

# Chemical disinfection in hospital hygiene in India

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Global Hygiene Strategies for Health Care facilities with  
special regard to chemical disinfection  
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# Overview

- India: sanitation status reports and guidelines
- Disinfectants
  - Selection of disinfectants: general principles
  - Policy in Tata Medical Center, Kolkata, India
    - Applications: Clinical, Housekeeping, CSSD, Endoscopy
  - Consumption > Expenditure
  - MEC: Minimum Effective Concentration
  - Safety: Ethylene Oxide monitor, MSDS
- MDRO bacteremia rates in the context of hospital hygiene
- Hospital Hygiene
  - Cost to keep the hospital clean

# The importance of sanitation

The Effect of Lack of sanitation and hygiene>>>>

“One gram of feces can contain: 10,000,000 viruses, 1,000,000 bacteria, 1,000 parasite cysts, and 100 parasite eggs.”

Source: WHO, 2008c.

# Economic Impacts of Inadequate Sanitation in India

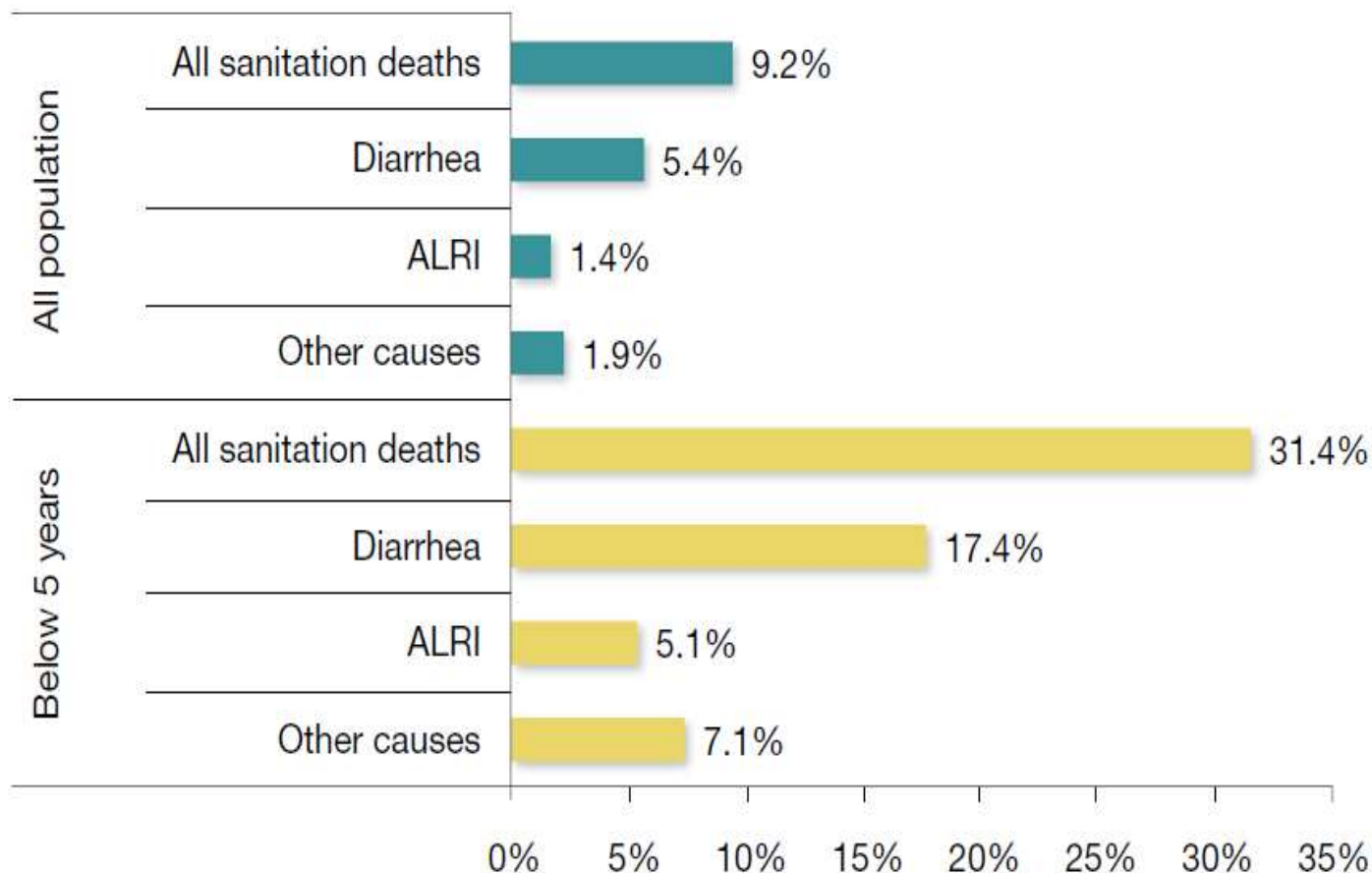
The annual economic impact of inadequate sanitation in India estimated in this report is ₹2.44 trillion (\$53.8 billion). This implies an annual impact of ₹2,180 (\$48) per capita.

This estimated impact is equivalent to 6.4 percent of the country's GDP in 2006. Monetary losses, a subset of economic

# Deaths attributed to inadequate sanitation in India

© 2011 Water and Sanitation Program

FIGURE 3.1 DEATHS ATTRIBUTED TO INADEQUATE SANITATION AS PERCENT OF ALL DEATHS, 2006



# Hospital infection prevention and control guidelines and sanitation status reports from India

- NCDC: National Centre for Disease Control:  
<http://ncdc.gov.in/writereaddata/mainlinkfile/File571.pdf>
- ICMR> Indian Council of Medical Research:  
<http://icmr.nic.in/guidelines/Hospital%20Infection%20control%20guidelines-2.pdf>
- National Accreditation Board for Hospitals & Healthcare Providers:  
[http://www.nabh.co/Images/PDF/HIC\\_Guidebook.pdf](http://www.nabh.co/Images/PDF/HIC_Guidebook.pdf)
- Swachhta Status Report , 2016>  
[http://mospi.nic.in/sites/default/files/publication\\_reports/Swachhta\\_Status\\_Report%202016\\_17apr17.pdf](http://mospi.nic.in/sites/default/files/publication_reports/Swachhta_Status_Report%202016_17apr17.pdf)
- Water, sanitation and Hygiene in Healthcare facilities, 2015 (low and middle income countries) >  
[http://apps.who.int/iris/bitstream/10665/154588/1/9789241508476\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/154588/1/9789241508476_eng.pdf)

# Selection of disinfectants: general principles

## 1. Microbiological Efficacy

- Virus, bacteria, parasite, fungus, mycobacteria, spores, prions
- Microbio-static or cidal

## 2. Material compatibility

- Cole-Parmer: <https://www.coleparmer.com/Chemical-Resistance>

## 3. Applications:

- Clinical, CSSD, housekeeping, endoscopy, WTP, STP

## 4. Safety: environmental, staff, patient

- MSDS: Material Safety Data Sheet; WHO Safety manual

## 5. Cost

## 6. Availability, reliability of supplies

## 7. User feedback

# Disinfectant use in Tata Medical Center, Kolkata, India

1. Clinical applications
2. Housekeeping > hospital Hygiene
3. Endoscopy unit
4. Central Sterile Supply Department (CSSD)
5. Water Treatment Plant (WTP)
6. Sewage Treatment Plant (STP)
7. Biomedical waste management
8. Hospital Laundry



# Clinical applications of Disinfectant in Tata Medical Center, Kolkata, India

- Clinical applications
  1. Hand hygiene: 2.5% chlorhexidine (w/v) + 70% isopropyl alcohol
  2. Skin preparation (vascular catheter insertion, surgery, blood cultures): CHG 2% w/v+ isopropyl alcohol 70% v/v
    - Some surgeons prefer 10% povidone iodine
  3. Skin disinfection before blood collection for lab tests: Alcohol swabs (70% isopropyl alcohol)
  4. Mouth wash: chlorhexidine gluconate 0.2%
  5. Post operative wound disinfection: 5% povidone iodine
  6. Surgical hand wash: 7.5% povidone iodine
  7. MRSA decolonization: Chlorhexidine (4% w/v) body wash

# Disinfectant use in Tata Medical Center, Kolkata, India

- Housekeeping > hospital Hygiene
  - Sodium hypochlorite > floors and lab bench tops
  - Sodium hypochlorite > spill management (infectious/clinical material spillage)
- Water Treatment Plant (WTP)
  - Sodium hypochlorite > chlorination of water
- Sewage Treatment Plant (STP)
  - Sodium hypochlorite > pollution control norms
- Biomedical waste management
  - Sodium hypochlorite > sharps container
- Hospital Laundry
  - Sodium hypochlorite > primary disinfection of contaminated linen

# Endoscope disinfection in Tata Medical Center, Kolkata, India

- Gastro-intestinal endoscopes and Bronchoscopes:
  - Automated: Olympus automated endoscope washer disinfectant > Glutaraldehyde
  - Manual disinfection: > Glutaraldehyde
  - Minimum Effective Concentration (MEC) checked using Cidex Test strips
- Urology cytosopes:
  - Peracetic acid > High level disinfection
  - Sterilization in CSSD: Ethylene Oxide or Hydrogen Peroxide (Plasma Sterilizer)

# Gas based sterilization at Central Sterile Supply Department (CSSD) in Tata Medical Center, Kolkata, India

- Ethylene Oxide sterilization: 3M
  - Less expensive
  - Long aeration time: 12-16 hours (cycle time)
  - Hazardous gas
  - Ethylene oxide detector to detect gas leakage
  - More effective sterilant
- Hydrogen peroxide sterilization (Plasma): Johnson & Johnson
  - Relatively fast: 2 hours
  - Not suitable for hollow devices with long lumen
  - More expensive
  - Less hazardous than ethylene oxide

# Hospital expenditure on disinfectants at Tata Medical Center, Kolkata

|                                   | 2012           | 2017           |
|-----------------------------------|----------------|----------------|
| In-patient numbers                | 4,556          | 8,483          |
| Cost/Out patient in INR<br>(Euro) | 29<br>(€ 0.36) | 26<br>(€ 0.32) |

# Disinfectant use and expenditure: 2017> TMC Kolkata, India

| Application                         | Chemical composition   | Rate(Rs) | Issues from Central Store for 2017 | Total cost(Rs) | Proportion (%) |
|-------------------------------------|--|----------|------------------------------------|----------------|----------------|
| Hand hygiene                        | 0.5% chlorhexidine (w/v)+ 50% 1-propanol+ 20% 1-propanol (v/v) | 0.46/ml  | 2620000                            | 1,205,200      | 26.2           |
| Surgical Skin disinfection          | Chlorhexidine 2% w/v and Isopropyl alcohol 70% v/v             | 0.57/ml  | 1347500                            | 768,075        | 16.7           |
| Surgical Skin disinfection          | 2.5% chlorhexidine (w/v)+ 70% propanol (v/v)                   | 0.45/ml  | 1346500                            | 605,925        | 13.2           |
| Biomedical equipment disinfection   | Ethanol: 10%; 2-propanol: 9%; 1-propanol- 6% (v/v)             | 0.9/ml   | 409500                             | 368,550        | 8.0            |
| Urology cystoscope disinfection     | 0.26% peracetic acid (w/v) + acetic acid + hydrogen peroxide   | 4.9/gm   | 72900                              | 357,210        | 7.8            |
| Skin disinfection before phlebotomy | Isopropyl alcohol 70%  | 1.9/pc   | 144228                             | 274,033        | 5.9            |
| Surgical Skin disinfection          | 10% povidone iodine (w/v)                                      | 0.56/ml  | 464500                             | 260,120        | 5.6            |

# Disinfectant use and expenditure: 2017> TMC Kolkata, India

| Application                                    | Chemical composition   | Rate(Rs)         | Issues from Central Store for 2017 | Total cost(Rs) | Proportion (%) |
|--|--|------------------|------------------------------------|----------------|----------------|
| Surface disinfection                           | sodium dichloroisocyanurate<br>2 gm tablet   | 116.96/50 tablet | 1464                               | 171,229        | 3.7            |
| Surgical Hand scrub                            | 7.5% povidone iodine (w/v)<br>in a viscous base  | 0.56/ml          | 299000                             | 167,440        | 3.6            |
| Water disinfection                             | Sodium Hypochlorite  | 188.8/50 liter   | 788                                | 148,774        | 3.2            |
| Endoscope disinfection                         | 2.45% w/v glutaraldehyde<br>with activator   | 896.8/5 liter    | 95                                 | 85,196         | 1.8            |
| MRSA<br>decolonization and<br>pre-op body wash | 4% w/v Chlorhexidine<br>Gluconate  | 1.32/ml          | 63300                              | 83,556         | 1.8            |
| Surgical Hand scrub                            | 4% Chlorhexidine<br>Digluconate, Glycerol (w/v),<br>Non ionic surfactant,<br>Amphoteric surfactant | 0.48/ml          | 97500                              | 46,800         | 1.0            |
| Surface disinfection,<br>fumigation            | 11% w/v hydrogen peroxide<br>stabilized by 0.01% silver<br>nitrate                                 | 0.65/ml          | 59000                              | 38,350         | 0.8            |
| Lumbar puncture;<br>regional anesthesia        | 0.5% w/v chlorhexidine<br>gluconate in 70% ethyl<br>alcohol (v/v)                                  | 0.59/ml          | 45500                              | 26,845         | 0.6            |

# Patient Numbers in Tata Medical Center, Kolkata

| Year   | OPD Registrations | Absolute Increase | % Increase | Inpatient Numbers | Absolute Increase | % Increase |
|--------|-------------------|-------------------|------------|-------------------|-------------------|------------|
| Y 2012 | 67,360            |                   |            | 4,556             |                   |            |
| Y 2013 | 104,153           | 36,793            | 55%        | 5,857             | 1,301             | 29%        |
| Y 2014 | 128,357           | 24,204            | 23%        | 7,156             | 1,299             | 22%        |
| Y 2015 | 141,990           | 13,633            | 11%        | 7,578             | 422               | 6%         |
| Y 2016 | 153,375           | 11,385            | 8%         | 8,036             | 458               | 6%         |
| Y 2017 | 175,828           | 22,453            | 15%        | 8,483             | 447               | 6%         |

**Tata Medical Center in Kolkata, India is a Cancer hospital**

**Phase 1> Total in-patient bed numbers: 183;**

**Phase 2> > Total in-patient bed numbers: 250 (to be operational from 2018)**



# MDRO bacteremia patient numbers

| Year          | Inpatient numbers | MRSA | VRE | ESBL+ AmpC | CRO | ColRE+A+P |
|---------------|-------------------|------|-----|------------|-----|-----------|
| <b>Y-2012</b> | 4556              | 1    | 4   | 46         | 23  | 0         |
| <b>Y-2013</b> | 5857              | 2    | 1   | 119        | 56  | 6         |
| <b>Y-2014</b> | 7156              | 5    | 3   | 141        | 83  | 1         |
| <b>Y-2015</b> | 7578              | 6    | 1   | 125        | 90  | 2         |
| <b>Y-2016</b> | 8036              | 6    | 1   | 129        | 105 | 8         |
| <b>Y-2017</b> | 6341              | 6    | 4   | 123        | 74  | 5         |

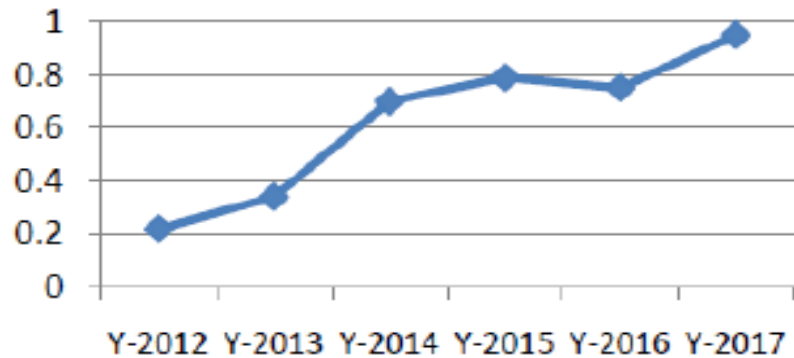
MRSA: methicillin resistant Staph aureus; VRE: Vancomycin Resistant Enterococci; **2017 data Till Sept 30th**  
 ESBL: Extended Spectrum Beta-Lactamase; AmpC: a type of Beta-lactamase;  
 ESBL and AmpC: lead to resistant to most cephalosporins; CRO: carbapenem Resistant organisms'  
 Col RO: Colistin Resistant Organisms: Enterobacteriaceae, Pseudomonas, Acinetobacter

# MDRO bacteremia rates in Tata Medical Center, Kolkata, India

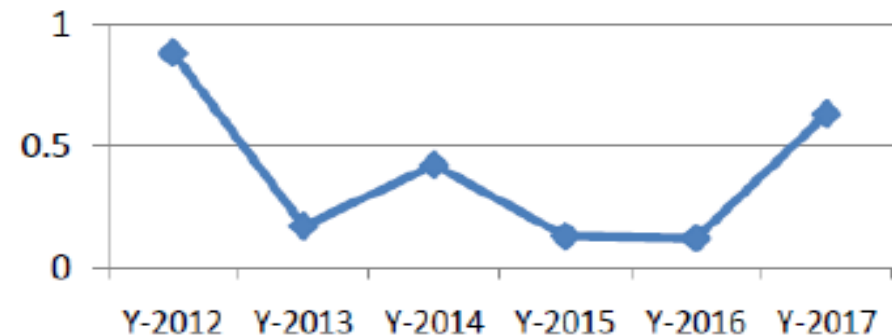
Cumulative picture > MDRO BSI rate per 1000 In-patients >

Data till  
30 Sept 2017

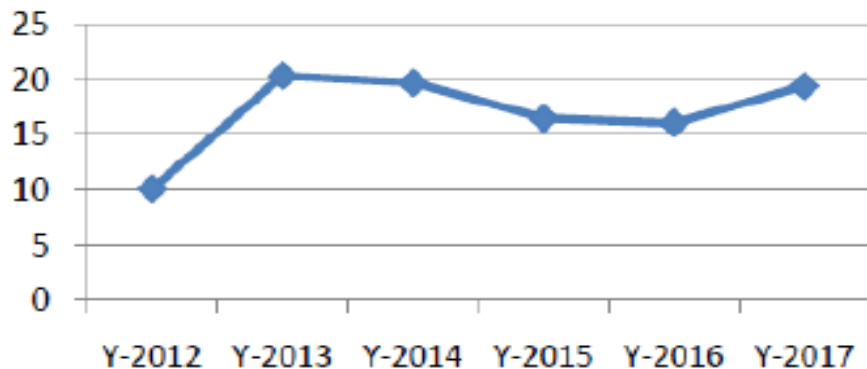
**MRSA BSI rate per 1000 In-Patients**



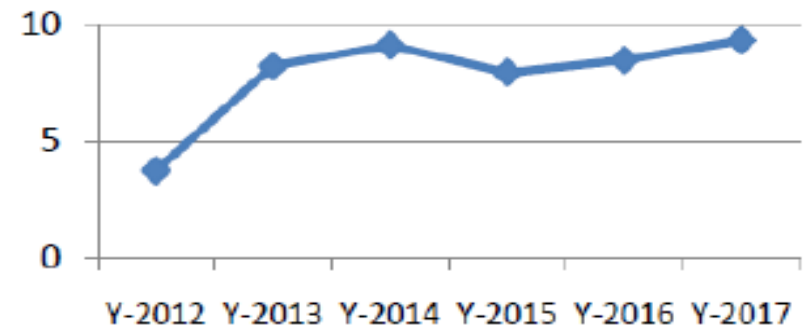
**VRE BSI rate per 1000 In-Patients**



**ESBL+AmpC BSI rate per 1000 IP**



**CRE BSI rate per 1000 In-Patients**



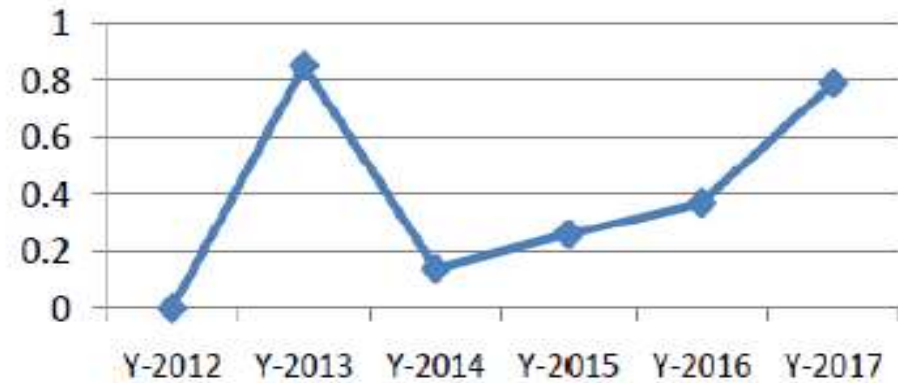
# MDRO bacteremia rates in Tata Medical Center, Kolkata, India

Data till  
30 Sept 2017

### CRO BSI rate per 1000 In-Patients



### Col RE BSI rate per 1000 In-Patients



### ColR O BSI rate per 1000 In-Patients



Cumulative picture > MDRO BSI rate per 1000 In-patients >

### Summary:

- MDRO BSI rates have shown a variable trend
- There is increase in MRSA and Col RE rates
- ESBL+ AmpC and CRE rates appear stable
- Further analysis required to understand underlying factors

# Mortality due to infections in cancer patients

| Infection and patient cohort              | TMC Kolkata | International data                |
|---|-------------|-----------------------------------|
| Mold infection in ICU (proven + probable) | 63%         | 56% MSKCC;<br>67 to 79% Belgium   |
| Carbapenem resistant Acinetobacter BSI    | 60%         | 84% Brazil                        |
| Carbapenem resistant Pseudomonas BSI      | 50%         | 35% Spain                         |
| Colistin Resistant Klebsiella             | 33%         | 26% Italy; 31% Spain              |
| Carbapenem resistant Klebsiella BSI       | 40%         | 46% Israel                        |
| Gram negative sepsis in critical care     | 44%         | 34 to 39% MSKCC-<br>severe sepsis |
| Candidemia without neutropenia            | 44%         | 55% Taiwan                        |
| Candidemia with neutropenia               | 39%         | 24% MSKCC- cancer                 |
| Staph aureus bacteremia                   | 13%         | 12% MDACC                         |
| Tuberculosis (3 months)                   | 2.5%        | 25% MSKCC                         |
| Influenza A and B                         | 2.5%        | 5% MDACC- HSCT                    |
| Varicella/ zoster                         | 2.5%        | 0% MDACC                          |
| CMV in allogeneic HSCT*                   | 2.3%        | 11% MSKCC Cord BT                 |



**Sweeping brush>  
Outdoor and indoor**



**Wet mop**



**Dry mop**



**Wringer trolley**



**Floor squeeze**



**Scrbbing Pads**



**WC brush**

**Cleaning utensils and chemicals  
At Tata Medical Center, India**



**Dust pan**



**Anhydrous citric acid>  
Toilet cleaning**



**Gloves>  
Toilet,  
garbage,  
Patient care**



**Alkyl alcohol ethoxylate  
Aminoethanol Propanol>  
Hard surface cleaner**

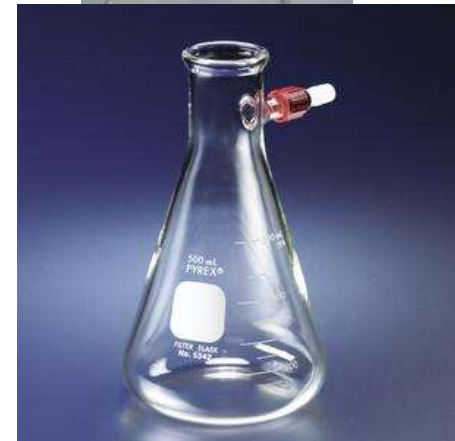


**Methoxy propanol  
ethanol  
> Glass cleaner**

# Water quality monitoring



**Water TDS-**  
total dissolved salt-  
Conductivity meter;  
CSSD target <10 mg/L  
Source: Aesculap



**Water microbiology**  
Membrane filtration  
Target:  
Coliforms- 0/100 ml  
Pseudomonas- 0/100 mL  
Ref: WHO, HPA (UK)



**Water chlorine level-**  
Colorimeter  
O-toluidine/  
Electronic  
Target: 0.2-0.5 ppm  
Ref: WHO



# Disposable Water Filter>

## Bone Marrow Transplant Unit, TMC Kolkata



- **Change -31 days; 0.2  $\mu\text{m}$  filter**
- Protective barrier against waterborne contaminants including *Legionella spp.*, and *Pseudomonas spp.*
- Maximum upstream operating pressure 5 bar (500 kPa) @ 60 °C
- Normal upstream operating pressure 2 – 4 bar (200 – 400 kPa)
- Maximum temperature exposure 70 °C for a total cumulative period of 30 mins over the life of the filter

# Hospital cleaning cost > TMC Kolkata, India

| Costing heads (FY: 2015-2016)                          | Cost in INR (Euro)          | % cost       |
|--|-----------------------------|--------------|
| Housekeeping staff salary (outsourced )                | 34,028,585 (€ 425,358)      | 67.38        |
| Laundry (outsourced)                                   | 8,193,936 (€ 102,424)       | 16.23        |
| <b>Cleaning Consumables (chemicals, disinfectants)</b> | <b>6,287,083 (€ 78,589)</b> | <b>12.45</b> |
| Cleaning Equipment                                     | 728,460 (€ 9,106)           | 1.44         |
| Waste Autoclave (maintenance+ consumables)             | 461,784 (€ 5772)            | 0.91         |
| Biomedical Waste management (outsourced)               | 352,009 (€ 4,400)           | 0.70         |
| Water Consumption for Cleaning Purposes                | 327,797 (€ 4097)            | 0.65         |
| General Waste management (government)                  | 120,600 (€ 1,508)           | 0.24         |
| Total (INR)  | 50,500,254 (€ 631,253)      | 100          |



# Conclusion:

## Hospital Hygiene and Disinfection priorities for India

Provision of Safe Water:  
Rural areas,  
Underprivileged  
communities

Infection Control  
In Health Care  
Organizations

Further Strengthening  
of the  
Public health system



Hospital disinfection >

Priorities for India >

Microbiologically efficacious  
Good material compatibility  
Safe for the users  
Reasonably priced  
Reliable supply

# Acknowledgement

- Medical Administration
- Materials Department
- Housekeeping
- Central Sterile Supply Department
- Infection Control Team



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