Influenza and the Implications of a Pandemic for Malta

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Abstract

An influenza pandemic is inevitable and recent reports from Southeast Asia on avian influenza viruses infecting humans have served to fuel worries that a new pandemic is near. The purpose of this article is to provide an overview of the epidemiological and public health aspects of seasonal, avian and pandemic influenza through a literature review and to describe the possible effects of an Influenza pandemic on Malta using the FluAid model.

The results of the model indicate that between 158 and 454 deaths would be expected for a 12-week pandemic causing clinical symptoms in 25% of the population. There would be between 432 and 1,488 hospitalisations and between 40,483 and 74,704 general practice consultations.

Although the results of the model show a wide range of estimates and are limited by a lack of local parameters, the data presented in this article shows the severe effect of a pandemic on the Maltese health care system and will be useful for pandemic planning. Further research needs to be undertaken to determine local parameters to improve the model estimates and local health authorities need to ensure that adequate resources are provided to implement an effective pandemic preparedness plan.

Key words

Influenza, Pandemic, Malta

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Introduction

The twentieth century was the setting for three major influenza pandemics. The 1918-19 pandemic killed an estimated 40 million people, mainly young adults;[1] in contrast the First World War killed about 15 million. The 1957-58 and 1968-69 pandemics, although milder, killed a total of 1.5 million people. With the emergence of the H5N1[2] and H9N2[3] strains in the Far East, the World Health Organisation (WHO) has emphasised the importance of planning for a forthcoming pandemic.[4] Whilst nobody can forecast when another pandemic will start, the signs are ominously similar to what is thought to have happened prior to earlier pandemics.

The purpose of this article is to review the available evidence and provide an overview of influenza, its treatment and prevention options and use a static model to describe the possible effects of the first wave of an influenza pandemic on the Maltese population and on healthcare resources.

Classification

Influenza viruses are enveloped RNA viruses with a segmented genome belonging to the family Orthomyxoviridae. They are classified into three main types, A, B and C, based on their core proteins. Influenza C is poorly understood and probably of limited clinical significance. Strains are named according to the type, geographical site of isolation, strain serial number, year of isolation, and, for Influenza A, according to the Haemagglutinins (HA) and Neuraminidases (NA) in that order. So, for example, the WHO recommends that the seasonal vaccine for 2005-2006 should contain the following strains: A/New Caledonia/29/99(H1N1)-like virus, A/California/7/2004(H3N2)-like virus and B/Shangai/361/2002-like virus.[5] There are a number of Influenza A strains based on different combinations of 16 H subtypes and 9 N subtypes.[6] Strains with all different combinations are known to exist in waterfowl, whereas only H1 to 3 and N 1 to 2 subtypes commonly exist in humans. H1N1, H3N2 and H1N2 influenza A viruses and Influenza B viruses are currently circulating.[7]

Antigenic shift and drift

Frequent development of antigenic variants through antigenic drift is the virologic basis for seasonal epidemics and the reason for the incorporation of one or more new strains in each year's influenza vaccine. New virus variants occur every season due to point mutations resulting in antigenic drift. This

is mainly due to the infidelity of RNA polymerase and selective pressures from host immune responses. Pandemic viruses result from antigenic shift. This happens when reassortment (facilitated by the segmented genome) of a human influenza strain with a strain which had not previously caused disease in humans leads to a virus having heamaglutinin or neuramidinase proteins to which the majority of humans do not have antibodies. Immunity to the surface antigens, mainly to HA, reduces the risk of infection and the severity of illness.[8] Antibody to one antigenic type or subtype does not completely protect against a new antigenic variant of the same type or subtype.[9]

Illness due to influenza viruses

Illness due to influenza virus is characterised by the abrupt onset of symptoms, mainly fever, malaise, dry cough, myalgia, headache, sore throat and rhinitis. Constitutional symptoms are marked. Children can also present with nausea, vomiting and otitis media. The incubation period for influenza ranges from 1-4 days with a mean of two days.[10] Adults are infective from the day before symptoms start and for 5-7 days after onset. Children are known to shed virus from six days before onset of symptoms, to more than 10 days after onset. Immunocompromised children may shed virus for months.[11,12] Illness lasts between 3-7 days, although malaise and cough can last for over two weeks.[13] Influenza causes significant morbidity and mortality through the exacerbation of underlying medical conditions. Secondary bacterial or primary viral pneumonia may also occur. In children, illness may mimic bacterial sepsis with high fevers and may also cause seizures, encephalitis and Reye's syndrome.[7] Symptoms are very non-specific and the sensitivity and specificity of clinical diagnosis depends on the level of influenza activity as well as the degree of circulation of other respiratory viruses.[14]

Hospitalisations and Mortality

Estimates of hospitalisation due to influenza-related illness vary by age-group and by the severity of the season studied. Highest risk is seen in adults aged over 65 years and in children aged less than one year.[7] Over 63% of hospital admissions due to influenza-related illnesses are for persons aged >65 years.[15] In the United States, the highest numbers of hospital admissions have occurred in years when H3N2 viruses were circulating.[16] Mortality due to influenza related illness has been estimated at 0.4 deaths per 100,000 persons in the 0-49 years age-group, 7.5 in persons aged 50-64 and 98.3 among persons aged >65 years.[17] Deaths in children are rare, but do occur.[18]

Vaccine

Estimates of effectiveness of seasonal vaccine have varied between studies. In years when vaccine viruses and the circulating strain were well matched, the inactivated vaccine has been shown to prevent illness in 70-90% of healthy adults aged <65 years.[19,20] Effectiveness in years when the strains were poorly matched was 52% in healthy adults and 38% among adults with high-risk conditions.[21]

In children, the effectiveness increases with age. Healthy children aged over six months can develop protective levels of antibody after vaccination[22] but it is thought that children with diseases which make them at high-risk for influenza-related complications might have a poorer antibody response.[23] Vaccine effectiveness in children increases with age[24] and varies with the degree of match. It is lower in milder flu seasons.[7] There is some evidence that seasonal vaccine reduces the incidence of otitis media by around 30%.[25]

In adults aged >65 years and persons with chronic diseases, immunogenicity may be poor.[26,27] Randomised studies have shown an efficacy of 58% in preventing clinical influenza in this age-group. The authors report that efficacy might be lower in persons aged >70 years.[28] The most important effect of influenza vaccine in older people lies in decreasing influenza-related hospitalisation and death, particularly in residents of nursing homes. In >65 year olds not living in nursing homes, with or without chronic conditions, influenza vaccine prevents 30-70% of hospitalisations due to pneumonia or influenza.[29,30] In those living in nursing homes, influenza vaccine is 30-40% effective in preventing clinical influenza, 50-60% effective in preventing influenza-related hospitalisation and 80% effective in preventing influenza-related death.[31,32,33]

Antivirals

Antivirals can be useful as an adjunct to vaccination in preventing and treating influenza. However, they should not be considered as an alternative to vaccination.[8] Options for treatment of clinical influenza have increased in recent years with the development of neuraminidase inhibitors.

Amantadine is licensed in the UK for use in adults and children over 10 years of age. It is only effective against Influenza A and has a number of contraindications and drug interactions. Influenza A strains can quickly develop resistance to amantadine. Currently in the UK, about 2.3% of circulating influenza viruses exhibit amantadine resistance. Studies have reported that up to one third of patients shed resistant strains when treated with amantadine.[34]

Zanamivir is a neuraminidase inhibitor and is licensed in the UK for the treatment of influenza A and B in people aged 12 years or older, if given within 48 hours of the onset of symptoms, when influenza is circulating. Zanamivir is contraindicated in breastfeeding women and should be used with caution in people with asthma or chronic pulmonary disease because of risk of bronchospasm. It has been reported that after tuition 50% of patients were unable to load and prime the diskhaler and 65% were unable to do so 24 hours later.[35] Oseltamivir is also a neuraminidase inhibitor and unlike zanamivir, it can be taken orally. Side effects are uncommon. In the UK, oseltamivir is licensed for the treatment of influenza A and B in people of 1 year of age or older, within 48 hours of the onset of symptoms, when influenza is circulating. The dose

Table 1: *Population of Malta and distribution by risk and age-group*

	0-18yrs	*19-64yrs*	*65+yrs*	*Total*	*% total*
Non-High Risk	80,927	215,965	31,148	328,039	84%
High Risk	5,533	36,330	20,765	62,629	16%
Totals	**86,460**	**252,295**	**51,913**	**390,668**	**100%**

of oseltamivir should be adjusted for people with severe renal impairment. Resistance to the neuraminidases has been reported. However, the resistant strains do not appear to be of increased virulence. Only 0.4% of Influenza A strains and no Influenza B strains taken from patients not being treated with oseltamivir in Japan were reported to be resistant to oseltamivir in a recent investigation.[36]

The NICE report did not find convincing evidence that amantadine reduces the frequency of hospitalisations and complications of influenza, particularly among high-risk groups. The authors thus do not recommend treatment with amantadine, as this is not cost-effective and rapidly leads to the development of resistance. The guidelines state that for the neuraminidases to be cost-effective, their use should be restricted to treatment of high-risk patients (zanamivir for adults only and oseltamivir for adults and children) during times when influenza virus is known to be circulating in the community.

A systematic review showed that treating otherwise healthy adults and children with zanamivir and oseltamivir reduces the duration of symptoms by between 0.4 and 1.0 days and reduces the odds of complications requiring antibiotics by 29% to 43% when these are given within 48 hours of onset of symptoms.[37] There are still questions, however, about the effectiveness of antivirals in the prevention of influenza-related morbidity and mortality among high-risk groups. In one of the few studies reporting on this aspect, Kaiser *et al* found that oseltamivir reduces the incidence of lower respiratory tract complications by 34% in high-risk groups and reduces all-cause hospitalisation by about 59%.[38]

Antivirals have also been licensed in the United States and United Kingdom for prophylaxis. They are very effective in preventing clinical influenza, with one 6-week study of oseltamivir prophylaxis in a nursing home reporting a 92% reduction in influenza illness.[39]

Table 2: *Percentage of population at high risk of influenza-related complications by age group*

Age Group (years)	*Percentage at high risk*
0-19	6.4
20-64	14.4
≥65	40.0

Avian Influenza

Avian influenza, then known as bird plague, was first reported in Italy around the end of the 19th century when a number of outbreaks were reported.[40] Influenza viruses can cause varying disease severity in birds. Most subtypes cause mild illness in poultry, but outbreaks involving H5 and H7 subtypes can have a mortality close to 100% in chickens over 2-12 days. In recent years there have been increasing reports of avian influenza virus being transmitted to humans. The Hong Kong outbreak in 1997 of an H5N1 strain involved 18 cases with six fatalities.[41] An outbreak in the Netherlands in 2003 of a highly pathogenic strain of H7N7 caused infection in 89 persons, (symptoms mainly of conjunctivitis), and a veterinarian died after developing acute respiratory distress syndrome.[42,43] Since 2004, there have been three waves of human cases of H5N1 in Cambodia, Thailand and Vietnam, with 112 cases reported to WHO until 5 August 2005 and a mortality of 51%.[44] Recently, possible human clusters have also been reported in Indonesia.[45]

Genotype Z is currently the predominant circulating strain in Southeast Asia and is reported to be resistant to amantadine.[46] There is evidence that limited human-to-human transmission is occurring; however this appears to be relatively inefficient.[47,48] Epidemiological studies have shown that the major risk factor is contact with poultry and this is facilitated in Southeast Asia by the numerous backyard farms. It is thus unlikely that the current outbreaks will end in the near future.[49,50]

Oseltamivir and zanimivir are so far effective against H5N1 viruses *in vitro* and in mouse models. Mortality is reported to increase in mouse models with delay in treatment.[51] As a result, many developed countries are stockpiling neuraminidases for treatment of patients and in some cases for prophylaxis. Reports have suggested that Australia, for example, has stockpiled enough antivirals to protect 200,000 front-line workers prophylactically for 50 days during a pandemic.[52]

Pandemic influenza

Ten influenza pandemics have been identified through clinical and epidemiological records in the past 300 years, with an average of one every 33 years. In the twentieth century pandemics did not occur with such regularity, however, with three major pandemics in 1918-19, 1957-58, 1968-69 and a relatively minor one in 1977-78. Viral and seroprevalence studies show that these pandemics were caused by H1N1 (1977), H3N2 (1968), H2N2 (1957), H1N1 (1918), possibly H3N8 (1900) and H2N2 (1889).[50]

Based on information from previous pandemics, it is thought that a pandemic will first originate in Asia. Once the pandemic strain becomes adapted to human-to-human transmission, there will first be small localised outbreaks which will eventually spread along major trade routes, initially affecting the larger metropolis before spreading widely.[53] The UK Department of Health (DOH) estimates that the first cases be detected in the UK within three months of the pandemic strain appearing.[54] This is probably a conservative estimate as shown by the rapid spread of the SARS outbreaks of 2003. DOH estimates that it will take ten weeks for flu activity to reach the UK threshold for baseline activity and a further 2-4 weeks for high levels to be established throughout the country.

The timing of pandemics has been highly variable. Peak illness during the 1918-19 pandemic was seen in the UK in July. The second (worse) wave had peaks of illness in November. The 1968/69 pandemic had a first wave around March/April and a second one in January 1970. The length of the pandemic is impossible to predict. Pandemics in the last century have been of variable lengths and generally consisted of two or more waves of infections with each wave lasting 3-5 months. The second wave is usually more severe.

Table 3: *Estimates of hospitalisation, mortality and General Practice consultation rates (per 1000 persons) used in calculating results (Advisory Committee on Immunization Practices, USA)*

Age Group (years)	*Hospitalisation rates (not high risk)*		
	Minimum	Mean	Maximum
0-19	0.2	0.5	2.9
20-64	0.18	1.465	2.75
≥65	1.5	2.25	3
	Hospitalisation rates (high risk)		
	Minimum	Mean	Maximum
0-19	2.1	2.9	9
20-64	0.83	2.99	5.14
≥65	4	8.5	13
Age Group (years)	*Mortality rates (not high risk)*		
	Minimum	Mean	Maximum
0-19	0.014	0.024	0.125
20-64	0.025	0.037	0.09
≥65	0.28	0.42	0.54
	Mortality rates (high risk)		
	Minimum	Mean	Maximum
0-19	0.126	0.22	7.65
20-64	0.1	2.9	5.72
≥65	2.76	4.195	5.63
Age Group (years)	*GP Consultation rates (not high risk)*		
	Minimum	Mean	Maximum
0-19	165	197.5	230
20-64	40	62.5	85
≥65	45	59.5	74
	GP Consultation (high risk)		
	Minimum	Mean	Maximum
0-19	289	346	403
20-64	70	109.5	149
≥65	79	104.5	130

Effect on Malta

In the case of Malta, it is conceivable that the first cases would be seen some weeks after the appearance of outbreaks in larger European capitals. However, the high density of people on the island might make conditions for spreading of the virus easier and we could thus see high levels of activity sooner than other countries. First reported cases are likely to be travellers from affected countries. It is likely that once pandemic influenza is established in Malta, sporadic cases will first appear, then eventually small outbreaks possibly affecting places like schools and nursing homes, then leading on to more widespread activity.

Morbidity and mortality is likely to be high, and the strain on resources will be significant. In this section of the paper, we use static pandemic models to estimate the expected effect of the first wave of an influenza pandemic on Malta and on health care resources in the country. This data will be useful to decision-makers involved in pandemic planning.

Methods

The effect on Malta was estimated using the FluAid[55] and FluSurge[56] models. The FluAid model requires the user to input minimum, most likely and maximum estimates of some variables (eg: influenza-related hospitalisation rates and mortality rates). This model is based on the one used by Meltzer *et al* to describe the economic effects of a pandemic and different response strategies.[57] The major differences are that the FluAid model does not use Montecarlo methodologies to estimate the most likely values. The FluAid model was used to estimate mortality and general practice consultations. The FluSurge model, which is based on the FluAid software, is used to estimate the burden of hospitalisations throughout the pandemic period.

The National Statistics Office provided population estimates (www.nso.gov.mt). A number of assumptions have been made in order to arrive to our results. We assume that the pandemic will be of a single wave lasting 12 weeks. As no data is readily available for Malta, we assume that the percentage of high-risk persons is the same as in the United States of America (Table 1). We also use estimates of mortality and hospitalisation rates for influenza as used by Meltzer *et al* (Tables 2 and 3). Their data was taken from estimates of the Advisory Committee on Immunization Practices (USA).

We estimated that St.Luke's Hospital has about 825 beds (regular capacity excluding social cases) and that the Intensive Therapy (ITU) and High Dependency Units (HDU) have a total of 25 staffed beds available. These estimates were reached from the Annual Report of the Institutional Health Department for

Table 4: *Predicted deaths with different attack rates (including minimum and maximum estimates) per age-group*

		Deaths		
Attack Rates		15%	25%	35%
0-18 yrs	most likely	1	2	3
	minimum	1	1	2
	maximum	19	31	44
19-64 yrs	most likely	79	132	184
	minimum	11	19	26
	maximum	148	247	346
65+ yrs	most likely	85	142	199
	minimum	83	138	193
	maximum	106	176	246
Total:	most likely	165	276	386
Total:	minimums	95	158	221
Totals:	maximums	273	454	636

Table 5: *Predicted hospitalisations with different attack rates (including minimum and maximum estimates) per age group*

		Hospitalisations		
Attack Rates		15%	25%	35%
0-18 yrs	most likely	26	43	60
	minimum	13	21	30
	maximum	108	180	252
19-64 yrs	most likely	456	761	1,065
	minimum	84	141	197
	maximum	498	830	1,162
65+ yrs	most likely	227	378	530
	minimum	162	270	379
	maximum	287	478	669
Total:	most likely	709	1,182	1,655
Total:	minimums	259	432	606
totals:	maximums	893	1,488	2,083

2004[58] that gives an adjusted mean hospital stay for inpatients, the total number of admissions to St Luke's Hospital and an overall occupancy rate. A similar method was used to calculate the number of ITU and HDU beds available. We estimated that there are 250 general practitioners in Malta and that they would be able to see 4 patients more than their usual load every day. There is no established research or official statistics to prove these numbers; however discussions with general practitioner colleagues confirm that this is a reasonable estimate.

Furthermore the following assumptions were made to produce the results (these estimates were used by the Centre for Disease Control, USA for regional projections):

- Mean duration of hospitalisation due to influenza-related illness was assumed to be one week.
- Mean duration of stay in the Intensive Care Unit was assumed to be 10 days and an average of 15% of hospitalised cases were assumed to need intensive care.
- The distribution of cases in time is assumed to follow a roughly normal distribution.

Attack rates varying from 15% to 30% were modelled.

Results

The models produce a range of results for each variable, describing the most likely, minimum and maximum values. We will discuss the results of the most likely values for an attack rate of 25%. The most-likely, minimum and maximum results for attack rates of 15%, 25% and 30% are reproduced in the tables.

If no intervention is made (ie: no vaccine is available and no antivirals are used) with a 25% attack rate, the model estimates 276 deaths in the most likely scenario but deaths can vary between 158 and 454 (Table 4). This would mean a mortality rate of 0.28% for clinical influenza in the most likely scenario. Eighty-three percent of deaths will be in high-risk groups (Table 7). Few deaths are estimated to occur in the youngest age-group and the number of deaths in adults aged 19-64 years will be almost as high as the number of deaths in >65 year olds. Peak number of deaths will be seen during weeks 8 and 9, when the model estimates that about 41 persons per week will be dying, 29 of which in hospital (Table 8).

In terms of hospitalisations, the majority will be low-risk patients (70%) and 54% will be from the 18-65 year age group (Table 7). The model estimates nearly 1400 hospitalisations during the 12-week period in the most likely scenario (Table 5). The peak in admissions will be in weeks 6 and 7, when over 200 patients per week will be admitted due to influenza related illnesses. Nearly 27% of hospital beds will be needed for patients admitted due to influenza-related complications (219 during the peak in week 7). During weeks 7 and 8, the Intensive Care Unit will have about 45 patients per week due to influenza-related complications (Table 8).

There will be more than 52,000 GP consultations (Table 6) and these will be mainly low-risk adults aged 19-64 years (62% of all consultations). General practitioners will need to see 208 patients each during the 12-week period, with 32 influenza patients per week during the peak weeks (Table 8).

Discussion

The data presented above is based on a model that has been used in a number of countries to estimate the burden of an influenza pandemic.[59,60] There are a number of limitations with the data, not least of which is the large number of unknown variables when calculating these estimates. The model does not take into account the possible varying distribution of cases between different age groups. During the 1918 pandemic, for example, attack rates were significantly higher in children and young adults. The estimates presented also do not take into account the effect of antivirals, vaccines and other public health measures. The length of the first wave was assumed to be 12 weeks. This could be an underestimate; however a shorter

Table 6: *Predicted consultations with different attack rates (including minimum and maximum estimates) per age group*

		Consultations		
Attack Rates		15%	25%	35%
0-18 yrs	most likely	8151	13,585	60
	minimum	6810	11,350	30
	maximum	9493	15,821	252
19-64 yrs	most likely	19,048	31,747	44,446
	minimum	13,677	22,795	31,913
	maximum	29,074	48,457	67,840
65+ yrs	most likely	4,030	6,716	9,403
	minimum	3,803	6,338	8,873
	maximum	6,256	10,426	14,596
Total:	most likely	31,229	52,048	72,868
Total:	minimums	24,290	40,483	56,675
Totals:	maximums	44,823	74,704	104,586

Table 7: *Percentage of consultations, hospitalisation and deaths by risk group*

Age Group	High Risk	Low Risk	Total
Consultations			
0-18 yrs	3%	23%	26%
19-64 yrs	8%	53%	61%
65+ yrs	5%	8%	13%
Total	**16%**	**84%**	**100%**
Hospitalisations			
0-18 yrs	1%	3%	4%
19-64 yrs	10%	54%	64%
65+ yrs	20%	12%	32%
Total	**30%**	**70%**	**100%**
Mortality			
0-18 yrs	0%	1%	1%
19-64 yrs	41%	6%	47%
65+ yrs	42%	10%	52%
Total	**83%**	**17%**	**100%**

pandemic would have a more acute effect on healthcare services and thus might be considered appropriate for planning.

Despite the uncertainties inherent in making such predictions, some of the results presented above and the information on seasonal influenza have clear implications for pandemic planning. Persons with conditions making them at high risk for influenza-related complications will be disproportionately affected. This group generally accounts for about 15% of the population but will account for 85% of the mortality and 31% of hospitalisations even though they will only account for 16% of general practice consultations. It is also important to note that the mortality rate in the >65 years age group will have the most significant effect on the final death toll. It is therefore essential to have plans for dealing with places such as nursing and residential homes, which have a high proportion of high-risk >65 year olds. Furthermore, if availability of vaccines and antivirals is limited (as is likely), then these groups should be targeted early with specific strategies.

Hospital capacity will be overwhelmed even in case of a mild pandemic. Nearly 30% of all hospital beds will be needed for use for patients admitted due to influenza-related complications during the peak weeks. Whilst the postponing of non-urgent surgery and the use of makeshift wards might reduce coping problems, specialised services such as intensive care facilities and ventilators will be very badly hit. In a situation when intensive care beds are already at a premium, it is necessary to create algorithms and define *a priori* guidelines for admissions to intensive care. The actual effect on hospital resources could be even worse as the model does not calculate the effect of staff sickness levels on health care provision. During the 1957 pandemic, for example, nearly a third of nurses were absent during the peak week in one Liverpool hospital.[54]

A shorter pandemic will not mean a decrease in the number of deaths, unless there is a lower attack rate, but it will result in an even more severe shortage of hospital beds, equipment and strain on health service providers. Thus interventions which aim to slow down spread, such as closing of schools, churches, discotheques and other meeting places will have a place in pandemic planning, even though this should be balanced against the effects of preventing working parents of school-children from being economically active. A recent study found that school closure reduced the diagnosis of respiratory infections by over 40% in children aged 6-12 years.[61] The role of children in spreading influenza viruses is well known.[62]

Antivirals will play an important role in combating the pandemic until a vaccine is developed. A recent study has indicated that even without the use of vaccines, a stockpile of antivirals for 20% of the population will reduce mortality by 53% in a three-wave pandemic with characteristics similar to that of 1918-19.[63] Lower attack rates would mean that smaller stockpiles of antivirals would be needed. Antivirals would reduce the burden of a pandemic both by directly decreasing morbidity and mortality but also by reducing circulation of influenza virus (they do not prevent infection, and thus would allow build up of immunity and reduce the period of infectivity by about one day). In any case, it is essential that antivirals are taken within 48 hours of symptoms starting as effectiveness decreases quickly with any delays. Plans must therefore include methods for their quick and widespread distribution as any bureaucratic delays will lead to preventable deaths. Guidelines need to be issued on the use of antivirals, both during seasonal epidemics and in pandemics. Such guidelines should consider the fact that antivirals are most cost-effective when used in high-risk groups during seasonal epidemics and that widespread prescribing of these drugs could also potentially lead to resistance.

Table 8: *Impact of an Influenza pandemic on Malta with varying attack rates. Peak of the pandemic is in bold*

Attack rate: 15%		*Week*													
Influenza Pandemic Impact		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
GP Consultations	Weekly consults	1	5	9	12	16	**19**	**19**	16	12	9	5	1		
Hospital Admission	Weekly admission	8	33	58	83	108	**125**	**125**	108	83	58	33	8		
	Peak admission/day						**19**	**19**							
Hospital Capacity	# of flu patients in hospital	8	33	58	83	108	125	**131**	122	104	79	54	29		
	% of hospital capacity used	1%	4%	7%	10%	13%	15%	**16%**	15%	13%	10%	7%	4%		
ICU Capacity	# of flu patients in ICU	1	6	11	16	22	26	**28**	27	23	18	13	8		
	% of ICU capacity used	5%	22%	44%	66%	88%	105%	**110%**	108%	93%	73%	51%	30%		
Deaths	# of deaths from flu			2	7	12	17	22	**25**	**25**	22	17	12	7	2
	# of flu deaths in hospital			1	5	8	12	15	**17**	**17**	15	12	8	5	1

Attack rate: 25%		Week													
Influenza Pandemic Impact		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
GP Consultations	Weekly consults	2	8	15	21	27	**31**	**31**	27	21	15	8	2		
Hospital Admission	Weekly admission	14	56	97	139	181	**208**	**208**	181	139	97	56	14		
	Peak admission/day						**32**	**32**							
Hospital Capacity	# of flu patients in hospital	14	56	97	139	181	208	**219**	204	174	132	91	49		
	% of hospital capacity used	2%	7%	12%	17%	22%	25%	**27%**	25%	21%	16%	11%	6%		
ICU Capacity	# of flu patients in ICU	2	9	18	27	37	44	**46**	45	39	30	21	13		
	% of ICU capacity used	8%	37%	73%	110%	146%	174%	**184%**	180%	154%	121%	86%	50%		
Deaths	# of deaths from flu			3	11	19	28	36	**41**	**41**	36	28	19	11	3
	# of flu deaths in hospital			2	8	14	19	25	**29**	**29**	25	19	14	8	2

Attack rate: 35%		*Week*													
Influenza Pandemic Impact		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
GP Consultations	Weekly consults	3	12	20	29	38	**44**	**44**	38	29	20	12	3		
Hospital Admission	Weekly admission	19	78	136	194	253	**292**	**292**	253	194	136	78	19		
	Peak admission/day						**45**	**45**							
Hospital Capacity	# of flu patients in hospital	19	78	136	194	253	292	**306**	286	244	185	127	69		
	% of hospital capacity used	2%	9%	16%	24%	31%	35%	**37%**	35%	30%	22%	15%	8%		
ICU Capacity	# of flu patients in ICU	3	13	26	38	51	61	**64**	63	54	42	30	18		
	% of ICU capacity used	12%	52%	103%	154%	205%	244%	**257%**	252%	216%	170%	120%	70%		
Deaths	# of deaths from flu			4	15	27	39	50	**58**	**58**	50	39	27	15	4
	# of flu deaths in hospital			3	11	19	27	35	**41**	**41**	35	27	19	11	3

Other questions remain regarding planning in Malta. Most European countries have had a functioning sentinel surveillance system for influenza for years. The UK system for example, has been running for the past three decades. On the other hand, the surveillance system in Malta is hampered by a lack of laboratory facilities (although this is reported to change soon) and a lack of funding and adequate staffing of the sentinel general practice system. The sentinel surveillance system was set up for the last two influenza seasons. However, due to the above issues, data has not been consistently provided, and the timeliness of the system needs to be improved. Unless such a system is working efficiently during a normal influenza season, it is highly improbable that it will cope during a pandemic. General practitioners, on the other hand, need to be involved more closely in this system and provide much needed data to the Public Health Department. The regular and widespread distribution of results from this system to both private and government general practice doctors would allow better planning and deployment of resources both during a seasonal epidemic and in the event of a pandemic.

Protocols need to be set up for the investigation and management of clusters of respiratory illness in the community, particularly within nursing homes, closed institutions and schools. This duty lies within the Public Health realm; however general practitioners should be aware of the importance of informing the department about such clusters. Unless these investigations are made standard practice during in the inter-pandemic period, there is no reason to believe these will be done effectively once a pandemic starts. Effective management of influenza outbreaks in closed settings even during the interpandemic period can lead to decreased morbidity[64] and possibly mortality.

Lack of local data makes estimating the effect of, and planning the response to, a pandemic difficult and imprecise. Besides the points mentioned above, vaccination rates for the seasonal influenza vaccine have never been published in Malta. Whilst there are difficulties with estimating coverage due to the segmented nature of the Maltese general practice system, more concerted efforts need to be made. Knowing current vaccination rates should help in planning how to vaccinate nearly 400,000 persons once a pandemic vaccine is available. The fact that a pandemic vaccine will probably be available as two doses will only serve to complicate matters.

It is unfortunate that data describing the risk profile of the Maltese populations in not readily available and it is not necessarily correct to model effects on the Maltese population using data derived from other countries. The high rates of certain chronic illnesses like diabetes mellitus in the Maltese population make such comparisons even more tenuous. It is also arguable that consultation rates with general practitioners in Malta and in the United States are the same. Health authorities need to understand that good quality research, both now, and in the early stages of a local response to the pandemic, is essential to provide an effective response to a pandemic.

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