



Hospitals for the future: architectural design and pandemic preparedness

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Hospitals for the Future: Architectural Design and Pandemic Preparedness

- Using a consultative risk management approach to designing facilities for pandemic preparedness
- The place of health facilities in managing disasters including pandemics
- Designing health facilities to ensure continuity of service delivery in the event of disasters such as pandemics
- Using physical design features to prevent and control the spread of infection within facilities



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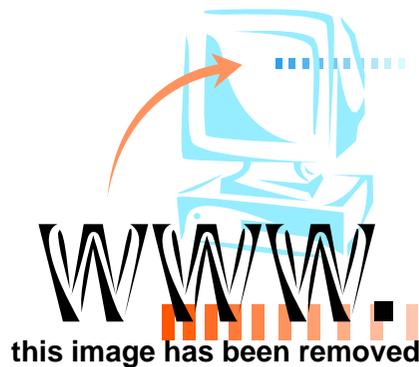


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Quarantine:
'We're calling
it Real World
Singapore'
Nature Medicine 9,
487 (2003)

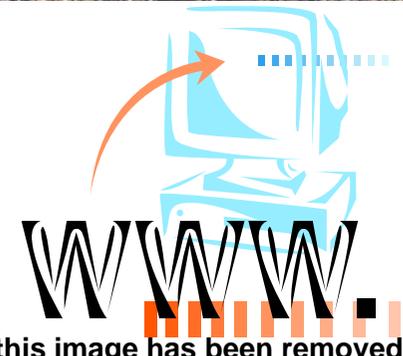


Cyclone Larry, Qld, 2006



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Hurricane Katrina, US, 2005 this image has been removed



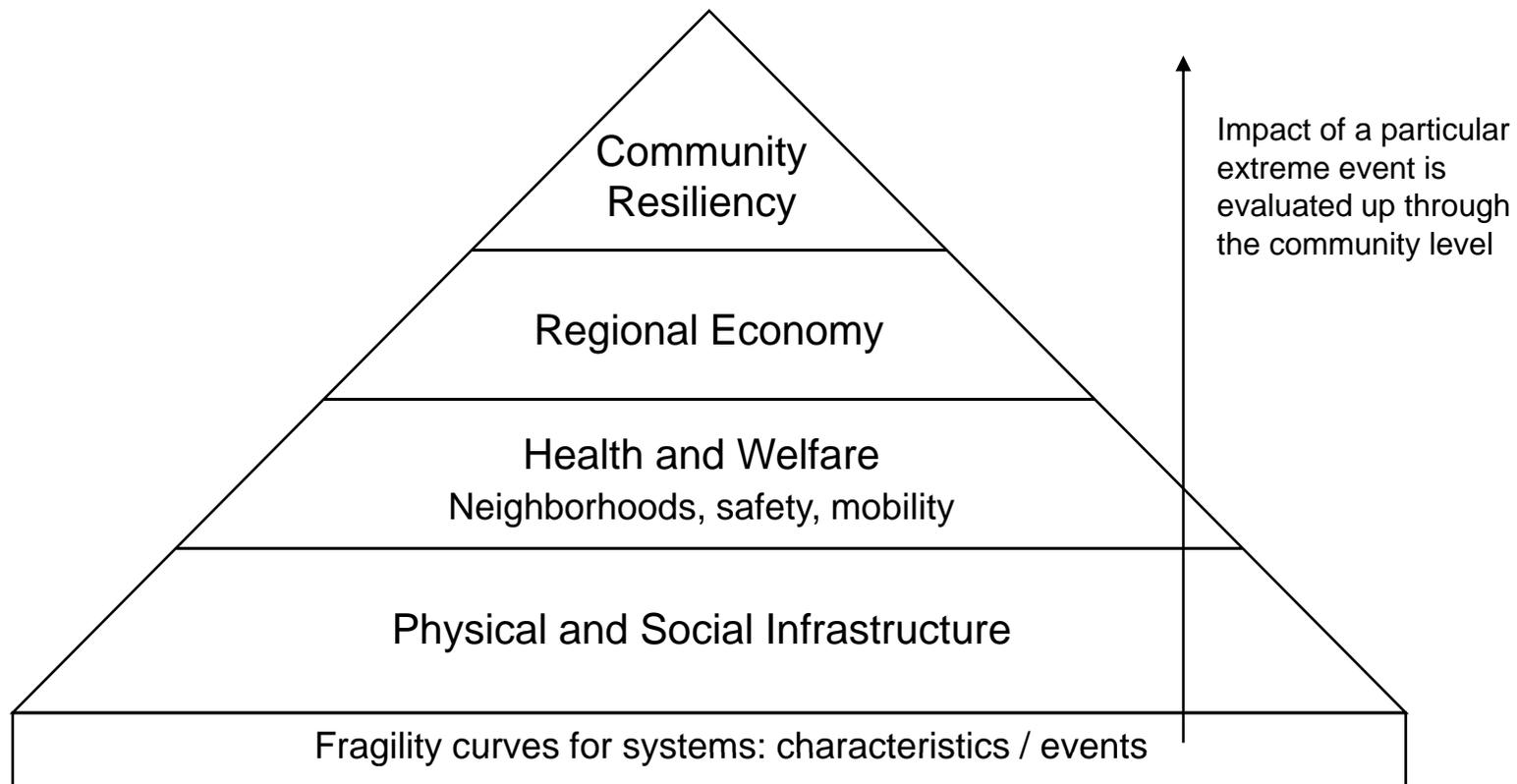


Using a consultative risk management approach to designing facilities for pandemic preparedness

“The essence of risk management lies in maximising the areas where we have some control over the outcome while minimizing the areas where we have absolutely no control over the outcome and the linkage between effect and cause is hidden from us”

Peter L. Bernstein, 'Against the Gods, The Remarkable Story of Risk, John Wiley & Sons, Inc.

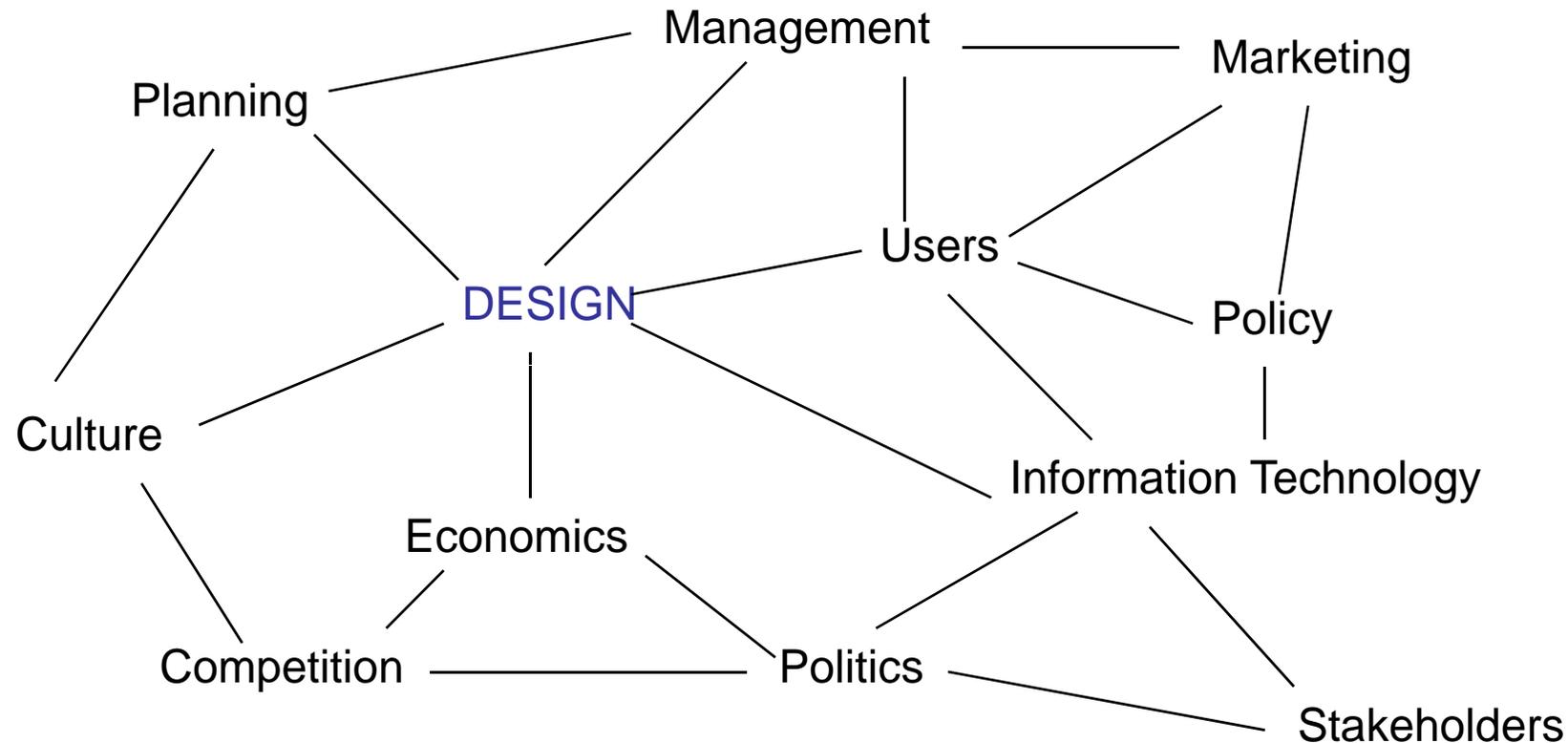
Using a consultative risk management approach to designing facilities for pandemic preparedness



Taken from Figure 1 Conceptual schematic
Simpson et al. Int J. Critical Infrastructures, Vol.2, Nos.2/3, 2005, 127

Using a consultative risk management approach to designing facilities for pandemic preparedness

HEALTH SYSTEM: A tangled web of interdependencies



The Organizational Ecology of Healthcare Environments

Becker & Carthey, 2007

Using a consultative risk management approach to designing facilities for pandemic preparedness

Case Study Methodology: NSW Health Climate Change Adaptation Study

1. Identify key stakeholders

Ability to implement project objectives

Objectives affected by project outcomes

<p><i>Minor Stakeholders</i> Clinicians Green Building Council of Australia</p>	<p><i>Important Stakeholders</i> Experts/scientists Aust Building Codes Board Peak Industry Bodies (FMA, IHEA, etc) Private Hospital Associations</p>
<p><i>Major Stakeholders</i> Rural services sector Aged care sector Community services sector Nursing care Mental health sector Local Government Planning Authorities EMA</p>	<p>KEY STAKEHOLDERS NSW Health Asset and Contract Services Ambulance/emergency Services Private - designers and/or contractors/ Government – NSW Dept of Commerce (Govt architect) NSW Health Statewide Services Branch NSW Health Environmental Health Branch NSW Area Health Services (clinicians/public health officers)– NSCCAHS NSW Greenhouse Office Aged Care Services Assoc (ACSA)</p>



Using a consultative risk management approach to designing facilities for pandemic preparedness

Case Study Methodology: NSW Health Climate Change Adaptation Study

2. Conduct Risk Management Workshop(s)

- Step 1 : Stakeholder analysis and common objectives
- Step 2 : Identify risks and opportunities to those objectives
- Step 3 : Assess their magnitude and prioritise them
- Step 4 : Develop an action plan to minimise risks and maximise opportunities





Using a consultative risk management approach to designing facilities for pandemic preparedness

Case Study Methodology: NSW Health Climate Change Adaptation Study

Workshop identified the following the common objectives for the study:

1. Quantifying impacts

Develop research program to identify, analyse & assess impacts of extreme weather events on health infrastructure

2. Evidence-based practice

Identify range of potential facility-related responses to healthcare challenges; ensure practitioner/researcher engagement, ensure research can be translated into practice, ensure relevance, practicality, dissemination in usable format

3. Asset management planning

Ensure effective procurement, design, FM, urban planning & asset management planning strategies responses & that these do not exacerbate the problems

4. Ensuring behavioural change

Raise awareness, change public expectations, behaviours, secure industry 'buy-in'

5. Integrated planning

Coordinated cross-jurisdictional responses – internal, local & society level

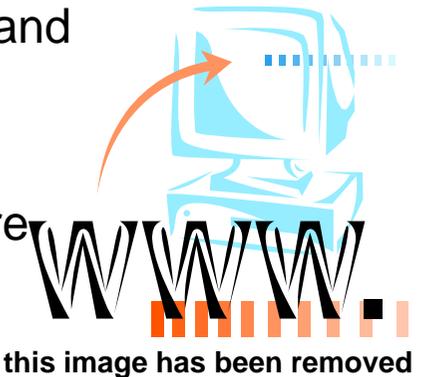


Using a consultative risk management approach to designing facilities for pandemic preparedness

Case Study Methodology: NSW Health Climate Change Adaptation Study

3. Summary of Results

1. Risks to the healthcare system exist due to climate change extreme weather events incl impacts on human health and on health facilities
2. Possible infrastructure responses identified from other countries/disaster events
3. Adaptive capacity – existing and required assessed
4. Integration with current disaster management strategies and other community responses is essential
5. Research required to improve our understanding
6. Communication of research findings & translation to future policy and practice must be ensured





The place of health facilities in managing disasters including pandemics

- **resilience** – the capability of a strained body to recover its size and shape after deformation; an ability to recover from or adjust easily to misfortune or change
- **robust** – having or exhibiting strength or vigorous health; strongly formed or constructed
- **redundant** – exceeding what is necessary or normal; serving as a duplicate for preventing failure of an entire system upon failure of a single component

Richard G. Little, 2003, Toward More Robust Infrastructure: Observations on Improving the Resilience and Reliability of Critical Systems, 36th Hawaii International Conference on System Sciences (HICSS'03)



The place of health facilities in managing disasters including pandemics

- Health facilities are **always part of a coordinated disaster response** (but often considered as ‘incidental’ to the big picture!)
- Disaster = ‘any event that threatens or overwhelms the normal operational capabilities of the local healthcare system and emergency medical services’.
- Mitigation, preparedness, response and recovery strategies are required



The place of health facilities in managing disasters including pandemics

- Mitigation strategies are those that **lessen the severity and impact of an emergency.**
- Can be addressed through **proper facility design** – but planning is essential!
- For example by designing buildings to handle **‘surge situations’**, the impact of an emergency can be lessened.

The place of health facilities in managing disasters including pandemics

- Example: NSW Health Interim Influenza Pandemic Action Plan, November 2005 notes place of health infrastructure in terms of:
 - ‘Fever clinics’
 - ‘Staging Facilities’
 - ‘Dedicated Influenza Hospitals’
 - ‘Isolation facilities within Hospitals’

http://www.health.nsw.gov.au/pubs/2005/pdf/pandemic_ap.pdf, accessed 8 March 2008



The place of health facilities in managing disasters including pandemics

'FEVER CLINICS'

Background

- **Discrete from existing hospital emergency departments** for assessing and triaging symptomatic individuals during an infectious disease emergency. Their purpose is to ensure:
 - emergency departments and general practice surgeries are not overwhelmed with pandemic influenza cases and can continue, as far as possible, their routine functions
 - within-hospital transmission of infection is minimised by ensuring potentially infectious patients visiting the clinic are kept separate from other patients seeking care in the health care facility
 - a standardised method for assessing and managing patients is adopted.
- **Patients assessed in fever clinics** would be assessed as being appropriate for care at home, as requiring further assessment and possible admission to designated influenza hospitals (see below), or as requiring care in a 'staging facility' (see below), according to their risk of disease, severity of illness, and ability to cope at home.

Strategies

- Prior to the onset of a pandemic, **each AHS is required to identify sites for fever clinic(s) in, or close to, all hospitals with an emergency department** using a framework developed by NSW Health.
- At Pandemic Alert period, Overseas 4 phase, the AHSs should anticipate the fever clinics and staging facilities becoming operational and begin readying the nominated facilities for use. The State HSFAC, with advice from the HSDCC, will advise the stage at which fever clinics (and staging facilities and influenza hospitals) are to be made operational in the AHSs.



The place of health facilities in managing disasters including pandemics

'STAGING FACILITY'

Background

- General term for a **facility to accommodate patients where it is impractical to manage them at home or in a hospital**. Size varies; supportive role rather than interventional.
- Staging facilities may be required to accommodate patients when patients are not unwell enough to require acute hospital care, but:
 - **lack adequate social supports** e.g., travellers, the frail elderly
 - when hospitals are full - **'overflow' facility**
 - when convalescing patients need a higher level of support than they can receive at home - **'step-down' facility**.
- Facilities and staffing required - **less intensive level than that of a medical ward in an acute care hospital**

Strategies

- In the Interpandemic and Pandemic Alert periods, each AHS is required to identify sites for staging facility(s) using a framework developed by NSW Health...
- In liaison with AHSs, CDU will manage a state-wide inventory of sites for staging facilities.
- During a pandemic, the State HSFAC, with advice from the HSDCC, will advise the stage at which staging facilities (and fever clinics and influenza hospitals) are to be made operational in the AHSs. Geographical variability in attack rates may dictate that staging facilities may not be required to be established in all AHSs simultaneously.
- At Pandemic Alert period, Overseas 4 phase, the AHSs should anticipate the fever clinics and staging facilities becoming operational and begin readying the nominated facilities for use. On instruction from the State HSFAC to AHSs, the fever clinics and staging facilities are to be made operational.



The place of health facilities in managing disasters including pandemics

'INFLUENZA HOSPITAL'

Background

- The aims of designating certain hospitals as influenza hospitals during a pandemic is to reduce the overall risk of hospital-transmitted infection as well as allowing others to carry out 'core' hospital functions of the state. Suitability will depend upon the size, layout, and areas of expertise of the hospital workforce. **However, to ensure that NSW has the flexibility to cope with any grade of pandemic, from mild to a severe, all state hospitals should be considered as potential influenza hospitals.**
- In the early stage of a pandemic, the order in which influenza hospitals will be brought on-line will be largely dictated by the geographical location of disease activity.
- Part of the process of identifying influenza hospitals would be to also **identify certain other hospitals that have important state-wide functions to be kept as free as possible of patients infected with the influenza virus.**

Strategies

- NSW Health will collaborate with AHSs to grade the suitability of all hospitals for influenza hospitals and manage a state-wide inventory of them.
- During a pandemic, the State HSFAC, with advice from the HSDCC, will advise the stage at which influenza hospitals are to be made operational in the AHSs. Geographical variability in attack rates may dictate that these may not be required to be established in all AHSs simultaneously.



The place of health facilities in managing disasters including pandemics

'ISOLATION FACILITIES WITHIN HOSPITALS'

Background

- The ability to isolate patients with communicable respiratory infections is a key method of containment. [Isolation rooms within hospitals, including negative pressure rooms, are an important component of this.](#) It is essential, therefore, in planning for a response to pandemic influenza that the number, design and location of these facilities are known, both within a hospital and across the state.
- There are a [limited number of isolation rooms within NSW health care facilities and it is likely that they would be of most benefit during the containment stage of a pandemic \(and prior\).](#) Once the pandemic virus reaches the stage of sustained transmission, other containment strategies will need to be employed for hospitalised patients (e.g., strict infection control practices, designated influenza hospitals, cohorting of patients).

Strategies

- The Australian Government initiative in 2005 to purchase portable machines designed to transform a positively pressured room into a negative pressured one may improve isolation room capacity in NSW. NSW Health will manage these and develop guidelines for their use.
- The [NSW Health Facility Guidelines* were released in December 2004](#), which included information relating to the design of isolation facilities. This will enable a standardised approach to the layout of isolation rooms in hospitals constructed in the future.
- NSW Health is responsible for keeping information relating to isolation facilities in NSW up to date.
- [*now replaced by Australasian Health Facility Guidelines in November 2007](#)



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*
 - Patient flow
 - Security
 - Wayfinding
 - Decontamination
 - Parking
 - Convertability
 - Other points
 - Role of the Facility Manager and his/her team
- Consider issues PRIOR to an emergency!



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Patient flow

- How patients arrive, enter, move through and exit a facility in a safe, orderly manner
- Increase in volume + increase in tension – rush/panic
- Different entry for paramedics & other emerg clinicians
- Separate traffic routes so ambulatory patients don't get in the way & can't see patients with more serious issues



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Security

- Control entry and exit to facilities – reduce the number of entry/exit points, control access via cameras and swipe cards
- May need to lock down a site to maintain order and security



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Wayfinding

- Many more people entering the facility than usual
- Many have never been there before (although some may have in a more normal context)
- Effective wayfinding systems required
- If functions changed, additional temporary wayfinding systems may be needed also.



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Decontamination

- Depending on type of emergency, patients may require decontamination
- Showers and negative pressure rooms may be required
- Consider how to keep 'dirty' patients away from 'clean' ones and prevent spread of infection
- May need to shut off emergency dept from rest of facility in some circumstances – must build this capability in during design phase



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Parking

- Typically an influx of vehicles
- Emergency vehicles, personal vehicles, supply delivery vehicles, etc
- Consider parking logistics
- Design for a surge in number of vehicles



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Convertability

- Consider developing spaces that can be converted to patient care, triage, or holding areas
- Could include ambulatory surgery suites, office space or meeting rooms
- May need to be close to the emergency dept – short travel distances for staff
- For biological emergency with risk of cross-contamination, may need to be far away from the main hospital building



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Other points

- Separate 'mission critical' areas depts and control access to these
- Adequate space – overall and per patient/distances between them
- Isolation rooms + ante-rooms, handwashing, ppe storage
- Appropriate systems eg mechanical and ventilation systems – support isolation + separate air intake and exhaust
- Adequate supplies of personal protective equipment (PPE) needed
- Cleaning protocols to be developed and applied consistently
- Infection prevention and control to be rigorously maintained



The place of health facilities in managing disasters including pandemics

- *Issues to consider in designing facilities for emergency management:*

Role of the Facility Manager

- Plays a vital role – has access to own staff plus engineering groups, suppliers and peer groups at other hospitals
- A potentially strategic resource – especially when working closely with senior management teams
- Can educate people on technical aspects of the building environment
- Expert experienced designers have similar, complementary abilities to contribute expertise, peer connections and a strategic view to a coordinated response



Designing health facilities to ensure continuity of service delivery in the event of disasters such as pandemics

- Available resource = Australasian HFG (www.healthfacilityguidelines.com.au)
- Adopted for national use as at 23 Nov 2007 by most jurisdictions (but not by Victoria)



Designing health facilities to ensure continuity of service delivery in the event of disasters such as pandemics

- **Available resource = Australasian HFG (www.healthfacilityguidelines.com.au)**
- Part B S80: Clause 80.10.00 'Natural Disasters'
- Part B S300: Emergency Dept – Clause 300.34.00 'Disaster Planning'

'The ED is the 'front line' facility in the case of a disaster. The local Disaster Plan should be considered in the design of the Unit. Requirements may differ between metropolitan and rural units. Flexible planning is required to accommodate the large workloads, critically ill and/or infectious patients, relatives, friends and hospital staff involved in managing a disaster situation. The flexibility to expand into adjoining areas such as Outpatients, or Main Entry should be considered.

Depending on it's designated role the ED may also become a communication hub during formal disaster function. Consideration should be given to allocating a suitable space with adequate communications ports to be used as a disaster management base and to allow briefing of the press. Direct telephone lines bypassing the Hospital switchboard should be available for use in internal and external emergencies or when the hospital PABX is out of service. A disaster may result in a high volume of ambulance traffic to the ED.

In addition, the communications base may be utilised by the Police as a communications centre. The ED plan should also accommodate a Disaster Equipment Store that is easily accessible and contains sufficient supplies to fully equip the disaster team for either on-site or off-site function.

Disaster planning is discussed in more detail in Part B Section 80 of these Guidelines.'



Designing health facilities to ensure continuity of service delivery in the event of disasters such as pandemics

- **Available resource = Australasian HFG**
(www.healthfacilityguidelines.com.au)
- Part D 'Infection Prevention and Control'
- Part D S820: Clauses 820.21.00 to 36.00 'Isolation rooms'
- Also *TS11 Engineering Services & Sustainable Development Guidelines, updated version released for review in Jan 2008* (NSW-specific) - other States have similar documents where TS11 not used e.g. WA. (links from AHFG website)



Using physical design features to prevent and control the spread of infection within facilities

- AHFG Part D S820: Clauses 820. 36.00 'Isolation rooms'

	CLASS S	CLASS N	CLASS P	CLASS Q
KEY VENTILATION CRITERIA	No air pressure difference between room and the adjacent corridor	Lower air pressure in the room than in the adjacent corridor or anteroom	Greater air pressure in the room than in the corridor	Lower air pressure in the room than in the adjacent corridor
TRANSMISSION-BASED PRECAUTIONS	To prevent contact or droplet transmission	To prevent airborne transmission	To prevent transmission of pathogens from the outside environment to profoundly immunocompromised persons	To prevent airborne transmission
EXAMPLES	VRE, gastroenteritis, cutaneous anthrax, hepatitis A.	Measles, varicella, suspected or proven pulmonary or laryngeal tuberculosis, suspected contact of measles, varicella, SARS, etc.	Prevention of aspergillosis in bone-marrow transplant recipients	Highly infectious pathogens such as haemorrhagic fevers, Hantavirus pulmonary syndrome

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Using physical design features to prevent and control the spread of infection within facilities

- AHFG 'Standard Components' = standard rooms/typical application
- Room data and room layout sheets
- Example shown of room layout for 'negative pressure isolation room'

Room Layout Sheet

Room Name: 1 Bed Room (isolation - Negative Pressure) RLB Room Code: 1 BR-1S-N RDS Room Code: 1 BR-1S-N

01 AIRPORT ENTRY
 02 ENTRY
 03 ENTRY
 04 ENTRY
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PLAN

ELEVATION 1

REV	DESCRIPTION	DATE	BY	CHKD	APPROVED	DATE	BY	CHKD	APPROVED
1	ISSUE FOR CONSTRUCTION	20/01/11	HCAMC	HCAMC					
2	ISSUE FOR CONSTRUCTION	20/01/11	HCAMC	HCAMC					
3	ISSUE FOR CONSTRUCTION	20/01/11	HCAMC	HCAMC					

Australasian KFG
 HCAMC
 UNSW
 HPI
 1 BR-1S-N
 1 BR-1S-N

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Using physical design features to prevent and control the spread of infection within facilities

- AHFG ‘Standard Components’ = standard rooms/typical application
- Room data and room layout sheets
- Example shown of room layout for ‘ante-room’ of 6sqm

AUSTRALASIAN HFG STANDARD COMPONENTS

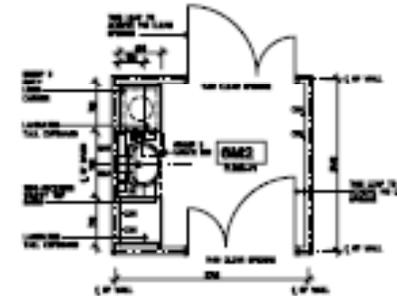
Room Layout Sheet

Room Name | Ante-Room

RLS Room Code | ANRM

RDS Room Code | ANRM

- AS AIRTABLE SWIP
- CS CUT EDGE
- DS DISPOSER - DISPOSAL SLAVE
- EP DISPOSER - WASH TANK
- ES DISPOSER - SINK
- MA MIRROR - SINK MIRROR
- MP SINK AND SINK PLANE PROTECTION
- PL PLUMBING
- LS LIGHT FIXTURE
- MS 3 PIN WALL COVER SWITCH
- VS VENT PLUMBING FIXTURE



PLAN



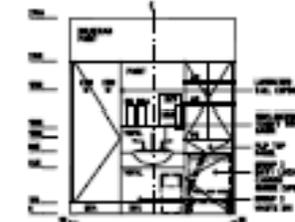
ELEVATION 1



ELEVATION 2



ELEVATION 3



ELEVATION 4

REV	DESCRIPTION	DATE	BY	CHK	DESCRIPTION	DATE	BY	CHK	DESCRIPTION	DATE	BY
1	PRELIMINARY										
2	REVISION										
3	REVISION										

DRAWN BY ANRM	CHECKED BY ANRM	DATE 10/10/11	PROJECT NO. ANRM	DRAWING NO. ANRM	SHEET NO. ANRM	TOTAL SHEETS ANRM	PROJECT NAME ANRM

This document is for advisory purpose only



Conclusions

- **Risk management** – predict & anticipate the required responses including the need for physical facilities
- **Emergency management strategies** – are part of the wider community response to pandemics & other disasters
- **Mitigation, preparedness, response and recovery strategies** needed
- Mitigation/preparedness/ response = **Design facilities to cope** with predicted loads and likely characteristics of patients presenting
- From a systems perspective ensure **resilience, robustness and redundancy** – apply this to the building solution (& the health system solution)
- Use available resources – e.g.
 - **Australasian Health Facility Guidelines**
www.healthfacilityguidelines.com.au
 - ‘**Planning, Design and Construction of Health Care Facilities, Joint Commission Resources, 2006**, www.jcrinc.com
- **Engage FM managers & designers early** in planning the required response!!

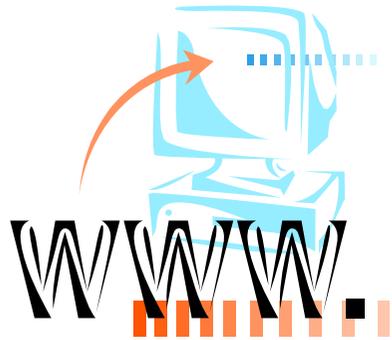
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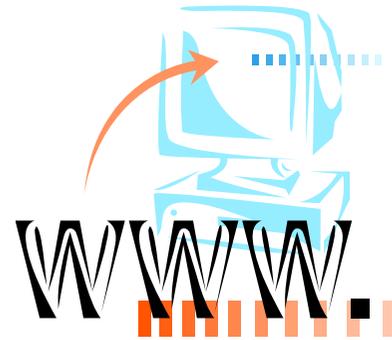
Centre for Health Assets Australasia



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CENTRE FOR HEALTH ASSETS AUSTRALASIA

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Major research programs include:

- Australasian Health Facility Guidelines
www.healthfacilityguidelines.com.au
- Australasian Post Occupancy Evaluation and Benchmarking projects
- Industry capacity building programs including bi-annual conference, regular seminars and other activities.