

# **Sources of Infection in Long-Term Care Facility - Environmental Issues**

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## **Environmental Issues**

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- Environmental Sampling
- Hand Hygiene
- Medical Waste
- Linen
- Plant Engineering
- Nutrition and Food Services
- Disinfection and Sterilization

# EPIDEMIOLOGY OF INFECTIONS IN EXTENDED CARE FACILITIES

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- Relative contribution of the following unclear (limited studies)
  - Endogenous flora (40-60%?)
  - Person-to-person transmission (direct and indirect, 20-40%?)
    - Other residents
    - Staff-to-patients
    - Visitors
  - Role of the contaminated environment (20%?)



# Environmental Sampling

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- The only routine microbiologic sampling recommended as part of quality assurance program is:
  - Biological monitoring of sterilization process by using bacterial spores (e.g., steam sterilizers should be monitored at least once per week with commercial preparation of Gs spores)
  - Monthly cultures of water used in hemodialysis applications (e.g., water <200mo/ml, and dialysate at the end of dialysis <2,000mo/ml)

## Environmental Sampling-CDC

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- Situations
  - Quality assurance such as assuring that equipment or systems have performed to specifications
  - Support of an investigation of an outbreak of disease or infections if environmental reservoir is implicated
  - Research purposes using a well-designed and controlled experimental method
  - Monitor a potentially hazardous environmental condition





# Evidence of Transmission of Pathogens on Hands

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- Transmission from patient-to-patient via HCW hands requires four elements
  - Organisms on HCWs hands (via patient or environment)
  - Organisms must survive for several minutes on hands
  - Hand hygiene must be inadequate or agent inappropriate
  - Contaminated hands of HCW must come in contact with another patient (or an inanimate object that will contact patient)

## Hand-borne Microorganisms

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- Presence – bacterial counts on hands range from  $10^4$  to  $10^6$ 
  - resident microorganisms-attached to deeper layers of the skin and are more resistant to removal; less likely to be associated with HAIs.
  - transient microorganisms-colonize the superficial layers of skin and amenable to removable; acquired by direct contact with patients or contaminated environment surfaces; frequently associated with HAIs.

## The Far Side



## Hand Hygiene Practices in Healthcare

- Hand hygiene has been reported to average 40% (34 studies)
  - Inaccessibility of hand hygiene supplies
  - Skin irritation from hand hygiene agents
  - Inadequate time for hand hygiene
  - Interference with patient care
  - Lack of knowledge of the guidelines
  - Lack of information on the importance of hand hygiene

# Hand Hygiene Practices in Healthcare

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- Observational studies revealed that duration averages from 6.6 to 21 sec, and in 10/14 (71%) studies HW <15 sec, and in 8/14 (57%) studies HW  $\leq$  10 sec
- HCWs also fail to wash all surfaces of their hands and fingers effectively

## Hand Hygiene History

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- Guidelines:
  - U.S. Public Health Service (1961)-soap and water, 1-2 min before and after patient contact
  - CDC (1975 and 1985)-nonantimicrobial handwashing between patient contacts, antimicrobial before invasive procedures
  - APIC (1988 and 1995)-similar to CDC, more discussion of alcohol-based handrubs
  - HICPAC (1996)-either antimicrobial soap or a waterless antiseptic agent be used for cleaning hands upon leaving MRSA/VRE patient rooms

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# **Guideline for Hand Hygiene in Healthcare Settings**

JM Boyce, D Pittet, HICPAC/SHEA/APIC/IDSA  
Hand Hygiene Task Force

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## **Indications for Handwashing and Hand Antisepsis**

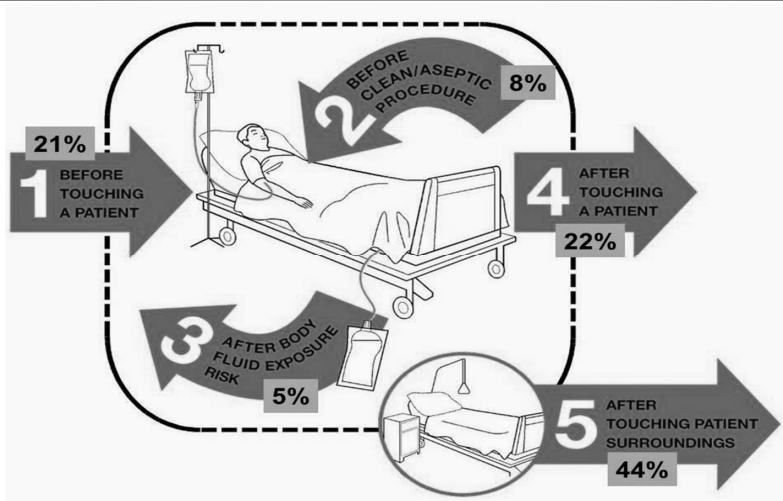
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- Hands are visibly dirty or soiled, wash with nonantimicrobial soap and water or antimicrobial soap and water. Category IA
- If hands are not visibly soiled, use an alcohol-based handrub for routinely decontaminating hands in all other clinical situations. IA. Alternatively, wash hands with antimicrobial soap and water. IB
  - Before having direct contact with patients. IB
  - Before donning sterile gloves when inserting a central intravascular catheter. IB

# Indications for Handwashing and Hand Antisepsis

- Decontaminate hands not visibly soiled with handrub/antimicrobial (continued)
  - Before inserting urinary catheter, peripheral vascular catheter, or other invasive device. IB
  - After contact with a patient's intact skin. IB
  - After contact with body fluids, mucous membrane, nonintact skin or wound dressings, as long as hands are not soiled. IA
  - If moving from a contaminated body site to clean site. II
  - After contact with inanimate objects in vicinity of patient. II
  - After removing gloves. IB

## Simplify the Message: Clean In, Clean Out



Diller T, AJIC 2014 June

# Indications for Handwashing and Hand Antisepsis

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- Use nonantimicrobial/antimicrobial before eating and after using a restroom. IB
- Antimicrobial towelettes may be an alternative to washing hands with nonantimicrobial soap and water. IB
- No recommendation on routine use of non-alcohol-based handrubs. Unresolved issue



## **Alcohol-Based Handrubs**

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- Minimize factors adversely affecting adherence to hand hygiene protocols
  - Reduce bacterial counts more effectively than washing hands with nonantimicrobial and antimicrobial soaps
  - Can be made much more accessible
  - Require less time to use
  - Produce less skin irritation and dryness
  - Improved adherence to hand hygiene policies and reduce NI rates

## **Hand Hygiene and “Clean Procedures”**

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- Personnel contaminate hands by performing “clean procedures”
- Nurses contaminate hands with 100-1000 CFU during such “clean” activities as lifting patients, taking the patient’s pulse, blood pressure, or oral temperature, or touching the patient’s hand, shoulder, or groin.

## **Studies Comparing Relative Efficacy of Plain Soap or Antimicrobial Soap vs Alcohol-Based Antiseptics in Reducing Counts on Hands**

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- Alcohol more effective than plain soap (17 studies)
- In all but two trials (15/17), alcohol-based solutions reduced bacterial counts on hands to a greater extent than washing with soaps or detergents containing povidone-iodine, 4% CHG, or triclosan

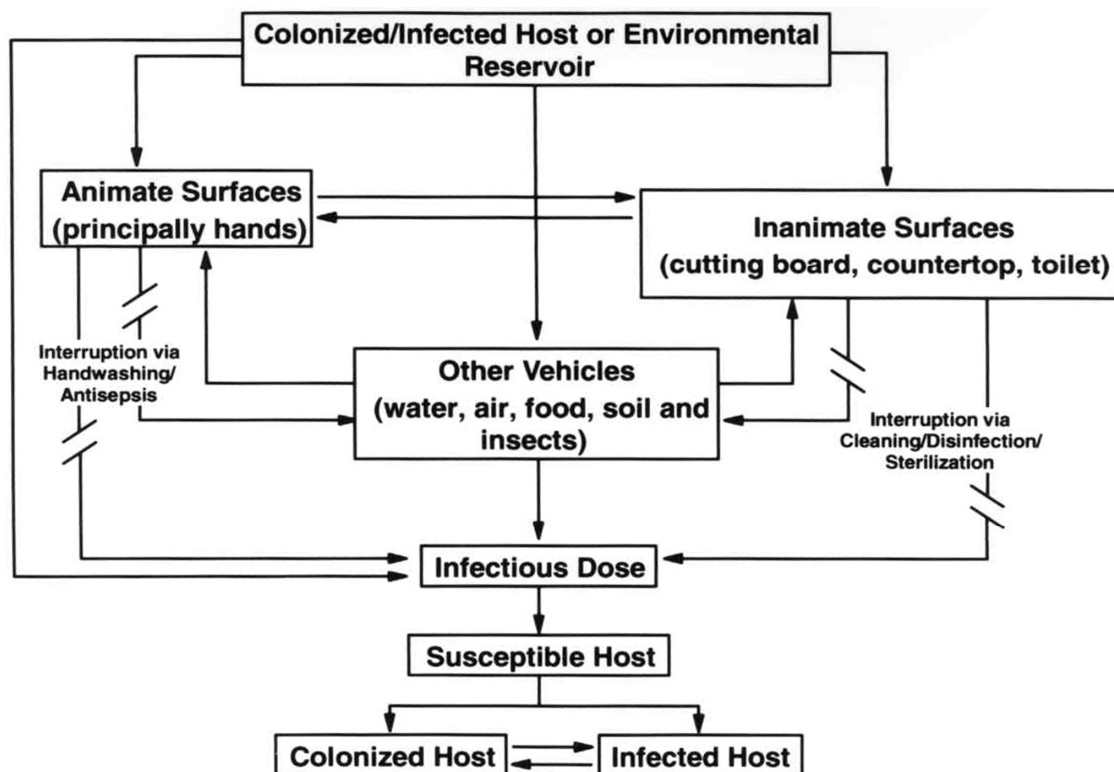
## **Hand Hygiene Technique**

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- Apply alcohol-based handrub to one hand and rub hands together, covering all surfaces. Follow manufacturer's recommendation on volume. IB
- Soap and water-wet hands, apply amount of product recommended, rub hands together for 15 sec, covering all surfaces. Rinse with water and dry with disposal towel. IB







Transmission of infectious agents via animate and inanimate surfaces

### Infection Prevention In Long Term Care Facilities

- Housekeeping in the facility should be performed on a routine and consistent basis to provide for a safe and sanitary environment (IC)
- Measures should be instituted to correct unsafe and unsanitary practices (e.g., environmental cleanliness may be monitored by walking rounds with a checklist)

Smith PW, et al.  
ICHE 2008;29:785-814

Elements	Examples
<b>Infection control activities</b> Establish and implement routine infection control policies and procedures <b>Infection identification</b>	Hand hygiene Standard precautions Organism-specific isolation Employee education Develop case definitions Establish endemic rates Establish outbreak thresholds
<b>Identification, investigation, and control of outbreaks</b> Organism-specific infection control policies and procedures Disease reporting	Influenza TB Scabies MDROs (eg, MRSA) Public health authorities Receiving institutions LTCF staff
<b>Antibiotic stewardship</b> Monitoring of patient care practices	Review of antimicrobial use Aspiration precautions Pressure ulcer prevention Invasive device care and use
<b>Facility management issues</b>	General maintenance Plumbing/ventilation Food preparation/storage Laundry collection/cleaning Infectious waste collection/disposal
<b>Product evaluation</b> Resident health program Employee health program TB screening Other program elements	Environment Housekeeping/cleaning Disinfection/sanitation Equipment cleaning Single use devices TB screening Immunization program TB screening Immunizations Occupational exposures
<b>Performance improvement</b> Resident safety Preparedness planning	Serve on PI committee Study preventable adverse events Develop pandemic influenza preparedness plan

# MRSA PREVALENCE IN NURSING HOME RESIDENTS

- **Study design:** Multicenter, prospective study of residents of 26 nursing homes in Orange County, CA, from 2009-2011
- **Methods:** Only nares cultured
- **Results:**
  - Admission prevalence = 16%
  - Point prevalence = 26%
  - Dominant clones = USA300 (ST8/t008), USA100 (ST5/t002) and USA100 variant (ST5/t242)

Hudson LO, et al. J Clin Microbiol 2013 (Epub)

# CONTAMINATION OF THE ENVIRONMENT WITH MRSA

- **Study design:** Assessment of environment for MDROs in an occupied and newly built replacement nursing home (samples 11 weeks before and after transfer to new building)
- **Results:** MRSA commonly isolated; ESBL producing *E. coli* isolated once

Detection of methicillin-resistant *Staphylococcus aureus* (MRSA) in old and new nursing homes

Environmental sites	Old occupied nursing home		New unoccupied nursing home		New occupied nursing home	
	No. of tests	No. with MRSA	No. of tests	No. with MRSA	No. of tests	No. with MRSA
Door handles ( <i>N</i> = 92)	18	1	18	0	56	13
Floor surfaces ( <i>N</i> = 26)	6	4	6	1	14	11
Tables ( <i>N</i> = 23)	6	2	3	1	14	5
Bedside lockers ( <i>N</i> = 26)	6	4	6	0	14	10
Bed frames ( <i>N</i> = 26)	6	2	6	0	14	11
Toilet seats ( <i>N</i> = 36)	6	1	9	0	21	7
Arm chairs ( <i>N</i> = 23)	6	3	3	0	14	6

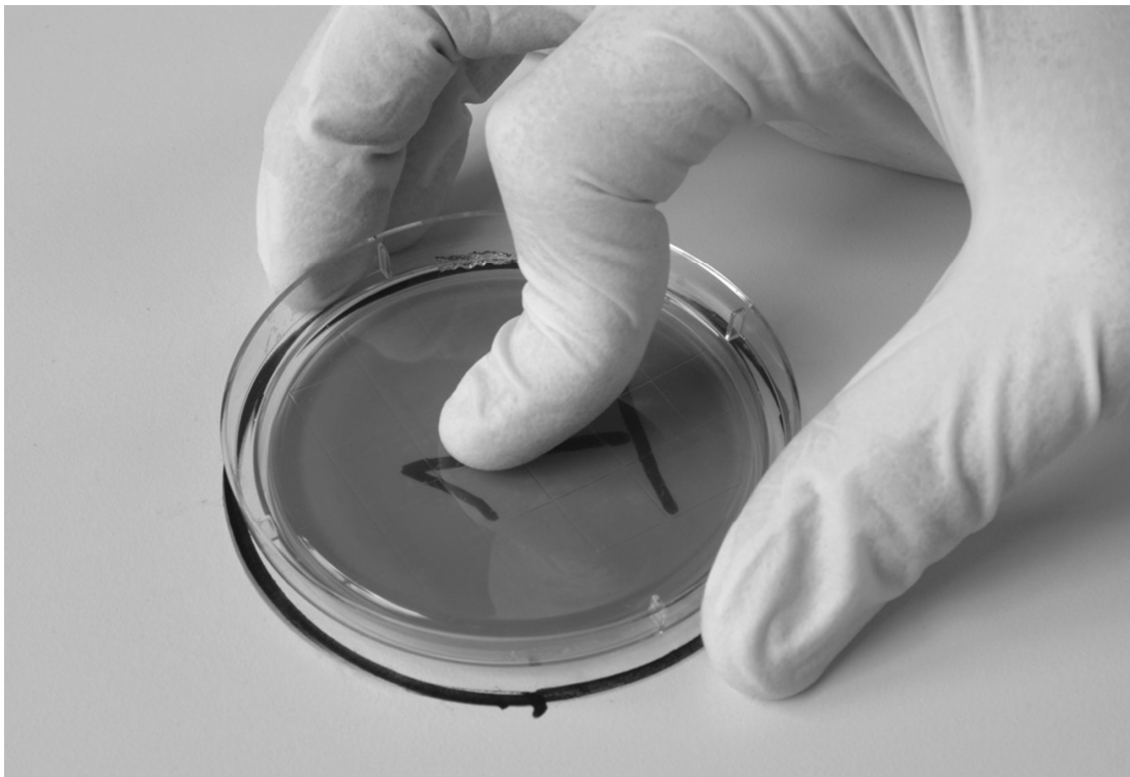
Ludden C, et al. J Hosp Infect 2013;83:327-9

# Quantitative Analysis of Microbial Burden on Long-Term Care Facilities Environmental Surfaces

DiBiase et al. ID Week Poster 2018

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- Microbiological samples were collected using Rodac plates from resident rooms and common areas in 5 local LTCFs
- 5 samples from up to 10 environmental surfaces were collected
- EIPs were defined as MRSA, VRE, *C. difficile* and MDR GNR



	Number of Rodac Sampling	Total CFU by Site	Mean CFU per Rodac	Total EIP by Site	Mean EIP Counts per Rodac	Number of Rodac Sampling	Total CFU by Site	Mean CFU per Rodac	Total EIP by Site	Mean EIP Counts per Rodac
<i>Sampling Site</i>	Non-Colonized Resident Rooms					Colonized Resident Rooms				
Bathroom Floor	54	8175	151.39	35	0.65	55	8227	149.58	1820	33.09
Bed Rail	48	5020	104.58	20	0.42	45	7176	159.47	614	13.64
Over Bed Table	48	5953	124.02	24	0.50	55	5123	93.15	123	2.24
Nightstand	55	4934	89.71	1	0.02	49	6081	124.10	223	4.55
Sink	55	5078	92.33	251	4.56	49	2684	54.78	371	7.57
Side Table	45	2477	55.04	4	0.09	34	3023	88.91	3	0.09
Chair	35	2008	57.37	1	0.03	44	2945	66.93	361	8.20
Head of Bed	15	799	53.27	0	0.00	20	1211	60.55	3	0.15
Window Sill	5	175	35.00	0	0.00	5	361	72.20	0	0.00
Foot of Bed	35	779	22.26	1	0.03	45	1127	25.04	20	0.44
Bed Remote Control	3	56	18.67	0	0.00	3	64	21.33	0	0.00
Door	25	157	6.28	0	0.00	14	98	7.00	16	1.14
Closet Door	10	65	6.50	0	0.00	10	55	5.50	7	0.70
Resident Room Total	433	35676	82.39	337	0.78	428	38175	89.19	3561	8.32

## Quantitative Analysis of Microbial Burden on Long-Term Care Facilities Environmental Surfaces

DiBiase et al. ID Week Poster 2018

	Resident Rooms			Community Rooms			Overall Total		
Pathogen Identified	Number of Positive Rodac with EIP	EIP Total Counts on Positive Rodacs	EIP Counts per Positive Rodac	Number of Positive Rodac with EIP	EIP Total Counts on Positive Rodacs	EIP Counts per Positive Rodac	Number of Positive Rodac with EIP	EIP Total Counts on Positive Rodacs	EIP Counts per Positive Rodac
<i>C. difficile</i>	34	856	25.18	5	7	1.40	39	863	22.13
MRSA	51	2998	58.78	15	101	6.73	66	3099	46.95
VRE	1	1	1.00	1	7	7.00	2	8	4.00
MDR GNR	10	43	4.30	7	144	20.57	17	187	11.00

# Quantitative Analysis of Microbial Burden on Long-Term Care Facilities Environmental Surfaces

DiBiase et al. ID Week Poster 2018

- Varying levels of CFU and EIP on environmental sites at LTCFs were found
- Colonization status of a resident was a strong predictor of higher levels of EIP being recovered from his/her room
- MRSA was the most common EIP recovered from Rodac plates, followed by *C. difficile*
- Infection prevention strategies (e.g., hand hygiene, disinfection, etc) should be performed in the LTCF setting on a routine and consistent basis

## Blood Pressure Cuff Non-Critical Patient Care Item



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# Surface Disinfection

## Noncritical Patient Care

Rutala, Weber. [www.cdc.gov](http://www.cdc.gov)

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- Disinfecting Noncritical Patient-Care Items
  - Process noncritical patient-care equipment with a EPA-registered disinfectant at the proper use dilution and a contact time of at least 1 min. *Category IB*
  - Ensure that the frequency for disinfecting noncritical patient-care surfaces be done minimally when visibly soiled and on a regular basis (such as after each patient use or once daily or once weekly). *Category IB*



# Surface Disinfection

## Environmental Surfaces

Rutala, Weber. [www.cdc.gov](http://www.cdc.gov)

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- Disinfecting Environmental Surfaces in HCF
  - Disinfect (or clean) housekeeping surfaces (e.g., floors, tabletops) on a regular basis (e.g., daily, three times per week), when spills occur, and when these surfaces are visibly soiled.  
*Category IB*
  - Use disinfectant for housekeeping purposes where: uncertainty exists as to the nature of the soil on the surfaces (blood vs dirt); or where uncertainty exists regarding the presence of multi-drug resistant organisms on such surfaces. *Category II*







# North Carolina Medical Waste Rules

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## Regulated Medical Waste Definitions

Microbiological - cultures and stocks of infectious agents

Pathological - human tissues, organs and body parts; carcasses and body parts of animals exposed to pathogens

Blood - liquid blood, serum, plasma, other blood products, emulsified human tissue, spinal fluids, and pleural and peritoneal fluids; in individual containers in volumes greater than 20 ml (bloody gauze, used gloves, tubing and dressings are not regulated medical waste).

# North Carolina Medical Waste Rules

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- Definition - “sharps” means and includes needles, syringes with attached needles, capillary tubes, slides, cover slips and scalpel blades.
- Requirement - sharps will be placed in a container which is rigid, leakproof when in an upright position and puncture-resistant. Contained sharps shall not be compacted prior to off-site transportation.
- Treatment - none required. The package may be disposed with general solid waste.

# North Carolina Medical Waste Rules

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## Regulated Medical Waste Treatment\*

Microbiological - incineration, steam sterilization or chemical treatment

Pathological - incineration

Blood and body fluids in individual containers in volumes greater than 20 ml - incineration or sanitary sewage systems, provided the sewage treatment authority is notified.

\*Other methods of treatment shall require approval by the Division of Solid Waste Management





## Routine Handling of Soiled Linen

- Soiled linen should be handled as little as possible.
- Soiled linen should be bagged or put into carts at the location where used. It should not be sorted or rinsed in patient care areas.
- Wet linen should be placed and transported in bags that prevent leakage.

## **Transportation of Linen**

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- All soiled linen should be transported in well covered and clearly identified carts used exclusively for linen.
- If laundry chutes are used, all linens should be bagged.
- All laundry chute doors should be kept closed, be tight-fitting and should be located in well-ventilated rooms, not in corridors in patient care areas.

## **Linen**

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- Soiled linens can be a source of large amounts of microbial contamination, although the risk of disease transmission appears to be negligible.

## **Processing Linen**

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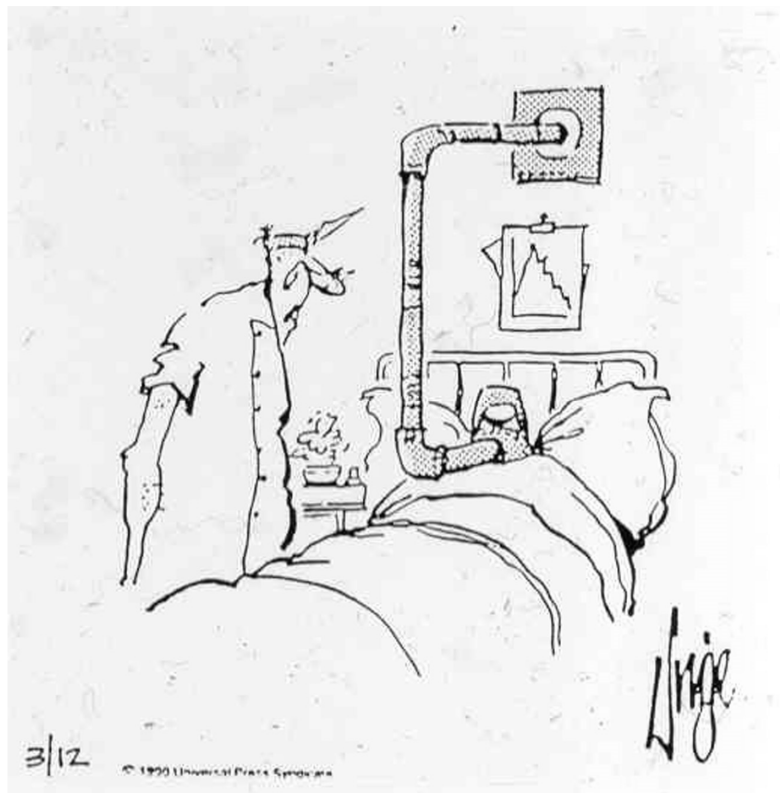
- All soiled linen will be treated as potentially infectious. White linen bags will be used for soiled linen from all patient care areas.
- Gloves and waterproof aprons should be worn when processing soiled linen. Handwashing facilities should be made available to personnel who sort linen.
- In the laundry, soiled linen should move from the dirtiest to the cleanest areas as it is being processed. The flow of ventilation air in the laundry should be from the cleanest to the dirtiest area.

## **Processing Linen (cont)**

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- Linen should be washed with a detergent in water hotter than 160°F for 25 minutes or if low-temperature laundry cycles are used, the wash formula must be controlled especially the amount of bleach.
- Heavily soiled items (e.g., floor mops, door mats) should be laundered separately from linens.









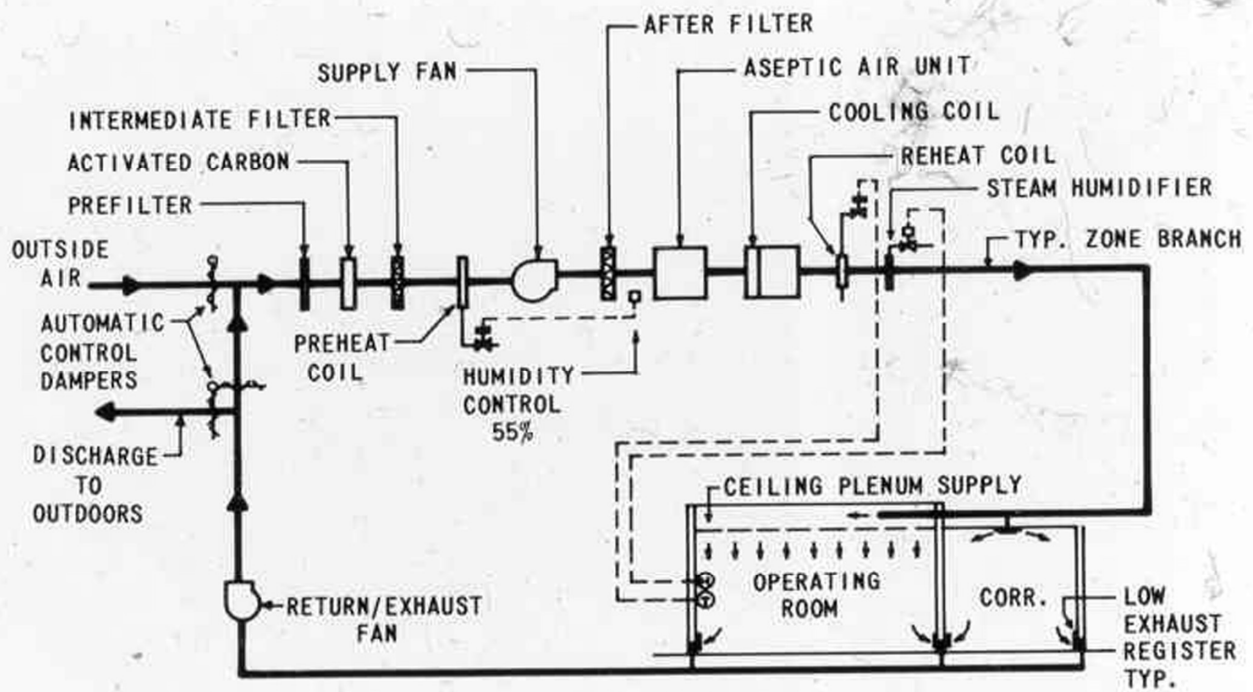


Fig. 2-1. Schematic flow diagram of Aseptic Air System.