckmann I, Weigmann A, Shevchenko A et al. Ephrin B1 is expressed on neuroepithelial cells in correlation with neocortical neurogenesis. J Neurosci 2001; 21: 2726-37.
28. Chen G, Rajkowska G, Du R et al. Enhancement of hippocampal neurogenesis by lithium. J Neurochem 2000; 75: 1729-34.
29. Moore GJ, Bedchuk JM, Wilds IB et al. Lithium-induced increase in human brain grey matter. Lancet 2000; 356: 1241-2.
30. Manev H, Uz T, Smalheiser NR, Manev R. Antidepressants alter cell proliferation in the adult brain in vivo and in neural cultures in vitro. Eur J Pharmacol 2001; 411: 67-70.

PROCEEDINGS

Christchurch Medical Research Society Scientific Meeting, July 27 2001

NZ Med J 2001; 114: 479-80

Subconscious saccadic adaptation is not affected by mild closed head injury. Marcus H Heitger, Michael R MacAskill, Timothy J Anderson, Richard D Jones, Michael W Ardagh, Ivan M Donaldson. Christchurch Movement Disorders and Brain Research Group (CMDBRG), Dept of Medicine, Christchurch School of Medicine and Health Sciences, Depts of Neurology, Medical Physics and Bioengineering, and Emergency Medicine, Christchurch Hospital, Christchurch.

Mild closed head injury (CHI) can cause diffuse axonal dysfunction within the brain and, amongst other things, cause deficits in several areas of oculomotor function. This study aimed to determine whether such deficits extended to saccadic adaptation, a form of subconscious (implicit) motor learning, within two weeks of mild CHI. Saccadic adaptation is the unconscious adjustment of saccade amplitude to surreptitious target displacements. Thirty patients (15-40 yr, Glasgow Coma Scale 13–15, alteration of consciousness < 20 min, post-traumatic amnesia < 4 h, and no oculomotor deficits on clinical examination) and 30 matched controls were compared using the following paradigm: Seven consecutive test blocks - a reflexive baseline block (no intrasaccadic target displacements), followed by five adaptation blocks, and a final baseline block. Each block comprised 50 horizontal jumps of a computer-generated stimulus. In the adaptation blocks, the target was always displaced centripetally by 12.5% of the initial target amplitude, triggered to occur during the saccades. Subjects were unaware of target displacements because of suppression of vision during saccades, but, over time, their primary saccades adapted subconsciously to land on the displaced target. Both groups adapted equally towards the ideal of 12.5% (CHI 8.43% vs control 9.14%, p = 0.44). Similarly, there was no difference in absolute saccadic gain over any of the seven blocks between the two groups. Exponential regression analysis of the adaptation curves confirmed that both the CHI and control subjects adapted with similar learning curves. These results indicate that neural damage caused by mild CHI does not impair oculomotor adaptation to intrasaccadic target displacement and suggest that implicit motor learning is not affected by mild CHI.

Protein hydroperoxide formation on apo B may be a significant event in the development of atherosclerosis. Joseph Pearson, Steven Gieseg, Free Radical Biochemistry Laboratory, Department of Zoology, University of Canterbury, Christchurch.

There is considerable evidence that the oxidation of low-density lipoprotein (LDL) by free radicals is the initiating event in atherosclerotic plaque formation. A considerable amount is known about the mechanisms of oxidation occurring in the lipid part of the LDL particle. In contrast very little is known about the oxidation of the protein moiety of the LDL particle, apo B. However, cell studies have shown that oxidative alterations to apo B, label the LDL as damaged, and cause it to be recognised by the macrophage scavenger receptor. Uncontrolled uptake of oxidised LDL by macrophages via their scavenger receptor leads to their deposition in the arterial wall. The three major cell types present in atherosclerotic plaque, macrophages, endothelial cells and smooth muscle cells, can all mediate LDL oxidation in vitro. Using LDL purified from human donors, we have measured the formation of protein and lipid hydroperoxides during copper or peroxyl radical induced oxidations. After three hours of oxidation with copper, the hydroperoxide concentration was 8.200uM, which corresponds to 82 hydroperoxide residues per LDL particle. This suggests that protein hydroperoxide formation is a major form of protein damage occurring on the LDL molecule during oxidation. Kinetic analysis has shown that the rate of protein hydroperoxide formation parallels that of lipid oxidation. The addition of the macrophage-synthesised antioxidant 7,8-dihydroneopterin (7,8-NP) strongly inhibited the formation of both the protein and lipid hydroperoxides. Other studies in our laboratory have shown that the synthesis of 7,8-NP in interferon-stimulated macrophages may inhibit cell mediated LDL oxidation. Our results suggest that hydroperoxide formation on apo B is a major form of free radical mediated damage to apo B. The toxic and reactive nature of protein hydroperoxides suggests that their formation within atherosclerotic plaques may have a major influence on the progression of plaque formation.

Comparison of the management of acute atrial fibrillation at Christchurch Hospital in 1997 and 2000. Sally H Wu, Matthew Widdowson, A Mark Richards, John M Elliott. Department of Medicine, Christchurch School of Medicine and Health Sciences, Department of Cardiology, Christchurch Hospital, Christchurch.

Atrial fibrillation (AF) is a common irregular heart beat which increases the risk of heart failure and stroke. We audited the management of AF at Christchurch Hospital by review of case notes of all patients discharged with a primary diagnosis of AF during two time periods- 1 July 1996 to 30 June 1997 and 1 July 1999 to 31 March 2000. Arranged admissions for electrical cardioversion were excluded. We assessed clinical characteristics, in-hospital treatments and the use of warfarin at discharge. Of 228 patients admitted in the twelve months to July 31 1997, 78% were admitted to Cardiology, compared with 89% of 312 patients admitted in the nine months to March 31 2000 ($p<0.01$). Mean age increased from 71 to 74 years ($p>0.05$). More than 50% of both groups had a past history of AF, most complained of palpitations and dyspnoea, and one quarter had heart failure at presentation. Heart rate had slowed to <100 beats/min within 6 hours in one-third of both years, 53% were in sinus rhythm 24 hours after presentation in 2000 vs 41% in 1997, $p>0.05$. At discharge, 68% and 66% were in sinus rhythm. In 2000, 83% of those still in AF at discharge and in whom warfarin was not contraindicated received warfarin, including 77% of those with multiple risk factors for future stroke. There has been an increase in the number of patients admitted with AF but no change in the proportion discharged in normal rhythm or receiving warfarin at discharge.

Wireless technology and automated insulin infusion. J. Geoffrey Chase, ZH Lam, JY Lee, KS Hwang, Graeme C Wake. Departments of Mechanical Engineering and Mathematics, University of Canterbury, Christchurch.

Close control of blood glucose levels reduces vascular complications in type 1 diabetes. This project develops 'modeless' control methods for the automation of insulin infusion employing converging technologies in blood glucose biosensors and wireless data transmission. The goal is to develop an active interface able to provide more optimal control of blood glucose levels than current methods while accounting for variation in patient response, insulin employed, sensor bandwidth and insulin pump dynamics and limitations. This research evaluates physiologically accurate models to assess their utility in representing critical system dynamics for control design. Our current research approach employs simulation to test control protocols created in consultation with clinicians. The simulations account for the use of commercial, or easily developed, insulin pumps wirelessly connected to control computation with sensor measurements from a commercially available, semi-invasive blood glucose sensor, or similar device. The term 'modeless' applies to the control design as a means of eliminating the dependence on time-varying parameters. Results to date compare favourably with analytically determined optimal values and indicate that automated insulin infusion for the control of blood glucose levels is feasible via relatively simple control systems. Comparisons with results in the controls literature show reductions of over 50% in the magnitude and duration of blood glucose excursions from basal levels with significant promise of further improvement using more flexible controllers. These initial results show that the greater amounts of data available from modern biosensors should enable near optimal automation of insulin infusion.

Simulating the open-loop behaviour of the human motor control system. Paul R Davidson, Richard D Jones, John H Andreae, Harsha R Sirisena. Departments of Electrical and Electronic Engineering, University of Canterbury, Medical Physics and Bioengineering, Christchurch Hospital, Christchurch School of Medicine and Health Sciences, Christchurch.

When we perform voluntary movement our central nervous system acts as a hybrid feedforward and feedback adaptive control system. In recent human motor control models, feedback is often used to correct errors while an inverse model is simultaneously tuned to provide accurate feedforward control. This popular and appealing hypothesis, based on a combination of psychophysical observations and engineering considerations, predicts that once the tuning of the inverse model is complete the role of feedback control is limited to the correction of disturbances. This hypothesis was tested by looking at the open-loop (no feedback) behaviour of the human motor system during adaptation. An experiment was carried out involving 20 normal adult subjects who learned a novel visuomotor relationship on a pursuit tracking task with a steering wheel for input. During learning, the response cursor was periodically blanked, removing all feedback about the relationship between hand motion and response cursor motion. Open-loop behaviour was not consistent with a progressive transfer from closed- to open-loop control. Our recently developed computational model of the brain – a nonlinear generalization of the Adaptive Model Theory (nAMT) – was able to reproduce the observed closed- and open-loop results. In contrast, other models were unable to reproduce the observed open-loop results as they relied on feedforward control after adaptation. nAMT, unlike other models, continues to use feedback to control slow movements after adaptation. In summary, our computational model is currently the only motor control model able to accurately simulate the closed- and open-loop characteristics of the experimental response trajectories.