The Potential Impact of the Next Influenza Pandemic on a National Primary Care Medical Workforce

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Abstract

Background: Another global influenza pandemic is highly probable. We estimated its potential impact on the medical workforce in New Zealand, so that planning could mitigate the disruption from the pandemic and similar challenges.

Methods: The model in the "FluAid" software (CDC, Atlanta) was applied to the primary care component of the New Zealand medical workforce (based on national survey data for 2002).

Results: At its peak (week 4), the pandemic would lead to 1.2% to 2.7% loss of primary care doctors' work-time, using baseline assumptions. Most workdays (88%) would be lost due to illness, followed by hospitalisation (8%), and then premature death (4%).

Inputs for a "more severe" scenario included more severe health effects and time spent caring for sick relatives. For this scenario, 9% of medical workdays would be lost in the peak week, and 3% over a more compressed six-week period of the first pandemic wave. As with the base case, most (64%) of lost workdays would be due to illness, followed by caring for others (31%), hospitalisation (4%), and then premature death (1%).

Conclusion: The model results provide parameters of the surge capacity required in the primary care medical workforce to deal with the next influenza pandemic or other health challenge of similar scale.

Background

It is probably only a matter of time before the next influenza pandemic. The only uncertainties are the timing and impact of the pandemic. What appears certain is that effective planning for public health interventions before and during a pandemic is likely to reduce its impact [1]. A pandemic is likely to particularly disrupt the health sector because of the higher likelihood of exposure of its workforce on top of the increased demands for in- and out-patient services. This article aims to provide estimates for the impact of pandemic influenza on the primary care component of the medical workforce for a single country – New Zealand. Such estimates may also inform planning around other new emerging infectious disease threats, including those from bioterrorism, by providing some parameters of the level of 'surge capacity' that needs to be built into the health sector.

New Zealand has approximately 23,000 health practitioners plus around 30,000 support workers delivering services in the community [2]. Around 40% of its medical practitioners and 23% of its nurses work in primary care settings. The population to general practitioner (GP) ratio varies considerably across different territorial authorities from about 450 to about 2300 [3]. New Zealand's *Primary Health Care Strategy* [4], released in 2001, places primary care at the centre of the country's health system. It defines a future for primary care where, increasingly, primary care and public health strategies are expected to be coordinated and inter-meshed, with the overall objective of improving population health and reducing health inequalities. The *Strategy* led to the formation of new non-profit umbrella organisations, called Primary Health Organisations (PHOs) [5]. PHOs are responsible for ensuring that their constituent general practices and community organisations provide comprehensive, continuing and coordinated care to their enrolled populations, including health promotion and prevention programmes. Increasingly, PHOs are held accountable to their funders for a range of population health outcomes. The development of PHOs mirrors, to an extent, the development over the past five years of primary care groups and trusts in the United Kingdom [6].

Methods

The FluAid Model: The United States Centers for Disease Control and Prevention has developed a relatively simple deterministic model in its 'FluAid' software [7]. The output of the model is the number of deaths, hospitalisations, and illnesses requiring medical consultations for a wave of pandemic influenza. The model assumes no public health interventions (eg, limitations of movement, vaccine, or anti-viral drugs) are used to control disease spread. Specific details on the FluAid software and the various assumptions in the model are detailed on the CDC website [8] and other documents [9, 10].

Baseline model assumptions: The default values used in FluAid were used for the mortality rates, the hospitalisation rates and the rates of illness. The default values for the incidence rates of clinical illness were also used (ie, 15% and 35% for "most likely" results). However, doctors in employment are likely to have lower prevalence rates of chronic diseases and a better risk factor profile (eg, given their substantially lower smoking rates in New Zealand [11]). Therefore, the proportion of this population assumed to be in the "high-risk" category was arbitrarily halved (ie, from 14.4% for 19-64-year-olds down to 7.2%).

The length of time associated with hospitalisation (average of 8 days) and from clinical illness (2 days) was based on the United States data in a previously published model [10]. In addition to this it was assumed that there would be one day of convalescence for clinical illness and three days convalescence after hospitalisation (ie, before returning to work). To determine the *working days* lost, these figures were adjusted by the proportion of a typical week that is spent at work (ie, 5 out of 7 days).

Population data: The latest available national figure for the total number of registered medical practitioners working in primary care was 3,074 (ie, those working 4 or more hours per week in 2002 and who are classified as working in "general practice" or "primary care") [12]. The average hours worked per week by these doctors is 42 hours and it was assumed that they would work full time during the pandemic period (unless affected by illness).

Time distribution: The FluAid model does not consider the time frame of the epidemic within an affected region. The length of influenza epidemics is highly variable [13, 14]. For the baseline analysis the distribution of cases and a duration of eight weeks was used, based on the results of a stochastically simulated influenza epidemic [15].

"More severe" scenario assumptions: For this scenario the pandemic wave was assumed to last only six weeks and the upper range "maximum" values from the FluAid model were used (for the 35% incidence rate scenario). The proportion of cases in the peak week was raised to 40% (from 32.3%), the upper limit of the days of hospitalisation was used (13 days [10]), and days lost from illness was doubled relative to the baseline model (ie, to 4 days). Furthermore, it was also assumed that each of these doctors would spend an average of 0.5 days during the pandemic wave period caring for sick relatives or household members.

Results

The baseline modelling indicated a loss of around 580 to 1,320 workdays (for 15% and 35% incidence rates – Table 1). The reduction in days worked was 1.2% to 2.7% of maximal capacity at the time of estimated peak pandemic impact (week 4). An estimated 88% of lost workdays arose from illness not requiring hospitalisation, 8% from hospitalised cases, and 4% from deaths caused by influenza (when using the 35% incidence rate).

The results for the "more severe" model inputs were a total of around 3,590 lost workdays (Table 2). The reduction in days worked was 9.3% of maximal capacity at the time of estimated peak pandemic impact and 2.9% over the six-week period. The lost workdays mainly arose from the impact of illness not requiring hospitalisation (64%), then the time spent caring for others (31%), the impact of hospitalisation (4%), and then the impact of premature death (1%).

Discussion

Impact on health and workdays: The modelling results suggest a potentially significant impact on the health of the primary care medical workforce. This is particularly so for the "more severe" scenario which predicted a mortality rate of 65 per 100,000 (albeit for just one pandemic wave). This is much less than the total population rate for the 1918 pandemic in New Zealand of 745 per 100,000 [16], but it is more than United States total population rates for the 1957 Asian flu pandemic (22 per 100,000) and the 1968 Hong Kong flu pandemic (14 per 100,000) [17].

The results suggest that illness is the major contributor to lost workdays in the baseline model. Nevertheless, if time spent caring for sick relatives is considered (ie, as in the "more severe" scenario) then this also made a significant contribution to the total workdays lost. Furthermore, the lost workdays would come at a time when the demand on the medical workforce is particularly high as a result of the pandemic.

Implications for the health sector: There are several broad strategies to reduce the impact of an influenza pandemic on health care workers. Firstly, infection control strategies aimed at doctors need to be in place. These include basic hygiene practices and mask use may also be appropriate (depending on risk [1]). Health authorities and doctors themselves could also stockpile and then utilise anti-virals [18] at the appropriate time.

Secondly, pandemic planning needs to include specific measures to maintain the functional capacity of health care workers, bearing in mind that the impact of an influenza epidemic is likely to vary between urban and rural areas. While exposure to infection may be less in relatively isolated rural areas, such areas generally have far less 'spare' health care capacity, should GPs be incapacitated. General practices and health authorities can consider plans to provide care for the ill dependents of their medical staff so as to reduce absenteeism rates. Through other pandemic planning activities they can also potentially reduce the overall impact of a pandemic and hence demands on their staff. For example, rapid action at the start of the epidemic to cancel elective procedures could enhance workforce capacity. Establishing dedicated primary care assessment centres for patients with suspected influenza could also reduce overall GP workload.

Thirdly, improving health sector surge capacity now would be desirable as the New Zealand health sector is often running at stretched capacity (eg, especially emergency departments [19]). Expanding existing services such as the "Healthline" (a free information service to the public staffed by nurses) may also be worthwhile. Similarly, active promotion of key websites with information on managing influenza (eg, as per the CDC website [20]) could be publicised each winter season. All such measures would benefit the public prior to a pandemic as well as potentially reducing the demands on the medical workforce in the primary care and secondary care settings during a pandemic.

Fourthly, a greater focus on the primary care nursing workforce would be of benefit. Following the implementation of the Primary Health Care Strategy there has been a rapid shift to capitation funding of general practices, and an attendant increased focus on team based primary care (principally GPs and practice nurses). This trend raises the possibility of increasing substitution of GP work roles by nurses. This type of substitution has occurred for a decade or more in a range of community-governed non-profit practices and other capitation-funded practices [21, 22]. The practice nurse workforce, while also vulnerable to infection, would provide a buffer for the GP workforce in the event of attrition of GP capacity.

Limitations with the modelling: The uncertainties associated with pandemic influenza mean that any modelling of its future impact is fairly simplistic. Modelling using the FluAid model also has a number of specific limitations (eg, the lack of any stochastic elements). Reasons why the results from this model could be substantial underestimates of the true health impact on the medical workforce include: (i) the new strain may be particularly infectious and/or virulent; (ii) the incidence rate for clinical illness might be higher for doctors given their occupational risk [23]; and (iii) doctors may be relatively slow to seek care for themselves – especially at the time of a national crisis.

Nevertheless, the predicted results could also be overestimates of the health impact for the following reasons: (i) various international and national public health interventions (as recommended by WHO [1]) may reduce the impact of pandemic influenza; (ii) at least for subsequent pandemic waves, an appropriate vaccine may be available; (iii) antivirals could prevent infection and reduce morbidity amongst the medical workforce [18]; and (iv) improved treatment could lower hospitalisation and mortality rates (relative to the figures used in this model).

Further research: This modelling could be further refined to address some of the limitations detailed above. Clarifying the prevalence of "high-risk" conditions among the medical workforce would be a particularly important refinement along with improving the estimates of time off work to care for relatives.

Summary: This modelling work has a number of limitations and so these results could still substantially over- or under-estimate the impact of the next influenza pandemic on the medical workforce. Nevertheless, this modelling work highlights the importance of infection control strategies for health care workers, pandemic planning, and improving current health sector surge capacity.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors contributed to the writing and NW, MB and OM also contributed to the design. NW conducted the analyses. All authors read and approved the final manuscript.

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Table 1: Predicted impact of pandemic influenza on the population of active and registered primary care medical practitioners based on modelling with FluAid (n=3,074 doctors, 15% and 35% incidence rates)

Week of epidemic in NZ	Deaths (No.)	Hospital - isations (No.)	Illnesses (No.)[a]	Lost workdays from deaths (No.)[b]	Lost workdays from hospital - isations (No.)	Lost workdays from illness (No.)[a]	Total lost workdays (No.)	Reduction in days worked (%)[c]
1	0.0	0	5 – 11	0	1 – 2	10 – 23	11 – 25	01 – 0.2%
2	0.1	1	26 – 61	1	5 – 11	56 – 130	62 – 142	0.4 – 0.9%
3	0.2	1 – 3	59 – 137	2	12 – 25	126 – 294	139 – 321	0.9 – 2.1%
4	0.3	2 – 4	77 – 180	3	15 – 33	165 – 386	184 – 422	1.2 – 2.7%
5	0.2	1 – 2	43 – 101	4	9 – 19	93 – 217	106 – 240	0.7 – 1.6%
6	0.1	1 – 1	20 – 47	5	4 – 9	44 – 101	52 – 115	0.3 – 0.7%
7	0.0	0	5 – 12	5	1 – 2	11 – 26	17 – 33	0.1 – 0.2%
8	0.0	0	3 – 7	5	1	7 – 16	12 – 22	0.1%
Total[d]	**1**	**6 – 13**	**239 – 556**	**25**	**47 – 102**	**512 – 1,192**	**584 – 1,320**	**0.5 – 1.1%**

[a]For those with clinical illness that is severe enough to require a medical consultation – but which does not result in hospitalisation.
[b]The impact is cumulative for deaths in terms of lost workdays.
[c]Relative to the full workforce working for five days per week.
[d]The figures in the columns do not add up exactly to the totals due to rounding.

Table 2: Predicted impact of pandemic influenza on the population of active and registered primary care medical practitioners using "more severe" scenario assumptions and based on modelling with FluAid (n=3,074 doctors)

Week of epidemic in NZ	Deaths (No.)	Hospital-isations (No.)	Illness (No.)[a]	Lost workdays from deaths (No.)[a]	Lost workdays from hospital-isations (No.)	Lost workdays from illness (No.)[a]	Lost workdays from caring for others	Total lost workdays (No.)	Reduction in days worked (%)[a]
1	0.2	1	64	1	13	184	88	285	1.9%
2	0.4	3	161	3	32	459	220	713	4.6%
3	0.8	6	321	7	64	918	439	1,428	9.3%
4	0.4	3	161	9	32	459	220	719	4.7%
5	0.2	1	64	10	13	184	88	294	1.9%
6	0.1	1	32	10	6	92	44	152	1.0%
Total*	**2**	**14**	**803**	**39**	**160**	**2,294**	**1,098**	**3,591**	**2.9%**

[a]See footnotes for Table 1.