More doctors, but not enough: Australian medical workforce supply 2001–2012

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ABSTRACT

Objective: To project the future size of the Australian medical workforce, from 2001 to 2012.

Design and setting: Stochastic simulation modelling of the Australian medical workforce, taking into account recent increases in medical school capacity and trends in the intake of foreign graduates.

Main outcome measures: Number of full-time equivalent (FTE) medical practitioners per 100 000 persons within various occupation groups from 2001 (baseline) to 2012.

Results: The total medical workforce was projected to rise from 53 384 in 2001 to 67 659 by 2012 (95% CI, 63 924–71 036). On a per capita basis, the number of FTE clinicians was projected to rise from 331 per 100 000 persons in 2001 to 382 (95% CI, 359–403) per 100 000 persons in 2012. The general practice workforce was projected to fall from 133 FTE general practitioners per 100 000 persons in 2001, to 129 per 100 000 persons in 2003, and then remain at around this level through to 2012. The specialist workforce was projected to show steady growth, rising from 162 FTE specialists per 100 000 persons in 2001 to 206 (95% CI, 194–218) per 100 000 persons in 2012.

Conclusions: The general practice workforce is likely to face continued chronic shortages, necessitating innovative policy responses to ensure that the community's need for primary medical care is met. Retirement rates are a key determinant of workforce supply, suggesting a need to encourage general practitioners to remain active as long as they remain effective. Further refinement of stochastic models will help facilitate a more proactive approach to workforce planning.

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More responsive planning for the future medical workforce has become increasingly necessary, as rapid changes are taking place in supply of medical practitioners and the requirement for their services.

Five new medical schools have opened since 2000, and the number of Australian medical graduates is set to increase by 60% in the next few years, from 1300 in 2005 to more than 2100 after 2010.[1] Furthermore, international students completing their medical training in Australia are increasingly likely to enter the Australian medical workforce, facilitated by changes in visa conditions.[2,3]

Other factors are reducing the supply of "effective full-time practitioners". For example, medical practitioners' working hours fell from 48.3 hours per week in 1995 to 44.4 by 2003 (Australian Institute of Health and Welfare, Medical labour force 1995–2001, custom data, June 2004).[4] Although this is partly driven by the feminisation of the medical workforce, working hours declined more for male doctors (by 7.4%) than for female doctors (6.4%). Few data are available about retirement rates, but the approach of retirement age for the "baby boomer" generation of doctors is another likely downward pressure on medical workforce supply.[5] Additionally, increasing opportunities, and requirements, for medical practitioners to carry out non-clinical activities, such as management, administration, research, continuing education, and supervision, reduce the effective supply for direct provision of clinical services.[6] The general practice (GP) workforce has been a particular concern, with perceived shortages that seem set to continue unless steps are taken to address this issue.[7]

Accurate projections of workforce supply are essential for effective planning, but the approaches used in Australia are limited. Current projections provided by the Australian Medical Workforce Advisory Committee (AMWAC) are generally limited to particular sectors or specialties within medicine. There has been no review of the medical workforce as a whole since 1996.[8]

A limitation of current Australian approaches to projecting workforce supply is the use of deterministic methods, which produce single-point estimates. These methods do not reflect the uncertainties inherent in projection modelling, and in the medical workforce supply system itself. Stochastic models, which use random numbers and probability distributions, produce results expressed as a probability distribution or range, which can be analysed statistically. Simulation has been identified as a preferred approach for health workforce modelling.[9]

Our aim was to use a stochastic simulation to project supply of the Australian medical workforce to 2012.

METHODS

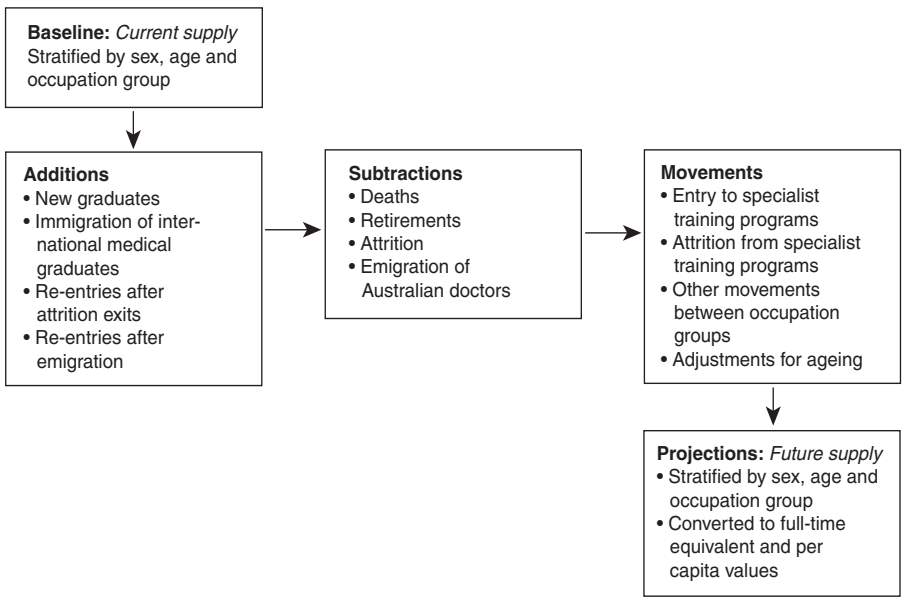
Our model was based on the "stocks and flows" approach. Our baseline year was 2001, and projections were made through to 2012. To generate projections, new graduations, immigrants and re-entrants to the workforce were added, and deaths, retirements and attrition exits subtracted for each year (Box 1). Adjustments were made for movement between occupations within the medical workforce, and for ageing, to estimate the number of doctors in subsequent years.

The model uses data from a wide range of sources which have not previously been drawn together for this type of analysis (Box 2). Key assumptions are summarised in Box 3. The main outcome measure was the number of full-time equivalent (FTE) doctors (per 100 000 persons) in broad occupational groups such as general practitioners, specialists, and clinicians overall.

Data analysis

The stochastic input variables were defined using triangular distributions (defined by the minimum, maximum and most likely values) in replacement of a single-point estimate input value. Monte Carlo simulation methods were used (with Latin hypercube sampling), with each run of the model involving 5000 iterations. In each iteration, a different value from within the defined range for the input variables was used. This produced output values that are value ranges rather than point estimates. These were expressed as mean values with 95%

1 Summary of process for model of future medical workforce



2 Data sources for the simulation model

Variable	Data source
Current supply at baseline (2001)	National medical labour force survey: Australian Institute of Health and Welfare (custom data, June 2004)
New medical graduates	Completions of medical degrees: Australian Government Department of Education, Science and Training (custom datasets RFI 03-312 and RFI 04-360, 2004) Projected completions based on commencements (Department of Education, Science and Training) and estimated completion rate
International medical graduates entering workforce	Number of immigrations, number of temporary visas issued, number of successful completions of Australian Medical Council exams, distribution of international medical graduates to occupational groups: Australian Institute of Health and Welfare; Australian Medical Workforce Advisory Committee (AMWAC); other[10-12]
Attrition from the workforce	Rate of temporary exits from the workforce and length of time before returning, both for general attrition exits and emigration of Australian doctors to other countries: Monash Medical Graduates Survey[13]
Retirement rates	Retirement rates by age and sex: AMWAC[14]
Deaths	Death rates by age and sex: Australian Bureau of Statistics[15]
Intake to training programs	Number of commencements of postgraduate medical training programs each year for general practice and all other specialist combined: Medical Training Review Panel; AMWAC; Monash Medical Graduates Survey;[13,16,17] General Practice Education and Training (Trainee statistics, personal communication, November 2004)
Movement between occupational groups	Attrition from training programs: AMWAC[16] Transfer between clinical and non-clinical occupations: Monash Medical Graduates Survey[13]
Full-time equivalent workforce	Number of hours worked per week by age (5-year bands) and sex in 2001: national medical labour force survey, Australian Institute of Health and Welfare (custom data, June 2004)
Per capita workforce	Population projections (series B): Australian Bureau of Statistics[18] ◆

confidence intervals. The model was implemented using @Risk 4.5 (Palisade Asia-Pacific, Sydney, NSW) and Excel 2003 (Microsoft, Redmond, Wash, USA).

Historical data from the national medical labour force survey from 1995 to 2001 were used to provide a context for presenting the results (Australian Institute of Health and Welfare, custom data, June 2004).

Alternative scenarios

In addition to the "base case" projection, key input parameters were varied to assess the effect on the projected number of doctors. Five parameters were explored:

- intake of international medical graduates (IMGs);
- flows of international medical students;
- retirement rates;
- decline in working hours; and
- intake to GP training programs.

For IMGs, two scenarios were projected. In the first, the number of temporary resident doctors was decreased, to explore the consequences if planned increases in intake of temporary resident doctors do not eventuate. In this scenario, the annual intake of temporary resident doctors was set as constant at the 2002 level (just under 3000). In the second scenario, the number of permanent resident IMGs was increased to reflect recent changes in government policy. We assumed that the number of such entries would be 500 in 2004, 800 in 2005 and 600 per year from 2006.

The alternative scenario for international medical students assumed that all members of this group entered the Australian medical workforce on completion of their training.

We also explored the effect of retirement rates on total workforce supply. Under the "high retirement" scenario, retirement rates by age and sex were increased by 25 percentage points, and under the "low retirement" scenario, they were decreased by 25 percentage points or to the minimum (zero).

The effect of continued reductions in working hours was explored by projecting a continuation of the rate of decline in working hours that was observed from 1995 to 2001, instead of the constant values (2001 levels) in the base scenario. These were stratified by age, sex and occupation group, with an average annual reduction of 0.94% for men and 0.66% for women.

Two scenarios were explored in relation to GP training intake from 2005 onward. The first looked at a 10% shortfall in new recruits to the GP training program (540 instead of 600 per year) to explore the

3 Key assumptions of the base simulation model

Variable	Key assumptions
New medical graduates	• Domestic students only • All graduates proceed to junior medical officer positions as point of entry to workforce • Estimated completion rate of 93%, based on analysis of historical patterns of commencements and completions
International medical graduates entering workforce	• 400 permanent international medical graduates per year, with age, sex, and occupation distribution constant at 2001 distribution patterns • 2973 temporary resident doctors enter in 2001; increase by 50 each year • Length of stay of temporary resident doctors in Australia for 2001–2004: 1 year for 66%; 2 years for 17%; with 16% remaining in Australia (converting to permanent residency). Length of stay of temporary resident doctors for 2005 onward: 1 year for 33%; 2 years for 33%; with 33% remaining in Australia
Attrition from the workforce	• Attrition rates applied to age ranges up to 39 years, and vary by age and sex, between 0 and 3.4% annually • 72% of attrition exits re-enter after 1 year; 8% return after 2 years, and 4% after 3 years • Emigration exits (from Australia) applied to age ranges up to 39 years, and vary by age and sex, between 0.5% and 4.8% annually • 26% of emigration exits return after 1 year, 28% after 2 years, and 25% after 3 years
Retirement rates	• Retirement rates remain constant • Fully retired at age 75 years
Deaths	• Death rates remain constant
Intake to training programs	• Intake to general practice training program: actual 2001–2004, 600 per year from 2005 • Intake to all other specialist training programs: actual 2001–2004, 1150 per year from 2005
Movement between occupational groups	• 1.4% of clinicians aged 25–29 years (and 1.1% of those aged 30–34 years) move to non-clinical workforce annually; 53% return to clinical workforce after 1 year, 18% after 2 years, 22% after 3 years, with 7% remaining • 0.04% of clinicians aged 35–39 years move to non-clinical workforce annually and all remain there • 0.04% annual attrition rate from vocational training programs
Ageing of the workforce	• Uniform distribution within 5-year age categories, so 20% of each category moved forward annually (except age group under 25 years, 33% moved forward)
Full-time equivalent workforce	• Full-time defined as 35 hours per week (Australian Bureau of Statistics) • Working hours by age and sex remain constant at 2001 levels

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consequences of failing to fill training places. The second looked at a 25% increase in annual intake (750), in line with current calls for further increases to the GP workforce.

RESULTS

In 2001, there were 53 384 doctors in the Australian medical workforce. Of these, 21 671 (40.6%) were general practitioners (including those in training), 22 552 (42.2%) were specialists (including specialists in training), and a total of 92.5% (49 392) were clinicians.

The total medical workforce was projected to increase by just over 14 000 during the projection period. Under the base case conditions, it would reach 57 988 by 2006 (95% CI, 56 867–59 090), and 67 659 by 2012 (95% CI, 63 924–71 036). This represents an average annual growth rate of 2.2%, which compares with 2.1% per year from 1995 to 2001. The rate of growth differed across the projection period, averaging 1.0% up to 2004, and then averaging 2.6% from 2005 onward. The higher rate of growth from 2005 onward is due to a combination of factors, including higher numbers of medical school graduates, longer average stays by temporary resident doctors, and a lower retirement rate.

The GP workforce was projected to reach 23 408 (95% CI, 21 705–24 953) by 2012 — a net gain of just 1737 general practitioners in more than a decade. By 2012, this category is likely to comprise about 35% of the active medical workforce. The specialist workforce was projected to experience steady growth, increasing from 22 552 in 2001 to 32 160 (95% CI, 30 614–33 560) by 2012, when it would be 47% of the medical workforce.

The total clinical workforce was about 330 FTE clinicians per 100 000 persons between 1995 and 2001, and was projected to reach 382 (95% CI, 359–403) per 100 000 persons in 2012 (Box 4). Most of this growth was projected to occur after 2004, with levels between 2001 and 2004 continuing recent past trends. For the GP workforce, past trends show a decline in the number of FTE general practitioners per 100 000 persons, from more than 140 in 1995 to 133 in 2001. This was projected to fall to about 129 per 100 000 persons by 2003 and remain at this level for the projection period (Box 4).

The specialist workforce was projected to rise from 162 FTE specialists per 100 000 persons in 2001 to 206 (95% CI, 194–218) per 100 000 persons in 2012, continuing the past pattern of growth (Box 4). The hospital non-specialist workforce showed some volatility from 1995 to 2001, varying from 32 to 40 FTE doctors per 100 000 persons. This workforce was projected to show little growth until 2007, and then rise to reach 47 (95% CI, 46–48) per 100 000 persons by 2012 (Box 4). The lack of growth before 2007 is largely attributable to increases in the number of vocational training positions, coupled with an absence of growth in the number of new graduates during this period.

Alternative scenarios

The first series of alternative scenarios explored the effect of a changed pattern of intake of IMGs. None of the alternative scenarios differed significantly from the base case, with mean values of all three alternative scenarios falling within the confidence intervals of the base case scenario (Box 5). This was also the case for the high retirement rate scenario. In contrast, a low retirement rate was projected to result in a significantly larger FTE clinical workforce by 2012, and with decreasing working hours the workforce was projected to be

significantly smaller (with projected means for both these scenarios outside the confidence intervals of the base case projections: see Box 5).

Neither a 10% decrease nor a 25% increase in GP training positions was likely to produce a significant difference from the base case projection of total GP workforce to 2012 (Box 5). However, a 25% increase in GP training positions would reduce the hospital non-specialist workforce. Under this scenario, the number of hospital non-specialists per 100 000 persons was projected to fall to 31.3 by 2007 and to be 38.3 by the end of the projection period. This is significantly lower than the number of hospital non-specialists projected under the base case scenario (47.0 per 100 000 persons).

DISCUSSION

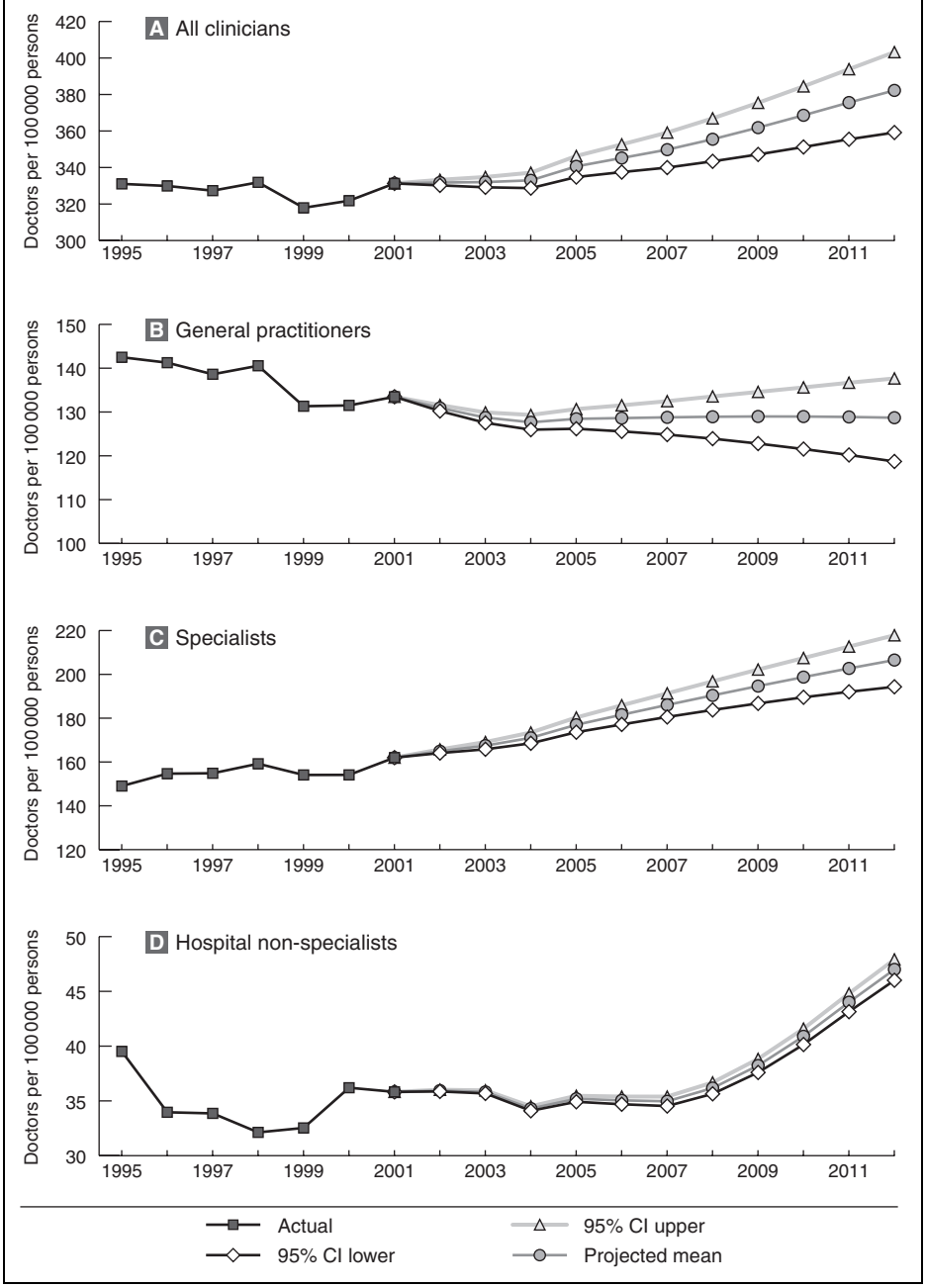
Our modelling indicates that overall supply of the Australian medical workforce would continue to grow until 2012 under the conditions specified. There would be notable differences between sectors, with steady growth in the specialist workforce, but no growth in real terms in the GP workforce, and no real growth in the hospital non-specialist workforce until 2008.

The FTE GP workforce in 2004 was projected to be at its lowest level since 1995. The study indicates that a 25% increase in training intakes from 2005, even if it were possible, would only return the FTE GP workforce per capita to its 2001 level by 2012. The results suggest an entrenched, long-term shortage in this workforce. This is consistent with previous conclusions.[7,12,19-21] For example, the recently completed AMWAC review concluded that future supply of the GP workforce would be unlikely to meet demand without significant additional entrants to the primary medical care workforce, in the order of an additional 400–500 per year.[7]

The projected increased specialist-to-population ratio, in contrast to the steady GP workforce, may lead to role changes between them. For example, specialists could take on more primary care in chronic conditions such as heart disease and diabetes.

Persistent chronic GP shortages imply the need for some lateral thinking on how to ensure that Australia's need for primary medical care can be met. Possible policy alternatives to supply enhancement, which should be the subject of further debate, include task substitution, demand management (including increased self-management) and remuneration changes.[20-24]

4 Past and projected full-time equivalent medical workforce per 100 000 persons, 1995–2012



Retirement rates were identified as a key determinant of supply. Lower retirement rates, with more doctors staying in the workforce longer, would result in a significantly larger workforce, particularly in the short term. Retirement rates are especially important when a large proportion of the workforce is older, and so the relative contribution of these cohorts to total effective workforce supply is higher. In the latest national data, a quarter of the medical labour force were older than 55 years.[4] With the ageing of the Australian medical workforce, retirement rates will remain an important determinant of total medical workforce supply.[5] Further research to generate more accurate information about retirement trends, and identify potential policy levers to influence retirement intentions, would be useful for medical workforce planning.

The alternative scenarios demonstrated that workforce levels are sensitive to the

5 Comparison of alternative scenarios

Scenario	Workforce in 2012		Difference from base case mean
	Mean	95% CI	
Total workforce (numbers)			
Base case scenario	67 659	63 924–71 036	
Steady TRD intake	66 355	62 633–69 660	–1304
Increased IMG intake	69 237	65 416–72 607	+ 1578
Added international students	70 468	66 807–73 788	+ 2809
FTE clinical workforce per 100 000 persons			
Base case scenario	382	359–403	
High retirement rate	365	339–389	–17
Low retirement rate	407	388–423	+ 25
Decreasing working hours	348	327–367	–34
FTE general practice workforce per 100 000 persons			
Base case scenario	128.7	118.7–137.7	
Less 10% intake	126.5	116.4–135.3	–2.2
Plus 25% intake	134.1	124.0–143.2	+ 5.4

FTE = full time equivalent. IMG = international medical graduate. TRD = temporary resident doctor. ◆

trend in decreased working hours. This opens possibilities for new policy options to influence supply by altering remuneration levels and structures to arrest this trend.

The validity of our modelling may be investigated by comparing its projections with the actual workforce numbers in the early part of the projection period (ie, 2002 and 2003). Since the completion of our analysis, the annual national medical labour force surveys for these years have been published. For 2002, there is close similarity between the predictions of our model and the actual data (for example, a projected total medical workforce of 53 782 compared with an actual workforce of 53 991).[25] For 2003, the projections were slightly lower than the actual workforce numbers (projected total, 54 294; actual total, 56 207).[4] This suggests that the model may be a conservative estimate of growth, and any potential shortages may be less than we predict.

As with any modelling exercise, the projections depend on the parameter estimates used. For example, the retirement rates we used, which were based on AWMAC estimates,[14] may have been too high. Our projected workforce for 2003 had 5.7% of doctors aged 65 years and older. In the actual data, doctors in this age group made up 8.5% of the workforce.[4] This reinforces the need for better data about this important determinant of workforce numbers.

Our estimates of the numbers of new graduates from Australian medical schools included domestic students only (again consistent with AMWAC methodology), but these may also underestimate new workforce entrants by excluding international students trained in Australia, and fee-paying domestic students. These groups may be already joining the Australian medical workforce in greater than expected numbers.

Our study demonstrates the advantages of stochastic processes in workforce supply modelling. This approach enables a clear indication of the degree of uncertainty surrounding the projections. Another advantage is the ability to make meaningful comparisons between the projections generated under various scenarios, enabling assessment of the importance of key variables.

The whole-system approach allows monitoring of system dynamics such as the balance between different sectors within the medical workforce. For example, alternative scenario analyses demonstrated that, although increasing the intake to the GP training program by 25% might not significantly influence the size of the GP workforce, it would significantly reduce the hospital non-specialist workforce. Another example of the system dynamics is the possibility that a GP workforce shortage limits the rate at which hospitals can improve their efficiency, and hence workforce requirements, by early discharge of patients to community-based care.

The current shift into a boom growth phase in Australian medical workforce supply will create a "square wave shift". A large, infrequent adjustment in supply such as this increases the risk of overcorrection. The previous boom in medical workforce supply, in the 1970s, was followed by a "bust", which saw strict limits placed on medical student numbers and GP training program intakes. A systems perspective, with due consideration of key dynamics inherent in the medical workforce supply system (such as the long lead times) would assist in producing a smoother progression of workforce supply growth over time. A proactive approach to the planning and management of the medical workforce, involving continued monitoring, would facilitate more frequent and less dramatic adjustments to supply. This in turn would reduce the likelihood of extreme supply conditions (shortages or surpluses) and assist more effective delivery of medical care.

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COMPETING INTERESTS

None identified.

AUTHOR DETAILS

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