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Design for IPC in "unconventional" locations

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Preamble – the presenter

Takes part in devising guidance – always aiming for the ideal situation
Advises and investigates on outbreaks of infection – often far from ideal

The approach for this presentation – I will try to outline the ideal, but also give ideas of the relative value of measures.

- Often the more resource-intense measures are relatively low payback interventions and the more affordable measures yield good results.

I have no conflict of interests

One point of definition: I will be using "decontamination" to mean any process or sequence of processes that make a reusable medical device safe for reuse – cleaning, cleaning + disinfection, cleaning + sterilization, cleaning + disinfection + sterilization.

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Preamble – The problem

Hospital design – Planning a facility that will serve its purpose for the next 30 – 50 years is impossible. No ideal approach – just looking for the least worst.

What will change?

The services and interventions, but also the microbial challenges.

The concept of a "hospital biome"?

- I am sceptical when it comes to the dry environment – this is just transient contamination
- I believe it when focussed on the wet environment – more from my co-presenters in this session

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Design for IPC in "unconventional" locations

This presentation will focus on those areas of healthcare not normally covered in sufficient IPC detail in guidance.

First:

Operating room surgical instrument "preparation" areas – those areas where sterile instruments are unpacked and prepared for use: "layup".

In UK use: "preparation" or "prep" rooms.

Much detail on ORs, little on prep rooms

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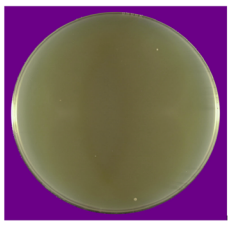
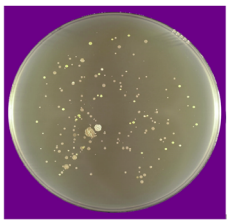
Airborne contamination in OR suites



1,000 litres of air in an empty room



Same - but now person walking by sampler

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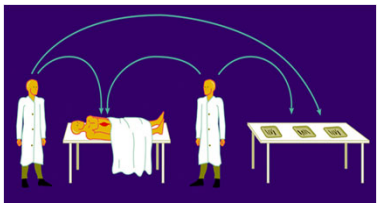
A critical purpose of OR suite ventilation is to keep exposed instruments clean



Probably the majority of airborne bacteria that end-up in a surgical wound, do so via exposed instruments. Anywhere that sterile instruments are exposed should be ventilated to be at least as clean as the OR

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OR suites – layup for conventional and laminar flow ventilation

- In conventional (i.e. non-laminar flow) ORs, either the preparation room is ventilated to the same standard as the OR, or layup occurs in the OR.
- For ultraclean ventilated ("laminar flow") ORs, layup should occur under the ultraclean airflow.
  - If that is not possible, consider horizontal laminar flow in the preparation room

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Interventional imaging and minimally invasive surgery

These are surgical procedures that have "evolved" via a different route.

Many facilities not ventilated to any particular standard.

Just because there is no effective wound does not mean there is no exposure to airborne microbes via the instruments used, but generally use individually packed items opened immediately before use.

UK Healthcare Infection Society guidance that these should have ventilation that gives 15 air changes per hour

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Minor surgical procedures

Poor definition but "*those that are carried out under local anaesthesia and that are superficial. The operative site is usually limited in size by whether it can be anaesthetized locally.*" is a reasonable place to start – but exclude intraocular procedures.

Here airborne contamination with skin microbes is not a particular problem.

Can be naturally ventilated rooms (opening windows with fly screens), cleanable surfaces, dedicated sterile instrument store.

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Guidance on facilities for minimally invasive and minor surgery is freely available on the Healthcare Infection Society website

Journal of Hospital Infection 80 (2012) 103–109

Guidelines

Guidelines on the facilities required for minor surgical procedures and minimal access interventions

H. Humphreys[a,b,*], J.E. Coia[c], A. Stacey[d], M. Thomas[e], A.-M. Belli[f], P. Hoffman[g], P. Jenks[h], C.A. Mackintosh[i]

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ORs in specialist burns units

In the UK, specialist burns units often have their own OR on the unit – debridement, skin grafts and dressings changes

With burns, the skin flora dispersed from the staff is of minimal risk to a burns patient

It is probable that there is significant aerosolisation of the bacteria infecting/colonising during surgical procedures/dressings changes

The main task in a burns OR would be to prevent these aerosols flushed-out into common wards area – as would happen with standard OR ventilation.

Consider burns ORs being designed with negative pressure ventilation

Will still get dilution of airborne contaminants for the safety of subsequent patients and dilution of anaesthetic gases, but no escape of aerosols into common ward areas

Currently the topic of a Healthcare Infection Society working group.

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Acinetobacter – the trojan horse of infection control?

L. Teare[a,*], N. Martin[b,c,d], W. Elamin[a], K. Pilgrim[a], T. Tredoux[b], J. Swanson[e], P. Hoffman[f]

Journal of Hospital Infection 102 (2019) 45–53

Conclusion: In an outbreak where contact precautions and environmental cleaning are optimal, it is important to give careful consideration to other mechanisms of spread. If there is a failure to do this, it is likely that the true causes of transmission will not be addressed and the problem will recur. It is recommended that burn theatres within burn facilities should be designed to operate at negative pressure; this is the opposite of normal operating theatre ventilation. Where showers are used, both the shower head and the hose should be changed after a patient with a resistant organism. The role of non-contact disinfection (e.g. hydrogen peroxide dispersal) should be reconsidered, and constant vigilance should be given to any 'trojan horse' item in the room.

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Isolation of infectious patients: "source isolation"

The vast majority of "isolation" is procedural (isolation of the microbes rather than the patient) – the facility has to enable and encourage good procedures.

- Lobbies – for storage and disposal of PPE, and handwashing. Useful space but negotiable.
- Shower/toilet – higher priority (except for immobile ITU patients)
  - can't isolate a patient with highly resistant Enterobacteriaceae adequatey if they have to use a communal toilet
  - commode decontamination can be poor QA
  - bedpans usually need to be transported to a different location for disposal – with same gloves on staff hands (*no 5 moments of glove hygiene*)

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Isolation of airborne infectious patients: "airborne isolation"

Need to ensure all gaps in a patient room's integrity do not leak out to adjacent occupied spaces

Negative pressure – more air extracted than supplied, deficit made up by air coming in through gaps

Also a high turnover of air to dilute infectious particles in the air

Comparatively easy to do if there is a mechanical ventilation system

In resource limited areas where this is not practical, local extract should be possible

- Local ducted extract, or fan in wall or window.
- Only staff should have control of that fan
- No opening windows

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Protective isolation

Most protection of patients is procedural

A small number of highly neutropenic patients need protection against inhalation of fungal spores – one of the few occasions when patients need protection against the environment outside the hospital

Air to their rooms supplied via HEPA filter; more air supplied than extracted ("positive pressure") so gaps leak outwards preventing ingress of unfiltered air

- Positive pressure without HEPA filtration is pointless
- The air change rate is irrelevant – the ventilation is to exclude not dilute

As these are usually cohortable patients, e.g. bone marrow transplant, can put HEPA filters in the air handling unit so the whole ward can be free of fungal spores

Air passes from patient room, out into common ward spaces and then out into the rest of the hospital

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Endoscopy procedure rooms

Much guidance says that these should be at positive pressure to protect the patient

Not sure how this protects patients and against what?

For lower GI endoscopy, no airborne risk to patients and negative pressure would contain smells

For those bronchoscopies where there may be a TB risk, negative pressure in both the procedure and the recovery area would contain infectious aerosols.

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Endoscope decontamination areas

Need to have a clear sequential flow from dirty to clean, with no cross over – to prevent recontamination.

These do not need special ventilation to control microbial contamination (but may do if toxic vapours from the disinfectant)

Ideally 2 rooms, with pass-through endoscope washer-disinfectors

Still possible to use 1 room dedicated to decontamination, but staff behaviour becomes much more critical.

Decontamination is far more difficult to do in the procedure room – not recommended

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Intracavity ultrasound devices – transvaginal, transrectal and trans(o)esophageal (TOE/TEE) probe decontamination

These are less complex than endoscopes (no lumens), but still present difficulties

Currently their decontamination is usually at the point of use and poorly controlled

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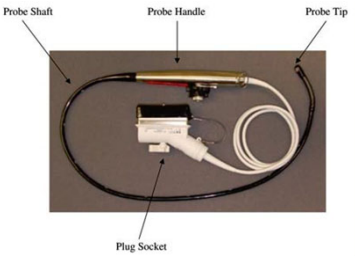
TOE/TEE probe



Probe insertion tube immersible but not angulation wheels or plug body, unlike endoscopes where they are totally immersible.

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My first encounter with TOE/TEE probes

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Then

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2 subsequent publications

Guidelines for transoesophageal echocardiographic probe cleaning and disinfection from the British Society of Echocardiography[☆‡]

P. Kanagala[1], C. Bradley[2], P. Hoffman[3], and R.P. Steeds[4,*]

European Journal of Echocardiography (2011) 12; i17 – i23

Guidance for the decontamination of intracavity medical devices: the report of a working group of the Healthcare Infection Society

C.R. Bradley[a], P.N. Hoffman[b,*], K. Egan[c], S.K. Jacobson[d], A. Colville[e], W. Spencer[f], S. Larkin[g], P.J. Jenks[h]

Journal of Hospital Infection 101 (2019) 1–10

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Intracavity probe decontamination – the future

- Covers/sheathes can not be relied on to protect the probe. Areas not covered will make contact with user's contaminated hands

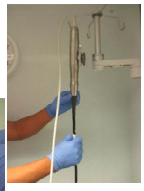
Decontamination of the probe (typically transvaginal and transrectal) when still connected to its associated equipment is likely to be poor QA

There need to be adequate facilities for probe decontamination, either at the location of use or elsewhere.

- As with endoscopes, there needs to be a defined dirty to clean flow. Preferably good facilities to clean, then controlled disinfection

Some automated systems do not disinfect the whole probe including parts that do not make patient contact; still need a manual element for these.

Redesigning the probes so that they are fully immersible would be a major step forward



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Neonatal intensive care units

Incubator decontamination

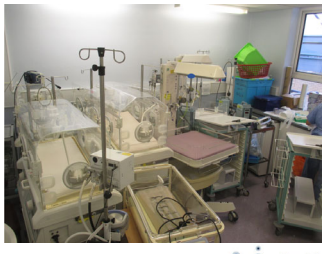
To dismantle, clean and disinfect an incubator and associated components (mattress, leads, stethoscope etc.) in a clear dirty to clean flow requires a lot of work space.

In a typical UK NICU, there are occasions when several incubators will need to decontaminated in a short time

The facility in which this is done is almost always too small and has insufficient space for optimal decontamination

This is not high technology and does not differ much between health economies

This requirement should be considered as a fundamental design parameter



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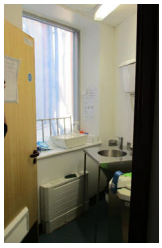
Dirty utility ("sluice") rooms

Used for disposal of body fluids, disposal or decontamination of bedpans and urinals, decontamination and storage of commodes, usually other storage as well, some point-of-use tests (e.g. urine dipsticks) and temporary storage of waste

Problem 1 – These are rarely large enough. Disassembly and decontamination of commode, plus their storage, requires space

Problem 2 – Contaminated gloved HCW hand opening sluice room door – common contact point. Solution unclear – non-touch door opening? Sluice room with no door?

In an era of multi-resistant Enterobacteriaceae, these rooms have become far more important.



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The Healthcare Infection Society as a resource

https://www.his.org.uk/

Has freely available resources –

- HIS guidelines
- other UK resources
- "*IPC in 5*" – 5 minute digested presentations from the HIS trainee program

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