Decontamination of the patient environment: Practical & quality assurance issues

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Cleaning and disinfection

Cleaning

- The removal of anything that it not part of the item being cleaned
- The definition will vary according to the item being cleaned and the risk it poses
- Always poorly defined with imprecise and arbitrary end-points

Disinfection

- The inactivation of pathogens to levels that negate any risk of infection
- The definition will vary according to the item being cleaned and the risk it poses
- Always poorly defined with imprecise and arbitrary end-points

These processes can be combined or sequential

Cleaning – preliminary considerations

The act of cleaning should not itself remobilise or transfer contamination

- Removal of dust by damp cloths so as not to raise dust
- The use of high efficiency (“HEPA”) filters in vacuum cleaner exhausts

Cleaning equipment should not be a source of contamination

- Mops should be heat disinfected in a laundering process and thoroughly dried
  - At least weekly in most areas
  - Daily in high risk areas
- Mop buckets dried after each use and stored upside down so as not to retain liquid

Dry “dust attracting” mops should be vacuum cleaned after each use

Quality assurance: Cleaning

Two approaches (common to many decontamination procedures):

Product control

Find ways of assessing that the cleaned surface/area is adequately free of “contamination”

- This is analogous to sterility testing sterilized items

Process control

Control the process such that parameters that are accepted as giving an adequate end-point always occur

- This is analogous to controlling a sterilization process to give a known acceptable sterility assurance

Cleaning: Product control

Visual inspection:

- Whilst this is always useful for an aesthetically acceptable end-point, much of the significant contamination may not be visible. If visual acceptability is your measurement, the tendency may be not to clean areas that do not look dirty.

  Visual inspection should be done – one of the aims of cleaning is an aesthetically acceptable result – but cannot be the sole criterion.

UV marker removal

- Only a few surfaces can be marked, which may or may not coincide with important surfaces; requires post-cleaning inspection with a UV light (darkness helps); can only be done on a sample of cleaning occasions and on a few surfaces

UV light illumination

- There is a belief that powerful UV lights can show-up areas of dirt. This system is not calibrated for used in infection control.

Cleaning: Product control

Microbiological sampling:

- Results will take at least a day to appear, longer if more specificity on contamination is required
- The simplest approach, total viable count, tells you nothing about pathogens and any efficacy of cleaning may be confounded by (irrelevant?) recontamination between cleaning and sampling
- If specific pathogens are sought, testing can get very complex (e.g. *C. difficile* or norovirus)
- The easiest places to sample are also the easiest places to clean.
- If contamination is not evenly spread, results can be random and independent of cleaning efficacy
- Impossible to know what acceptable limits are. Will have arbitrary approach.

Cleaning: Product control

Molecular methods:

- Very expensive and not amenable to routine use
- Would be specific for one target only
- PCR cannot tell the difference between, for example, viable and non-viable micro-organisms (but is the only way of detecting some – such as norovirus)
- Can be so sensitive that gives positives on non-significant contamination levels
- The easiest places to sample are also the easiest places to clean.
- If contamination is not evenly spread, results can be random and independent of cleaning efficacy
- Impossible to know what acceptable limits are. Will have arbitrary approach.

Cleaning: Product control

ATP-based technology (much used in the food sector)

- Gives a rapid result
- Will not show bacteria directly (unless in very high numbers) or viruses at all, but will show the presence of once-living matter they may be suspended in
- ATP levels may be indirectly related to pathogen presence: it is possible, for example, that norovirus in faeces will give a far higher reading than norovirus in vomit
- Will not show specific pathogens
- Results are given in Relative Light Units (RLUs). There is no general correlation between these and microbial levels significant in infection transmission. Limits of 500 RLU used in the food industry – for healthcare what limit?
- The easiest places to sample are also the easiest places to clean.
- If contamination is not evenly spread, results can be random and independent of cleaning efficacy

Cleaning: Process control

The use of adequately trained, motivated, equipped and supervised cleaning staff

- This is an approach more amenable to overall consistent quality assurance
- It can apply to all cleaning events, rather than those selected to be monitored
- The use of one or more product control measures may be a useful educational tool (i.e. show cleaners ATP readings on a surface before and after cleaning) or for occasional assessment but should not, in themselves, set benchmarks.

UK cleaning procedures and management standards (2009) – extracts from contents

Health Protection Agency

NHS
National Patient Safety Agency
National Reporting and Learning Service

The Revised Healthcare Cleaning Manual

Cleaning technologies

Microfibre cloths

- These have fibres with a shaped cross section that can attract and retain particles and fats without the need for surfactants (detergents).
- They have been shown in trials to remove more microbial contamination from surfaces than conventional cloths.
- They are too expensive to use as disposable and require laundering and return for reuse – extra logistical problems
- Most cannot be used with hypochlorite disinfectants
- There are concerns that, if improperly used, they could transfer contamination between surfaces
- It is not known whether the statistically significant additional microbial reduction have a practically significant infection control outcome or if, whatever cleaning method is used, they way it is used is more important than what is used.

Environmental disinfection

Consider under 3 headings:

- Conventional chemical disinfection
- Gaseous disinfection
- Heat disinfection

Conventional environmental disinfection

Use of broad spectrum chemical disinfectants

Hypochlorites, chlorine dioxide, alcohols, surfactants (QACs and triamines) …..

Most useful when an end to dispersion can be defined

Patients vacating an area; emptied wards, terminal disinfection of equipment …..

QA criteria of application are important

Spectrum, inactivation by organic matter, exposure time (time to evaporation), thorough coverage ....

Conventional environmental disinfection

Either as fabric application of separate disinfectant solutions or as pre-prepared wipes

There are no standard tests for disinfectants applied as wipes

There are both suspension and surface tests. Surface tests are more applicable.

The exposure times used in tests are usually far in excess of the exposure times of disinfectants wiped onto a surface

A disinfectant will dry in seconds to minutes when wiped onto a surface. After that, disinfection will cease. Some disinfectant wipes/solutions that make claims of, for example, sporicidal activity will base that claim on a 60 minute exposure. This will not occur in most environmental applications.

Any claim for activity needs to supported by tests that simulate the intended use

Gaseous disinfection

Hydrogen peroxide as a vapour

Most effective when the H_2O_2 is a gas. Fogging, the spraying of droplets which fall by gravity, leaves shadowed areas untreated

Cannot be used in occupied area

Preparation is vital – remove anything that may resist the passage of the gas, expose all surfaces

Remove bedsheets etc., remove and discard accumulations of single-use items, clean surfaces, leave mattresses & pillows with all surfaces exposed

Leave equipment in the room(s)

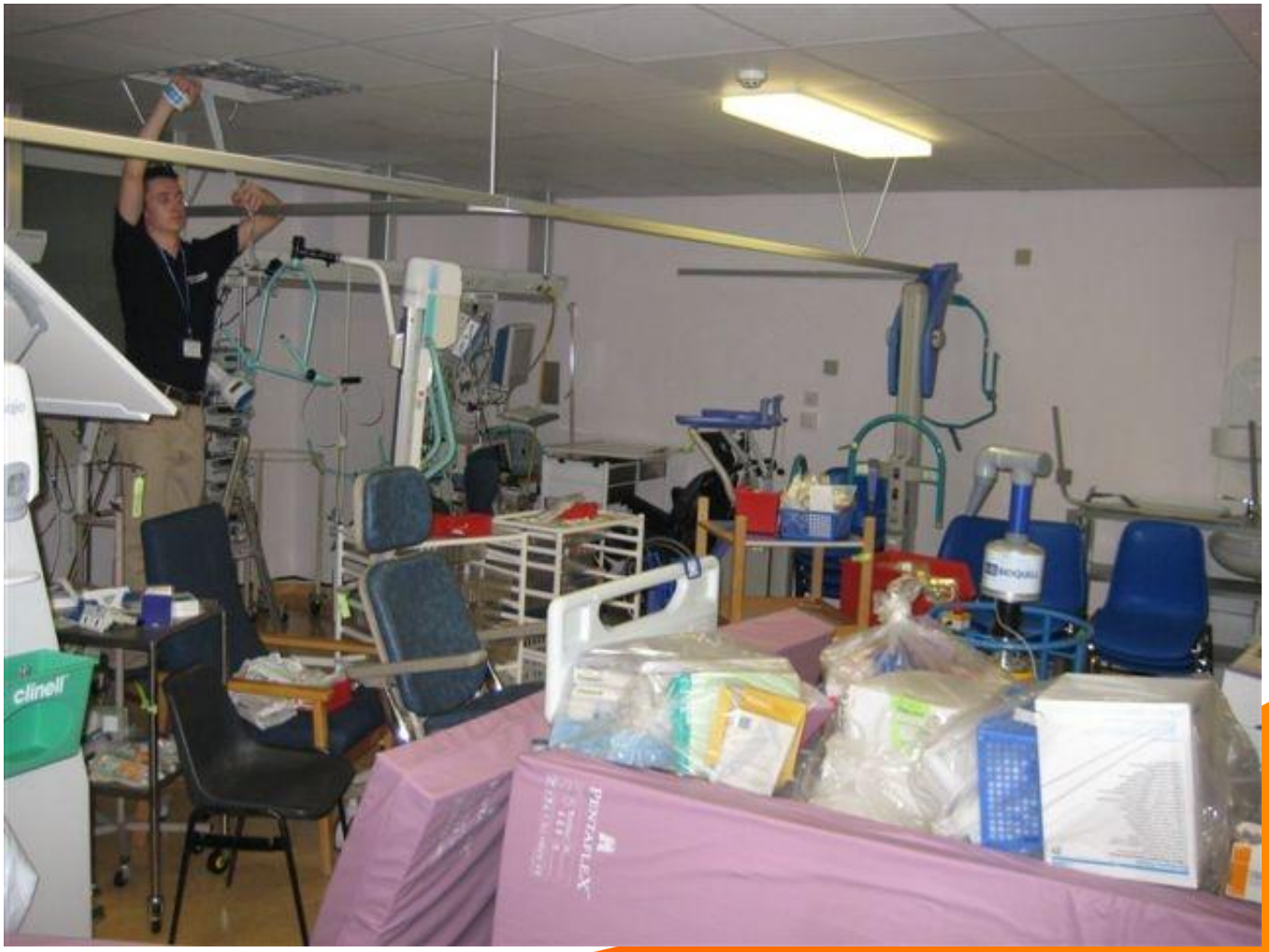
Do not remove possibly contaminated items and then move them back. If anything is removed, it must be disinfected separately

Validate the process with multiple spore strips

Time delay before reoccupation

Hydrogen peroxide fumigation of an ITU

Hydrogen peroxide fumigation of an ITU



Heat disinfection: steam cleaners

Portable devices that have electrically heated pressurised reservoirs of steam. The steam is released into a delivery hose and applied via a terminal nozzle.

The steam will be at 100^{o}C only immediately after depressurisation (many claim steam will be at the pressurised storage temperature) and then the droplets will cool rapidly thereafter.

- **The further the point of application from the point of steam generation, the greater this cooling**

Typically, temperatures at a steam cleaning nozzle are between 45 and 85^{o}C.

The further the nozzle is from the surface being cleaned, the less efficient the heat transfer

The shorter the dwell time of the nozzle over the surface being cleaned, the less efficient the heat transfer

Steam cleaning is a good method of cleaning, but has to be used by well-equipped, trained, motivated cleaners to be effective disinfection

“Antimicrobial” surfaces

There are many companies selling antimicrobial surfaces

Any antimicrobial chemical incorporated into surfaces requires a liquid “bridge” to enable it to mobilise from the surface and penetrate a microbial cell

The tests (JIS Z 2801 or ISO 22196) are done in 100% humidity (i.e. with a water film on the surface), but the products will be used in 30-70% humidity.

These tests lack the organic matter that would inactivate low concentrations of a disinfectant.

Such tests normally show a modest reduction after 24 hours – How would this help a contact surface such as a door handle or keyboard with seconds between each contact?

The danger is, that if staff know that there is a “self sterilising” surface, cleaning will become less important.