Influenza H1N1

Hospital Models of Preparedness and Response

Giuseppe Ippolito

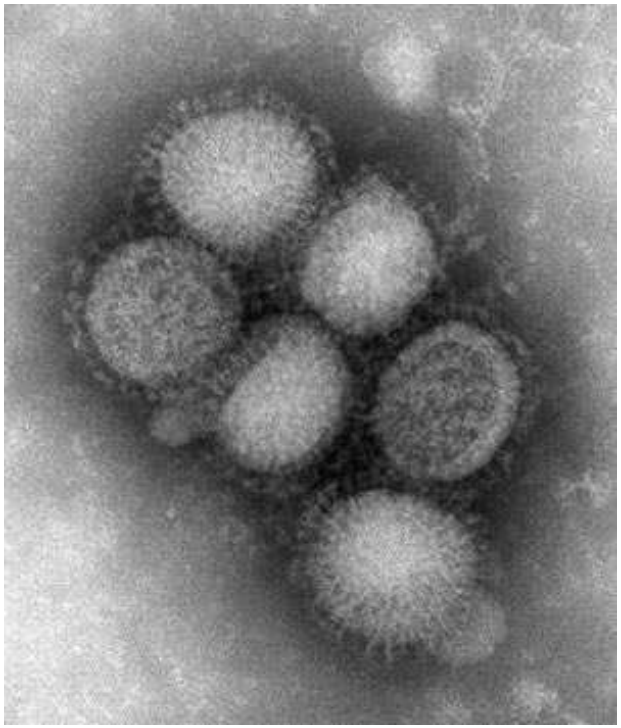
Scientific Director

INMI “L. Spallanzani”



H1N1 and Hospitals Summary

- Risk in the hospitals;
- Role of the hospitals;
- Main problems;
- Hot points in the hospital:
  - Emergency Department,
  - Isolation strategies,
  - ICU,
  - Laboratories;
- Hospital response to pandemic:
  - Mainteinance of essential service,
  - Key-role of training.



Health Care Settings: preferential places for disease transmission

- presence, in the same limited space, of infectious patients and many susceptible individuals;
- frequent and close contacts among patients and Health Care Workers (HCWs), often not protected by Personal Protective Equipments (PPE) because of delayed diagnosis, or not adequate perception of risk or shortage of PPE;
- lack of isolation of infectious patients, because of delayed diagnosis or not-existing of adequate structures.





Estimates for nH1N1 flu

- Models vary widely;
  - Total attack rate ranges from 20 to 30%;
  - Percentage of those seeking care ranges from 30 to 50% of clinical cases;
  - Hospitalization: from <1% to 2% of clinical cases;
  - ICU admittance: from 15 to 35% of hospitalized.

REPORT TO THE PRESIDENT ON U.S. PREPARATIONS FOR 2009-H1N1 INFLUENZA

TABLE 3-1: A POSSIBLE (NOT PREDICTIVE) SCENARIO TO HELP PLAN FOR THE FALL RESURGENCE OF 2009-H1N1 INFLUENZA IN THE UNITED STATES	
Peak incidence date (unmitigated)	October 15
Peak incidence of symptomatic disease	1–2% of U.S. population (3–6 million people) on the U.S. epidemic's single peak day
Percent of U.S. population (and approximate numbers) assuming no change in virus	
Infected (indicated by seroconversions, with or without symptoms)	30–50% (90–150 million)
Symptomatic	20–40% (60–120 million)
Needing medical attention	15–30% (45–90 million)
Needing hospital care	0.3–0.6% (0.9–1.8 million)
Needing intensive Care Unit (ICU) facilities	0.05–0.1% (150,000–300,000)
Deaths	0.01–0.03% (30,000–90,000)
Peak occupancy of ICU beds due to 2009-H1N1	10–25 ICU beds/100,000 population[1]
Peak occupany of hospital beds due to 2009-H1N1	50–150 hospital beds/100,000 population[2]
High-risk groups for death or hospitalization	Pregnant women; children (0–4 years old); patients with neuromuscular/neurocognitive disorders, asthma, chronic obstructive pulmonary disease, cardiovascular disease, diabetes, severe obesity, or immunocompromising conditions[3]

Notes:
[1] The United States has 20 ICU beds/100,000 population. The number of ICU beds available for pediatric patients is especially limited.
[2] The United States has 211 hospital beds/100,000 population.
[3] Cetron M, 2009 Pandemic Novel Influenza A (H1N1): Community Mitigation, powerpoint presentation to PCAST H1N1 Working Group, July 16, 2009.



President's Council of Advisors on Science and Technology

August 7, 2009

Characteristic	Moderate (1958/68-like)	Severe (1918-like)
Illness	**90 million (30%)**	**90 million (30%)**
Outpatient medical care	**45 million (50%)**	**45 million (50%)**
Hospitalization	**865,000**	**9,900,000**
ICU care	**128,750**	**1,485,000**
Mechanical ventilation	**64,875**	**742,500**
Deaths	**209,000**	**1,903,000**

CDC, 2007

CabinetOffice

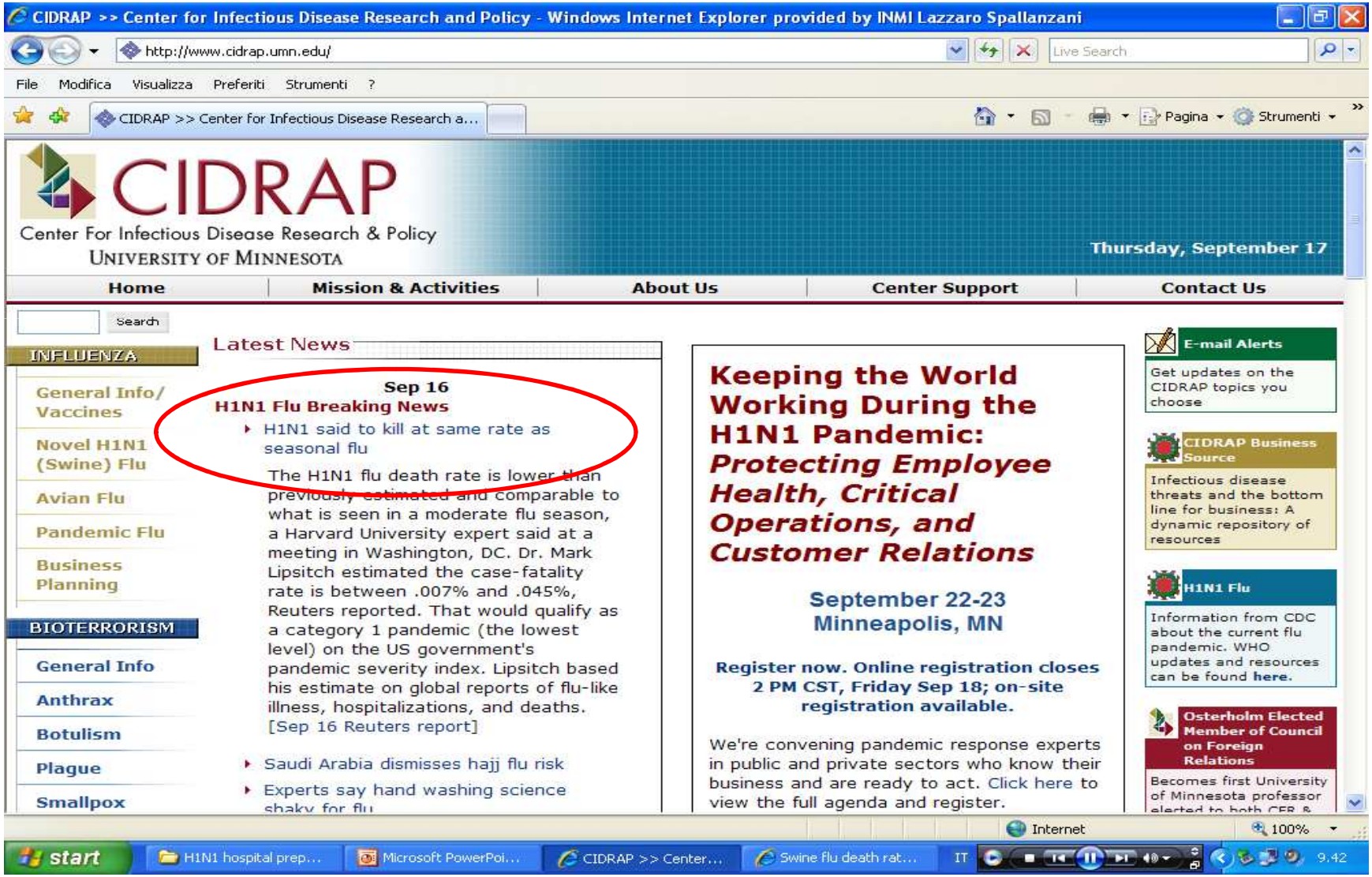
DH Department of Health

The Scottish Government

Planning assumptions to mid-May 2010: potential effects of A(H1N1) infection for the general population	
Clinical Attack Rate	up to 30% of population
Peak Clinical Attack Rate	nationally, up to 6.5% of population per week
	locally, 4.5%-8% of population per week
Case Complication Ratio	up to 15% of clinical cases
Case Hospitalisation Ratio	up to 1% of clinical cases, of whom up to 25% could require intensive care at any given time
Case Fatality Ratio	up to 0.1% of clinical cases
Peak Absence Rate	up to 12% of workforce

More recent estimation, based on South side observation

- Case-fatality rate 0.007-0.045 (as for the seasonal flu)



Pandemic H1N1 flu: More recent estimation, based on South side observation

Death rate from H1N1

-is likely lower than earlier estimates
-compares to a moderate year of seasonal influenza

Marc Lipsitch, Harvard University-
Flu meeting of U.S. IOM
September 15, 2009

Pandemic H1N1 flu: More recent estimation, based on South side observation

Pandemic Severity Index set by the U.S. government:

- five categories of pandemic

- The current pandemic is a category 1 pandemic (barring any changes in the virus)

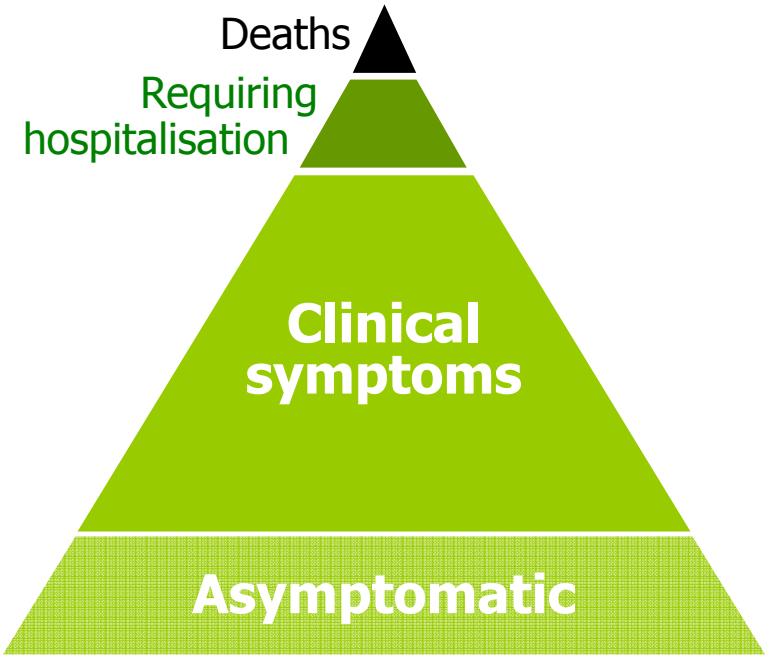
- range of mortality from 0.007 percent to 0.045 percent.

Marc Lipsitch, Harvard University
Flu meeting of U.S.
IOM September 15, 2009

In any case…
Seasonal influenza compared to pandemic — proportions of types of cases



Seasonal influenza



Pandemic

Role of hospitals during the pandemic - 1

- The hospitals may play a key-role in the containment as well as in the amplification of the novel Influenza A H1N1:
  - Early recognition and appropriate infection control and clinical management of suspected, probable and confirmed cases are effective measures for the containment,
  - On the other hand, hospitals may have an important role in the amplification of the pandemic, if infection control measures are inconsistently applied.

Role of hospitals during the pandemic - 2

- Different roles at the beginning and during the pandemic:
  - At the beginning: need of prompt recognition and isolation of cases and risks (increase attention, knowledge and sensibility);
  - During the pandemic: need to use resource only for those who really need medical care (increase effectiveness)

Main problems and main solutions

Problems:

- Overcrowding and increased waiting time;
- Shortage of staff (for illness and other reasons);
- Shortage of resource (beds, medical devices – i.e. PPE -, medical instruments – i.e. ventilators -, drugs…).

Solutions:

- Clear and effective procedures and criteria;
- Training and vaccination;
- Adequate hospital preparedness

Nonvirologic indexes of epidemiologic influenza activity

- School absenteeism
- Industrial absenteeism
- Emergency room visits
  - % visits for respiratory activity
- Pneumonia admissions
  - % among adults
- Pneumonia/influenza mortality which lags behind the other reporting

Hot points in the hospital

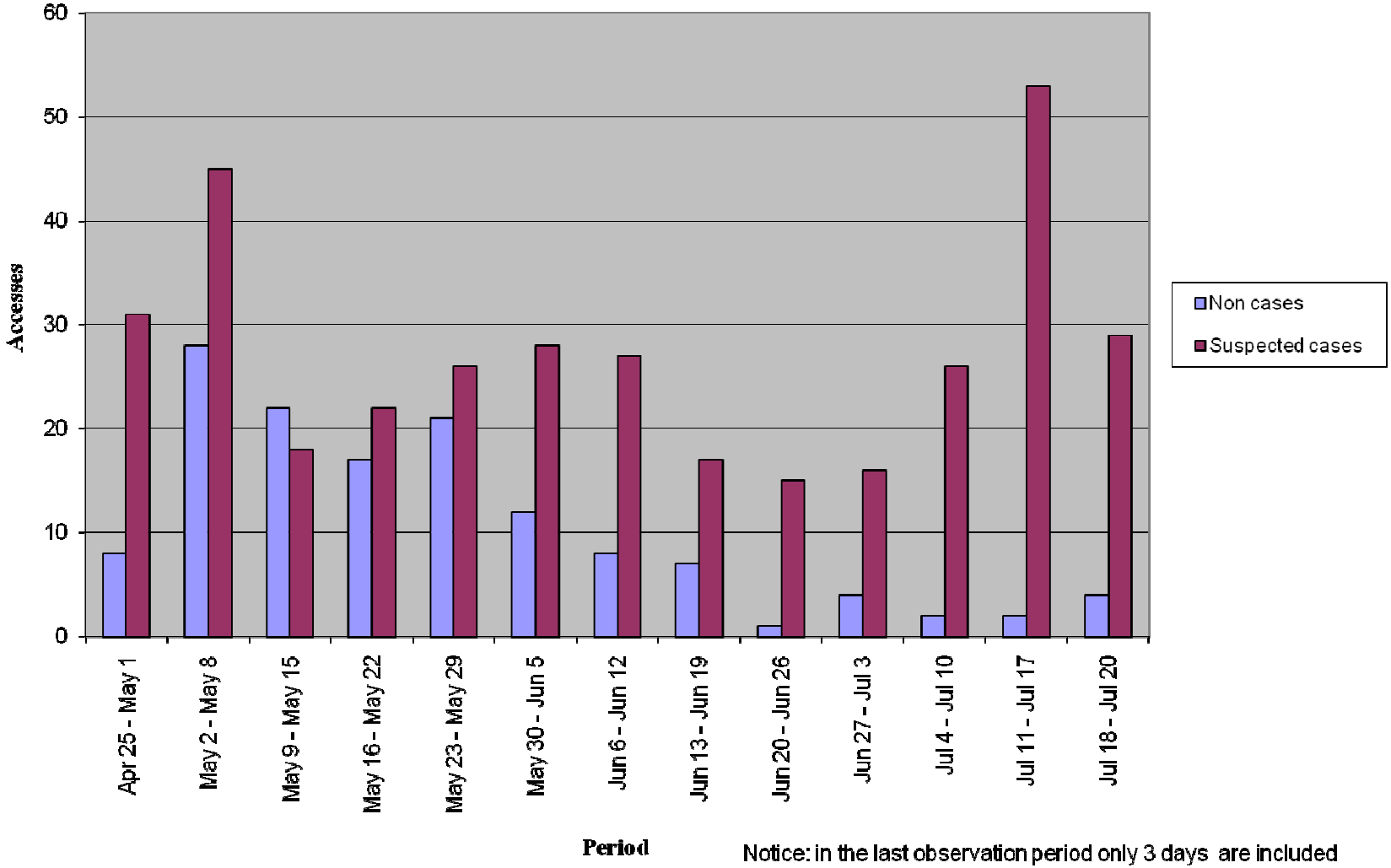
- Emergency Department;
- Admission wards;
- ICUs;

Hot points in the hospital - 1

- Emergency Department;
- Admission wards;
- ICUs;

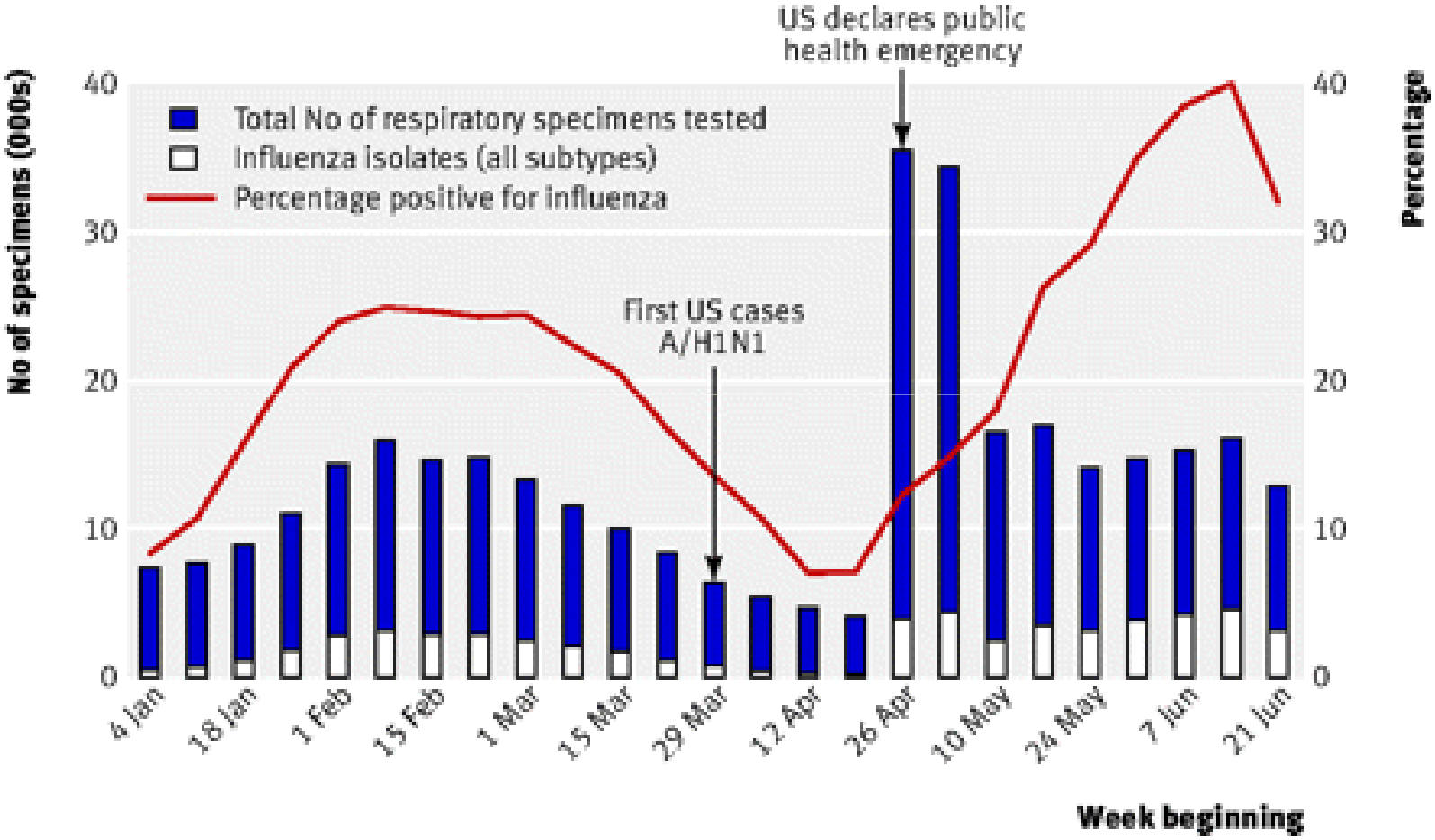
Pandemic vs. “PANIC emic”

Figure 3 - Distribution of non-cases and suspected cases attending at INMI MAD in the period from April 25 to July 20



Pandemic vs. “PANIC emic”

Numbers of respiratory specimens testing positive for influenza virus in US, January-June 2009



www.cdc.gov/flu/weekly/weeklyarchives2008-2009/data/whoAllregt31.htm

Hot points in the hospital – 1
Emergency Department

In order to avoid the risk of transmission during the waiting period (which may last for several hours):

- Triage procedures
- Reserved pathways/waiting areas

Hot points in the hospital – 1
Emergency Department

Triage procedures should be developed, not only based on diseases severity, but on risk of transmission too:

- A simply form exploring the presence of clinical and epidemiological criteria (contact with another case) should be submitted to all persons attending to ED;
- This form should been (optimally) submitted through telephone/entry phone or outside the waiting room.

Hot points in the hospital – 1
Emergency Department

Reserved pathway/waiting areas

Learning from the past: from temporary solution during SARS…



Figure 1. Due to limited space within the facility, temporary tents used for staff screening were set up at the entrance of the Toronto Western hospital.



Hot points in the hospital – 1
Emergency Department

Reserved pathway/waiting areas

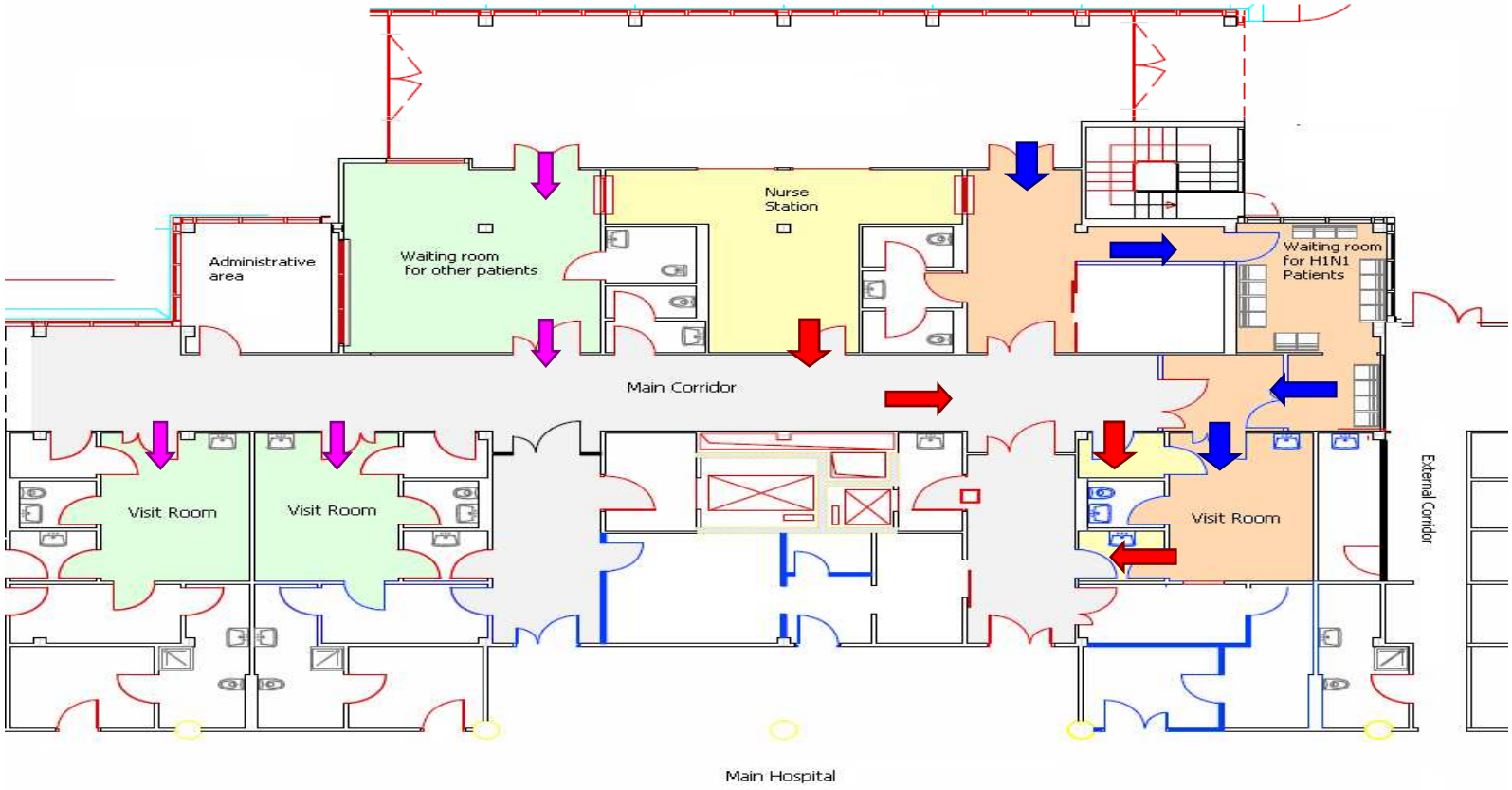
… to logistic solution at INMI

Map of MAD at INMI and pathways for HCWs, H1N1 patients and other patients

Pathway for HCWs visiting H1N1 patients

Pathway for H1N1 patients

Pathway for other patients



Hot points in the hospital – 2
Admission ward

- Emergency Department;
- Admission wards;
- ICUs;

Hot points in the hospital – 2
Admission wards

- In order to avoid the shortage of beds, it is mandatory to develop strict, evidence-based admission criteria.

Pandemic Medical Early Warning Score: **Physiological-social score (PMEWS) and CURB- 65**

Algoritmo per l'ammissione al ricovero per sindrome influenzale

Sede .....

Data ..... Ora .....

Paziente .....

Data nascita ..... Età ..... Sesso [M] [F]

Indirizzo .....

SINTOMI DI INFLUENZA PANDEMICA (WHO)

- febbre > 38°C
- cefalea
- mal di gola
- rinorrea
- tosse
- dispnea
- mialgia
- dolori osteo-articolari

DATI DEL PAZIENTE (1 punto per ogni fattore)

- età > 65 [ ]
- isolamento sociale (vive solo, e/o senza fissa dimora: 1 punto) [ ]
- malattie croniche(polmonari, cardiache, renali, sistema immunitario, oncologiche, metaboliche: 1 punto per malattia) [ ]
- gravidanze al terzo trimestre [ ]
- performance status > 2 [ ]

PERFORMANCE STATUS

- attività normale senza restrizioni: 1 punto
- limitate le attività intense, può svolgere quelle lievi: 2 punti
- attività limitata, ma autosufficiente: 3 punti
- attività limitata, limitata autosufficienza: 4 punti
- confinato a letto/sedia, non autosufficiente: 5 punti

DATI FISIOLOGICI (indicare un solo valore per ogni fattore)

Punteggio	3	2	1	0	1	2	3
Frequenza respiratoria	≤8			9-18	19-25	26-29	≥30
Saturazione 02	<89	90-93	94-96	>96			
Frequenza cardiaca	<40	41-50		51-100	101-110	111-129	≥130
Pressione sistolica	<70	71-90	91-100	>100			
Temperatura		<35°C	35.1-36	36.1-37.9	38-38.9	>39°C	
Sintomi neurologici				Sveglio cosciente	Confuso agitato	Fortemente agitato	Elevata compromissione con disorientamento spazio-tempo-persona

PUNTEGGIO TOTALE: ..... Paziente Ricoverato [ ] Paziente Non ricoverato [ ]

Deceduto [sì] [no] Firma del Medico .....

Data eventuale decesso .....

Qualifica. .....

Figura 1. Algoritmo per l'indicazione al ricovero per sindrome influenzale

Challen K., et al., BMC Health Services Research 2007; 7: 33

Hot points in the hospital – 2
Admission wards

- Admission in a negative-pressure room: yes or not?

- Hierarchical model of response:
  - Negative-pressure rooms,
  - Single rooms,
  - Cohorting of patients (only confirmed cases, cohorting of ILI patients may be very dangerous!).

- Development of surge capacity plan, that include evacuation of wards/structures.

Hot points in the hospital – 2
Admission wards

- Management of pneumonia during pandemic period:
  - All pneumonia isolated? Probably it should be suggested, watching to the South of the world

In Argentina, up to 90% of ILI were due to H1N1

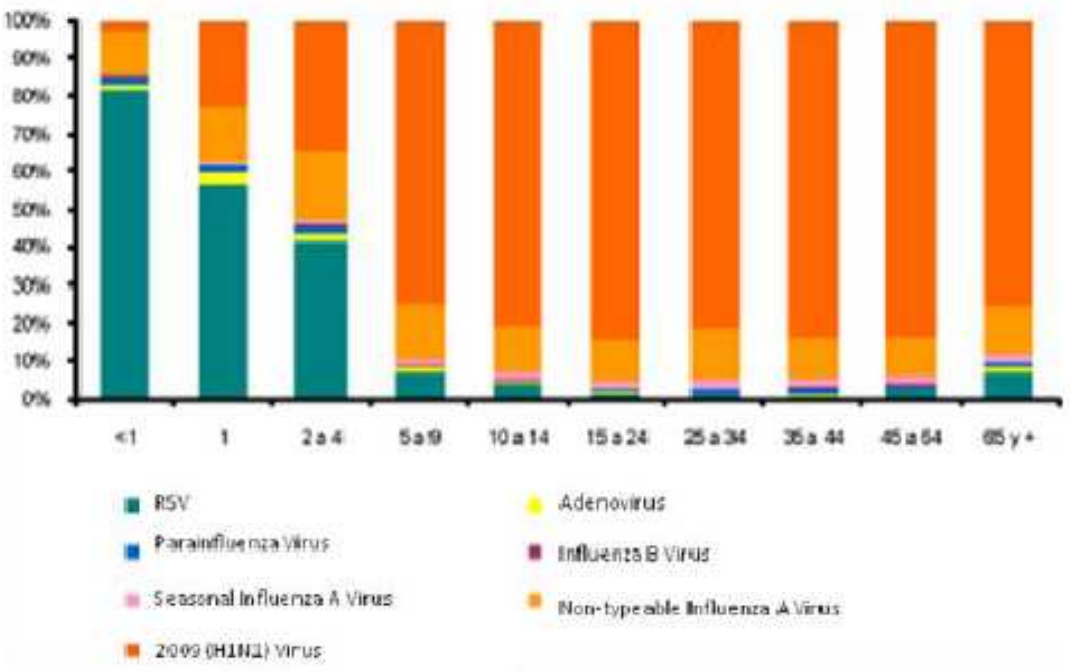


Figure 1: ***Percentage of Distribution of Respiratory Viruses per age group***. Ministry of Health, Argentina, 2009 H1N1 report, week of August 2-8[5]

Hot points in the hospital – 2
Admission wards

– All pneumonia isolated? Probably it should be suggested, watching to the South of the world

Similar results emerged in Chile and Uruguay

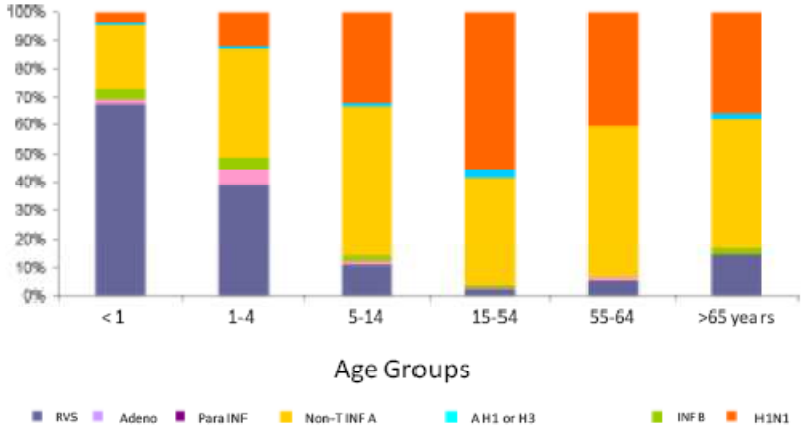


Figure 6: ***Distribution of respiratory Viruses by Age Group during the week of June 28-July 4 (Epidemiological week 26).*** Ministry of Health of Chile, 2009 H1N1 weekly report.

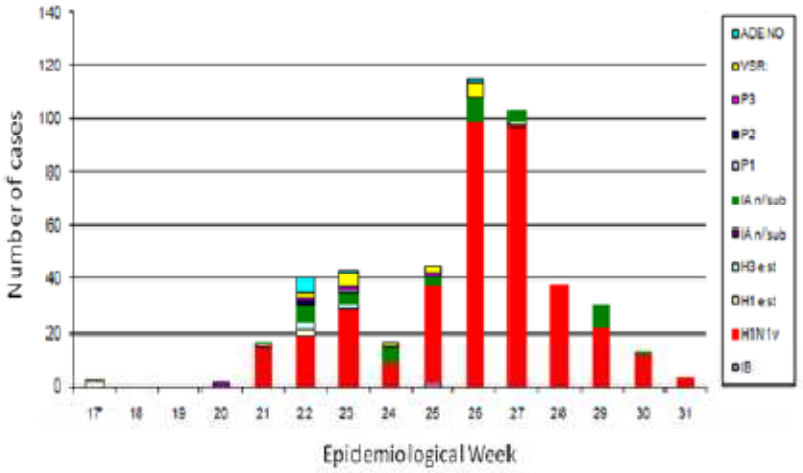


Figure 9. Proportion of Respiratory Viruses per Epidemiological weeks 20-31 (May 17-August 8). Ministry of Health, Uruguay-2009 H1N1 report, week of August 2-8. Adeno: adenovirus, VSR: Respiratory Syncytial Virus; P1-P3: parainfluenza; IA n/sub: Influenza A non-subtypeable; H1 and H3 est: Influenza A H1 and H3; IB: Influenza B;

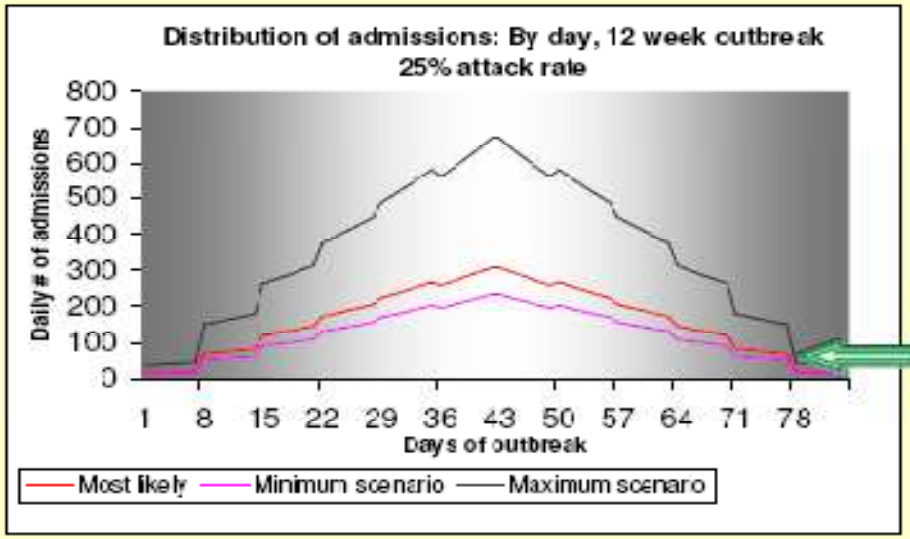
Hospitals with Infectious Diseases Wards, ICU beds and ventilators in Lazio, Italy

Hospitals	11
Negative pressure hospital beds	297
Hospital beds in single rooms	452
ICU hospital beds	459
Ventilators	1193

Fonte: Ministero della salute - Elaborazione Direzione Generale Prevenzione - Ufficio V Malattie Infettive e Profilassi Internazionale,

FluSurge2.0 Simulator - CDC

- Attack rate 25%, 12 weeks, hospitalization 1%, 100% Infectious Diseases beds dedicated; 60% ICU beds dedicated:



Total Hospital Admissions (most likely)	13,174
Total Deaths (most likely)	4,448

Pandemic Influenza Impact / Weeks		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hospital Admission	Weekly admissions	132	527	922	1,317	1,713	1,976	1,976	1,713	1,317	922	527	132		
	Peak admissions/day						308	308							
Hospital Capacity	# of influenza patients in hospital	97	387	678	968	1,259	1,453	1,504	1,346	1,140	863	586	308		
	% of hospital capacity needed	21%	83%	152%	214%	279%	321%	333%	298%	252%	191%	130%	68%		
ICU Capacity	# of influenza patients in ICU	13	59	116	174	231	275	291	285	244	191	135	79		
	% of ICU capacity needed	5%	21%	42%	63%	84%	100%	105%	103%	89%	70%	49%	29%		
Ventilator Capacity	# of influenza patients on ventilators	7	29	58	87	116	138	145	142	122	96	68	40		
	% usage of ventilator	1%	2%	5%	7%	10%	12%	12%	12%	10%	8%	6%	3%		
Deaths	# of deaths from influenza			44	178	311	445	578	667	667	578	445	311	178	44
	# of influenza deaths in hospital			42	169	296	423	549	634	634	549	423	296	169	42

Notes: 1. All results showed in this table are based on most likely scenario.
2. Number of influenza patients in hospital, in ICU, and number of influenza patients on ventilators are based on maximum daily number in a relevant week.
3. Hospital capacity used, ICU capacity used, and % usage of ventilator are calculated as a percentage of total capacity available (see manual for details).
4. The maximum number of influenza patients in the hospital each week is lower than the number of weekly admissions because we assume a 5-day stay in general wards (see manual for details).

Hot points in the hospital – 2 Admission wards

- Paediatric wards need special attention? Data from Argentina and Chile

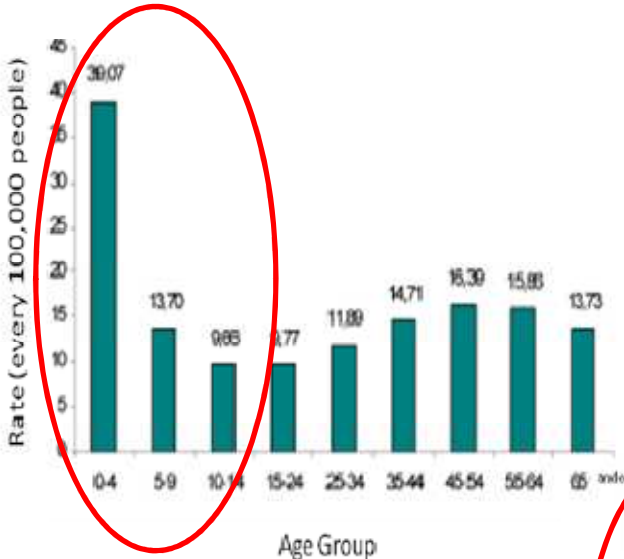
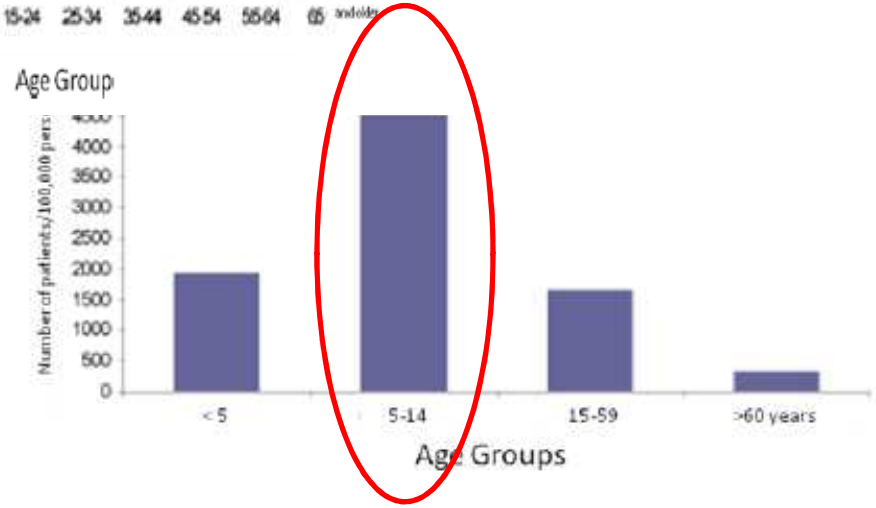


Figure 2. ***Distribution of cases with Severe Acute Respiratory Infection per age group (n=6,141).*** Ministry of Health, Argentina, 2009 H1N1 report, week of August 2-8[7]



: Rate of ambulatory clinical cases by Age Group during the weeks of June 14-August 15 (Epidemiological weeks 24-32). Ministry of Health of Chile, 2009 H1N1 weekly report[13].

Hot points in the hospital – 3
ICUs

- Emergency Department;
- Admission wards;
- ICUs;

Hot points in the hospital – 3
ICUs

ICUs will be probably severly involved in the management of severe H1N1 cases

Chile (pop 16.6 million)

- until **week 34: 12 190 confirmed cases** .
- **1 504 presented Severe Acute Respiratory Illness**

Brazil (pop. 192 million)

- until **week 34: 36 542 Severe Acute Respiratory Illness** of which **6 592 laboratory-confirmed as influenza A (H1N1)v : 657 (10%) died**.

New Zealand (pop. 4.2 million)

- At 6 eptember a total of **3219 confirmed cases of Pandemic Influenza (H1N1)v**,
- 988 cases have been hospitalised.
- Pneumonia : 300 cases and ARDS 46 cases.

Hot points in the hospital – 3 ICUs

A model just developed in USA, that assume:

- Attack rate 15%
- Hospitalization rate 6% of attack rate
- ARF-MV (acute respiratory failure necessitating mechanical ventilation) 12% of hospitalized

Calculate that:

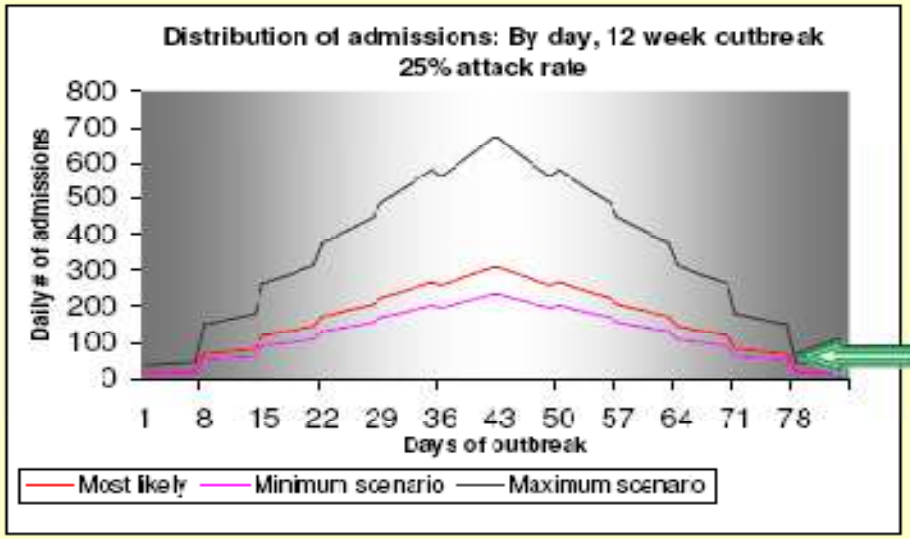
- About 330.000 ICU admittance are expected in USA;
- About 190.000 deaths are expected;
- ICU will work at 25 to 45% of current capability.



Swine origin influenza A (H1N1) virus and ICU capacity in the US. Are we prepared? Zilberberg MD et al.

FluSurge2.0 Simulator - CDC

- Attack rate 25%, 12 weeks, hospitalization 1%, 100% Infectious Diseases beds dedicated; 60% ICU beds dedicated:



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Shortage of staff

Due to:

- H1N1 infections among HCWs;
- Family reasons (i.e., in case of school closure, need to give care to children);
- Psychological reasons.

Rapid communications

First sequence-confirmed case of infection with the new influenza A(H1N1) strain in Germany

- **Index patient**: imported case from Mexico. Before the patient was isolated on the morning of 27 April under suspicion of new influenza, he had an estimated 19 close contacts among staff and one patient who stayed in the same twin room.

- **Nurse who had close contact with him** has tested positive for the new influenza A (H1N1), and had influenza symptoms for a period of two days on 26-27 April. Received oseltamivir treatment and stayed isolated at home until 5 May.

- **The patient sharing the room** with the index case was found positive on 29 April (sputum sample). He, was isolated and treated with oseltamivir in the afternoon of 29 April, and suffered only minor influenza-like symptoms

Shortage of staff

In the E-CDC preliminary report (3 june 2009), 4% of patients were HCW;



In the Mexico outbreak, 22% of initially described patients were HCWs;



Also in the preliminary report from USA, several cases were descibed among HCWs



Shortage of staff

BMC Public Health *2009, 9:142*

BioMed Central

Will the NHS continue to function in an influenza pandemic?

Initial estimates assumed absenteeism to be around twice that of normal National Health Service (NHS) levels, which are typically between 4–5%.

More recent modelling has predicted between 30–35% absenteeism at the peak of a pandemic, based on cumulative effects of staff illness and the possible closure of schools/childcare services .

Recent human resources guidelines issued by the UK Department of Health (DH) increase estimates further, suggesting that up to 50% of HCWs may require time off at the peak of a pandemic.

Shortage of staff

- School absenteeism strongly influence HCWs absenteeism

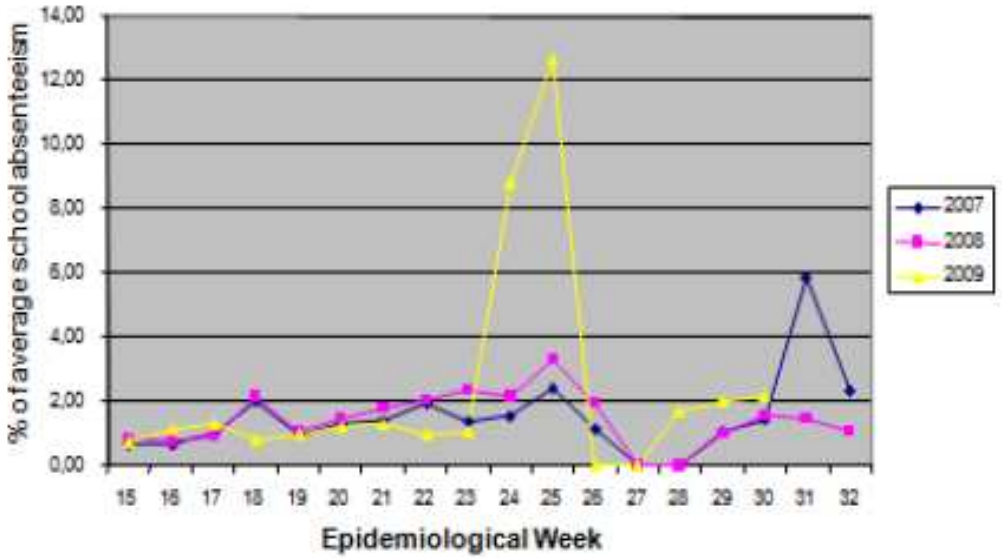


Figure 12. *Comparative absenteeism in sentinel schools in Uruguay during the flu seasons of 2007-2009.* Ministry of Health, Uruguay, 2009 H1N1 report, August 8, 2009.

Shortage of staff: main solution is vaccination. But…

BMJ 2009;339:b3461

Opposition to swine flu vaccine seems to be growing worldwide

Just over half of 8500 healthcare workers in Hong Kong said they would not be vaccinated against swine flu because of fears of side effects and doubts about the vaccine's effectiveness.

Evidence from 11 focus groups conducted in Canada before the current pandemic also indicates that parents and healthcare workers may refuse to be vaccinated or to vaccinate their children if they believe that the risks outweigh the benefits.

An online poll for *Nursing Times* last week indicated that in England almost a third of nurses who responded would not take up the offer of the vaccine, with 60% of respondents citing concerns about the safety of the vaccine as their primary reason.

A survey by Israel's ministry of health similarly found that at least 25% of the population is not willing to be vaccinated against swine flu.

Am J Epidemiol. 2009 Feb 1;169(3):382-8

Investigation of the temporal association of Guillain-Barre syndrome with influenza vaccine and influenzalike illness using the United Kingdom General Practice Research Database.

1990 - 2005
The relative incidence of Guillain-Barré syndrome within 90 days

- of vaccination was 0.76 (95% confidence interval: 0.41, 1.40).

- of an influenzalike illness was 7.35 (95% confidence interval: 4.36, 12.38)

The model of response at INMI at the beginning of the pandemic

- Development of procedures for clinical management and infection control:
  - Case definitions
  - Triage procedures
  - Clear procedures for the management of patients
  - Clear indication for therapy and prophylaxis
  - PPE (selection and procedures for donning and removal)
  - Surveillance and management of exposed HCWs
- Logistical interventions at ED
- Training and update programmes

Hospital Response to H1N1 pandemic

Maintenance of Critical Services

- Estimate existing capacity in health care sector
  - ✓ **hospital and ICU beds**
  - ✓ **ventilators**
  - ✓ **supply of antibiotic and antiviral drugs**
  - ✓ **medical staff and support staff**
  - ✓ **contingency medical care facilities**
  - ✓ **emergency response plans**
  - ✓ **mortuary/burial services**
  - ✓ **social and psychological services**

Hospital Response to H1N1 pandemic

To Measure Capacity, Hospitals must:

- Evaluate existing & immediately available services for inpatient & outpatient care;
- Assess its rapid expansion capacity – physical plant, personnel, supplies & equipment;
- Consider maintenance of standards for medical care, monitoring & tracking;
- Consider contingency plans to ensure patient care – alternative care centers, discontinuance of services & patient transfers.

Hospital Response to H1N1 pandemic

Maintenance of Critical Services: Key role of training

In order to:

- Apply correctly the protocols;
- Develop the awareness of their role in the pandemic;
- Avoid mistakes and breakages:

it is essential to develop training for health care/medical and and first responder personnel.

INMI TRAINING AND UPDATE EVENTS

- Since the beginning of the novel influenza A H1N1 epidemic, the INMI internal task force organized:
  - several training sessions, mainly offered to MAD staff:
    - the main points of the infection control procedures have been rapidly reviewed,
    - the specific procedures for patients with suspected/probable/confirmed novel influenza A H1N1 have been detailed explained and exercised.
  - weekly institutional meetings in order to update all the INMI staff about the evolving clinical and epidemiological characteristics of the disease.

Cost myopia



Grazie a tutti…