

# Sterile Supply in Times of Disaster, Crisis and War

## What we can learn from practices in Africa



2026/10/16

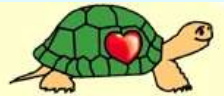
### Sterilization Management and Continuity of Sterile Services in Crisis and War

تهران، نمایشگاه بین‌المللی شهر آفتاب ساختمان اداری، طبقه اول، سالن سمینارها

Conference details and registration

Jan Huijs

Presented by Dr. Hamid Zare



**HEART** Consultancy

Healthcare through **A**ppropriate  
and **R**eliable **T**echnology

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Martin de Porres Hospital  
Eikwe, Ghana, 2009

All photographic material  
© Jan Huijs, except when  
different source indicated





# Where it all started

- Ghana: 1982-1989: work as medical equipment technician **2** for Catholic mission hospitals all over the country.
- Maintenance team: Covering whole spectrum of equipment
- Initially focus on repairs/installation; later more on education



# Lectures and workshops in many locations





# Sterile Supply in Times of Disaster, Crisis and War

## What we can learn from practices in health facilities in Africa

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- Advanced technology in health care; its vulnerability
- Focus on sterile supply
- If disaster strikes or war breaks out
- Experiences during workshops and training sessions related to sterile supply in various countries in Africa
- Conclusion/Recommendations

St. Joseph's Hospital, Monrovia, 2015



# Healthcare has become dependent on advanced technology



Alrijne Ziekenhuis  
Leiderdorp, NL, 2016



# Advanced technology in the CSSD



St. Franciscus  
Ziekenhuis,  
Roosendaal, NL, 2014



UMC Utrecht, NL 2021





# Advanced technology in the CSSD

Packaging robot: Jeroen Bosch hospital, Den Bosch, Netherlands

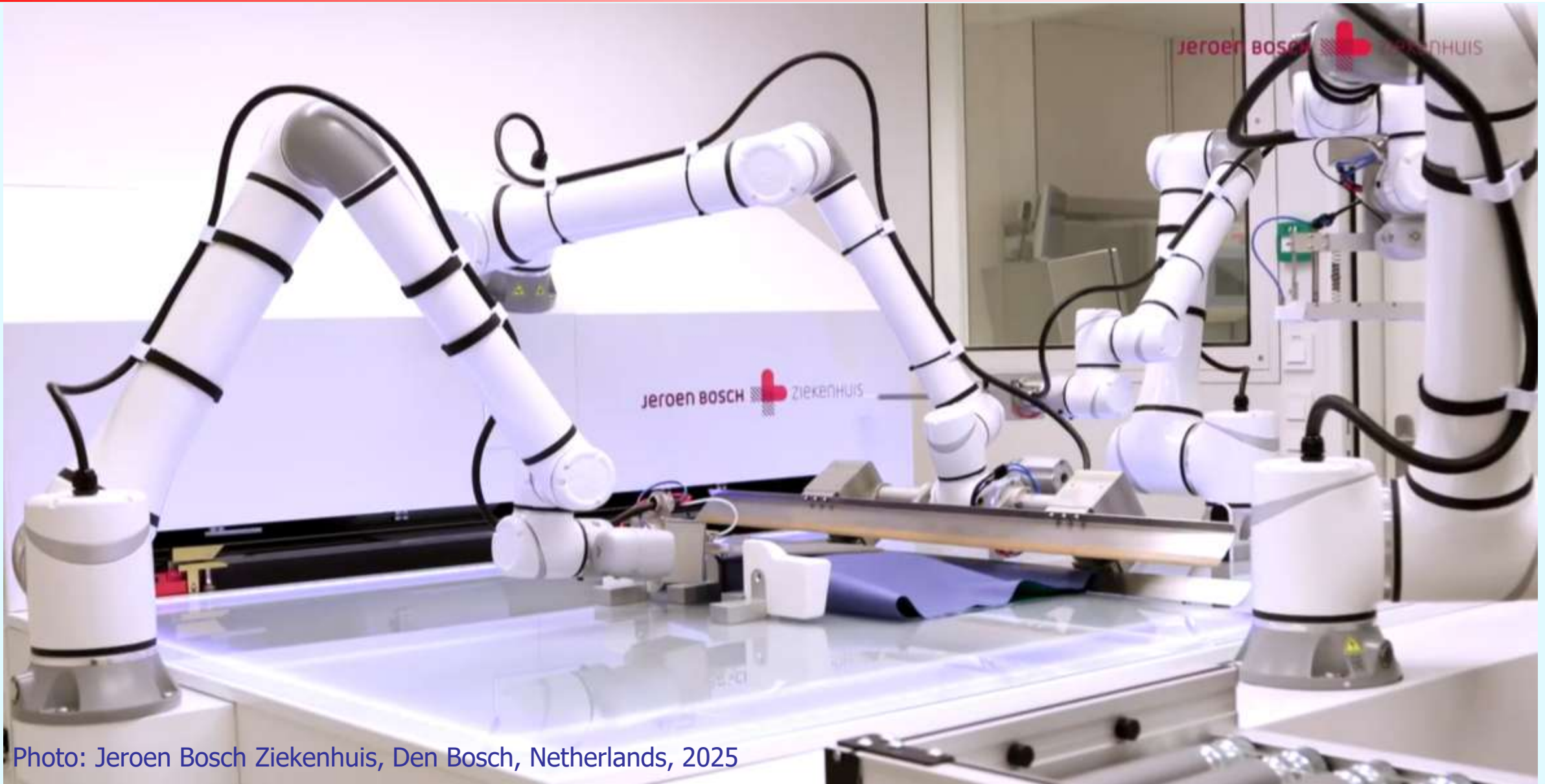
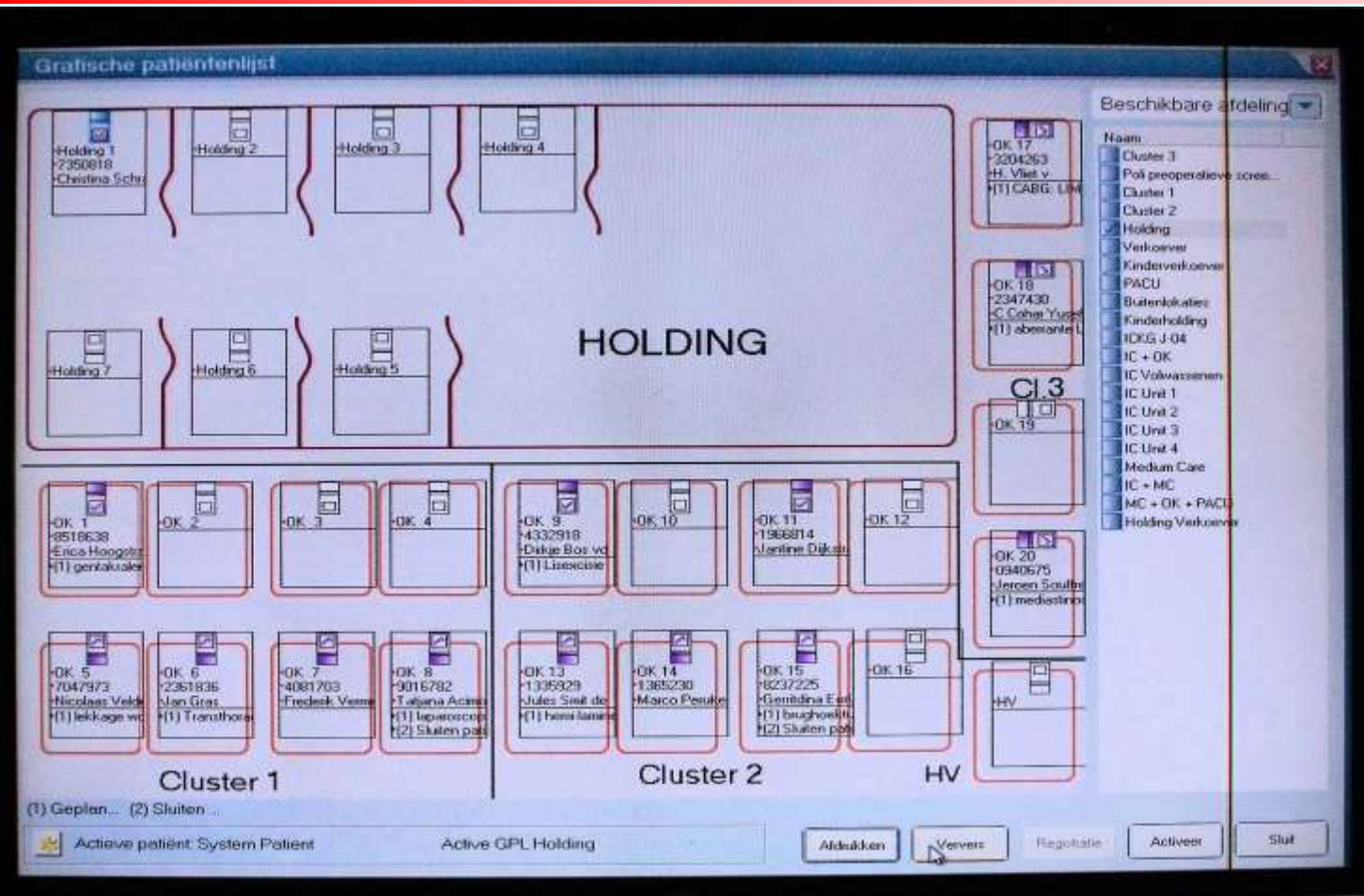


Photo: Jeroen Bosch Ziekenhuis, Den Bosch, Netherlands, 2025



# Dependence on IT systems



LUMC, Leiden, NL, 2014

Erasmus Ziekenhuis, Rotterdam, NL, 2012





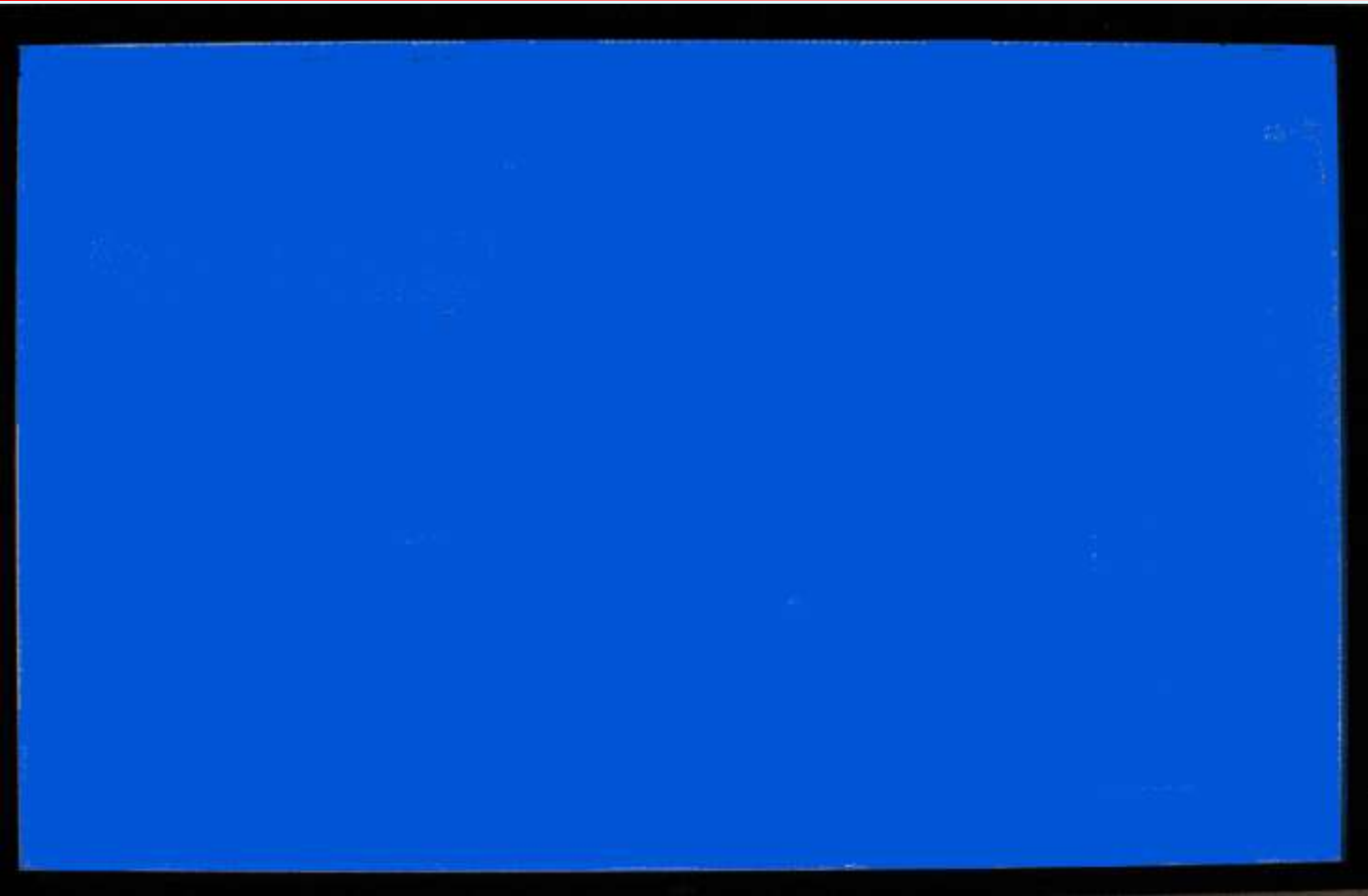
# Vulnerability if IT infrastructure: Fire in a data centre in Almere, The Netherlands

Photo's: National television  
NL, NOS 07-05-2026





# Dependence on IT systems



LUMC, Leiden, NL, 2014

Erasmus Ziekenhuis, Rotterdam, NL, 2012



# Dependence on information systems



T-DOC 12:07 13-10-2016 GETINGE

| Locatie Tijd        | Serie nr. Barcode | Product Artikel Naam       | Locatie Naam | Eenheid | Status   |
|---------------------|-------------------|----------------------------|--------------|---------|----------|
| 23-9-2016 17:34:59  | 000003121         | VA RINGSTRIPPERS           | Opdek-05     | 633473  | Gebruikt |
| 1-10-2016 17:46:51  | 000003745         | SEH OOGHECHTSET BERGMAN    | Opdek-10     | 621593  | Gebruikt |
| 13-10-2016 7:48:28  | 000003965         | KN TVB                     | OK-01        | 642213  | Gebruikt |
| 13-10-2016 8:06:27  | 000000245         | BO ACCULAN BOOR            | OK-07        | 642119  | Gebruikt |
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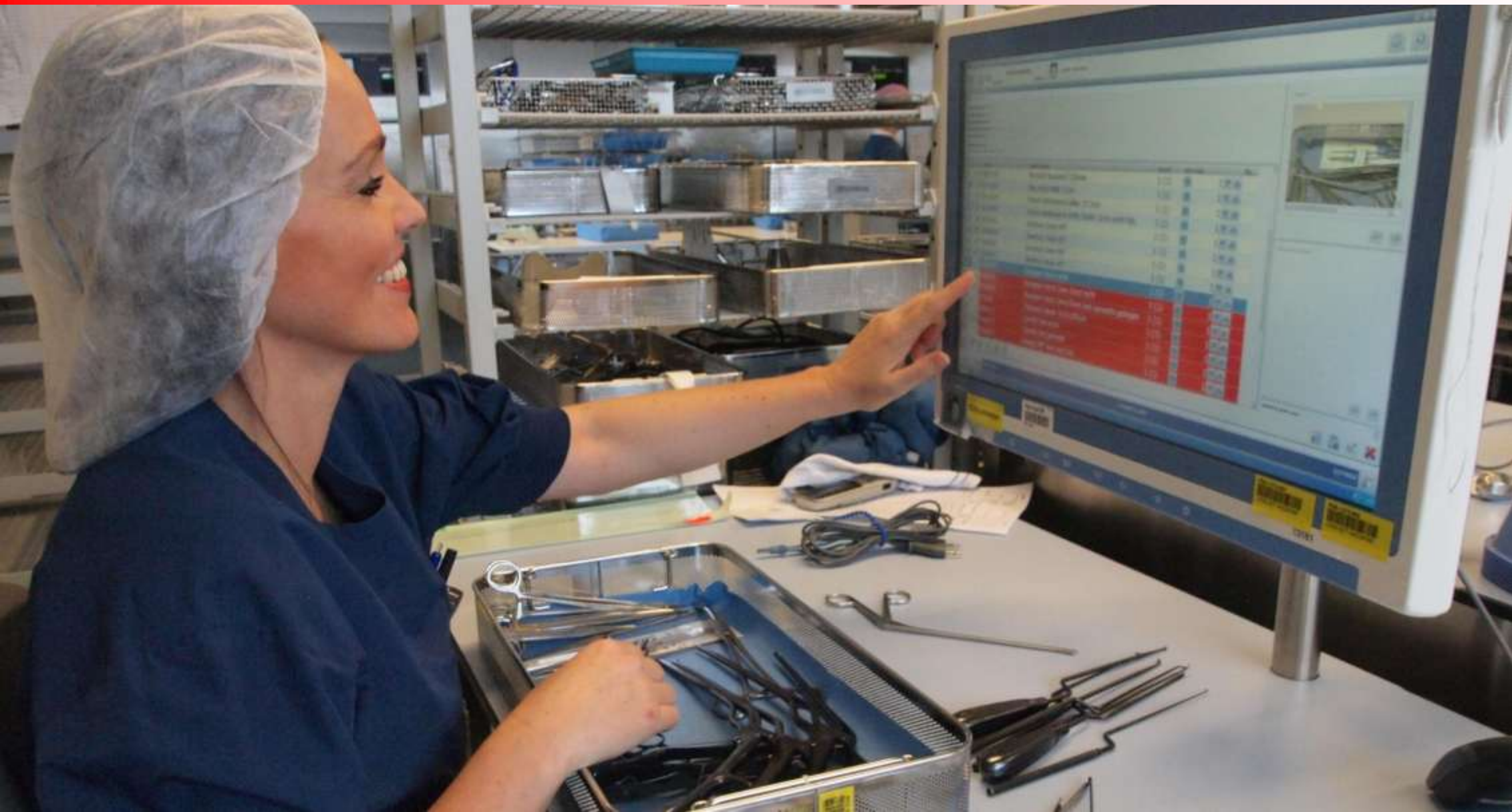
# Dependence on information systems

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# Dependence on information systems. Also in the sterilisation department





# Dependence on information systems Also in the sterilisation department



# When disaster strikes

Tsunami,  
Japan, 2011



Foto: Reuters 14-03-2011  
Yomiuri Shinbun



# When war erupts

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Gaza  
2024





# When war erupts

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Gaza  
Al Shifa  
Hospital  
2023



Photo: Al Monitor/AFP  
GettyImages-1767864153



# When war erupts

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Gaza  
Al Shifa  
Hospital  
2024



Photo: Mohammed  
al-Hajjar, 01-04-2024



Gaza, Rafah, 28-05-2024:

The ICRC Emergency Response Unit: 60 bed Referral Hospital



ICRC



# Guidelines for sterilization practices by WHO, ICRC

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<https://www.who.int/publications/i/item/9789241549851>

<https://shop.icrc.org/sterilization-guidelines-pdf-en.html>

## Decontamination and Reprocessing of Medical Devices for Health-care Facilities



## STERILIZATION GUIDELINES

THIRD EDITION  
2020



The All American autoclave and the SteriFlow Robustex manually operated autoclave in use in the ICRC ERU Referral Hospital



Photo's ICRC



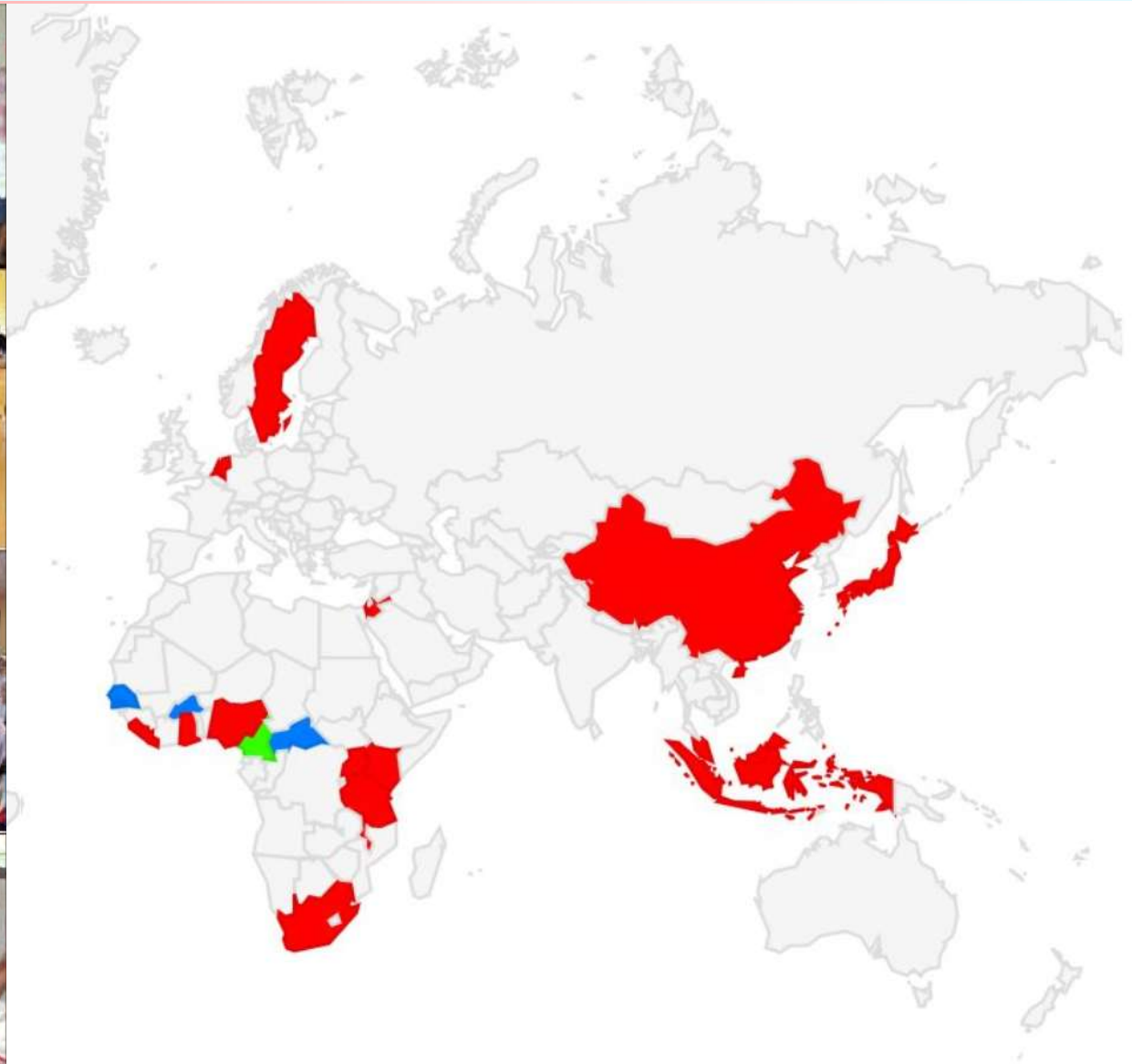
U. Sadiq/ICRC



# Experiences in many settings; lessons learnt



Lectures and workshops in many locations in 21 countries





# Lessons learnt from the reality in Africa



Hohoe, Volta  
Region, Ghana  
2026



St Joseph's Hospital, Monrovia, Liberia, 2016



Hospital Protestant de Mbouo, Cameroon, 2026



## A typical district hospital



Serabu Hospital,  
Sierra Leone 2017

Typical District Hospital in Africa  
Approx. 100 beds.  
Catchment population: 100.000  
With Outpatient Department,  
Maternity, Surgery, Laboratory,  
Radiology service and Wards.



# Local Context: Supplies/Infrastructure

Autonomy: Electricity supply: Diesel power plants; hydro power



Diesel generator  
Catholic Hospital,  
Assin Fosu,  
Ghana, 2005

Hydro-power  
Benedict Hospital,  
Ndanda,  
Tanzania, 2017



Solar power  
Community Hospital,  
Serabu, Sierra  
Leone, 2017

Diesel generator  
Maria Theresa  
Hospital,  
Dodi Papase,  
Ghana, 2026





# Local context: Supplies/Infrastructure

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Autonomy: Water supply



Benedict Hospital, Ndanda,  
Tanzania, 2017



Community Hospital, Serabu, Sierra Leone 2012



Community Hospital, Serabu, Sierra Leone 2015



# Local Context: Supplies/Infrastructure

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Autonomy: Water for sterilizers: from condensate of air conditioners



Harvesting  
condensate water  
from the air  
conditioners of the  
operating theatre

Serabu  
Hospital,  
Sierra Leone  
2017



Harvesting  
condensate water  
from the air  
conditioners of the  
administration block

Eikwe  
Hospital,  
Ghana  
2018





# Local context: Technical support

Maintenance of equipment: hospital-based/regional based. Good staff is scarce!



Joint Medical Stores,  
Kampala, Uganda, 2001



Sterilizer repair,  
Umuowa Hospital, Nigeria  
2013



Spare part store  
St. Josph's Hospital, Monrovia,  
Liberia 2015



Sterilizer repair,  
Dodi Papase, Ghana, 2026



# Local Context

## Infrastructure/roads

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Busy city traffic:  
Douala, Cameroon 2023



Road to Elmina Ghana, 2018

Road to Umuowa, Nigeria, 2015

Road to Serabu Hospital Sierra Leone 2012

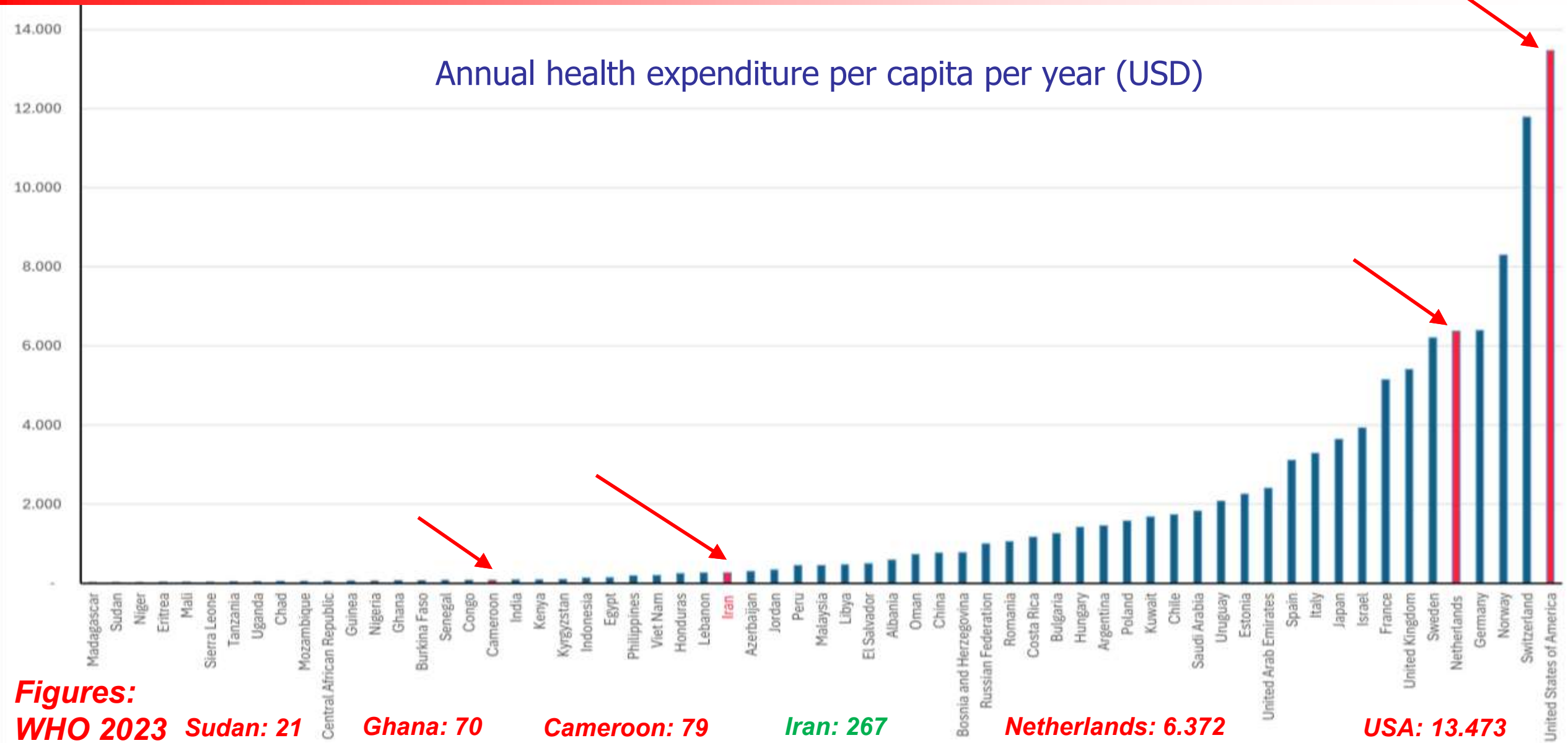




# Local Context

## Limited Budgets

Annual health expenditure per capita per year (USD)



**Figures:**  
**WHO 2023** Sudan: 21 Ghana: 70 Cameroon: 79 Iran: 267 Netherlands: 6.372 USA: 13.473



Also in rural hospitals operations take place;  
thus also need of sterile supplies

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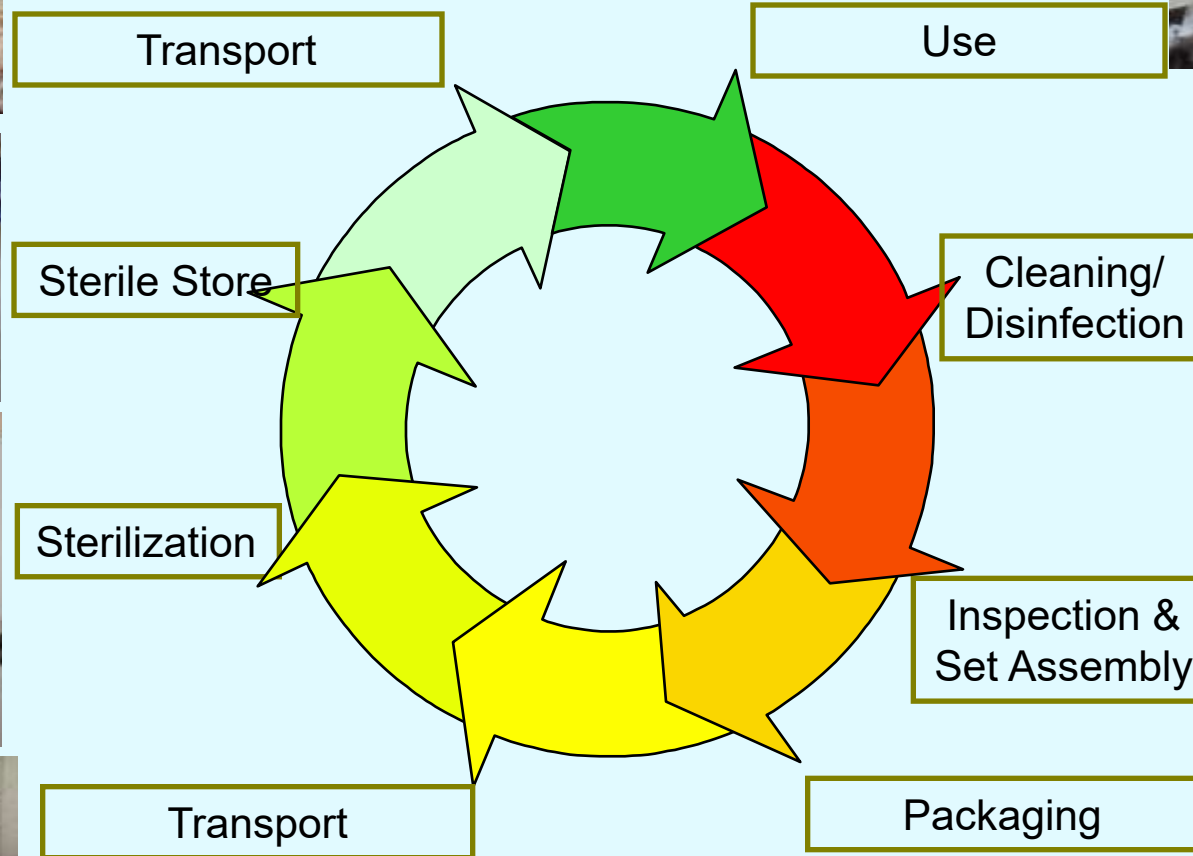
St. Martin de  
Porres Hospital  
Ghana  
2018





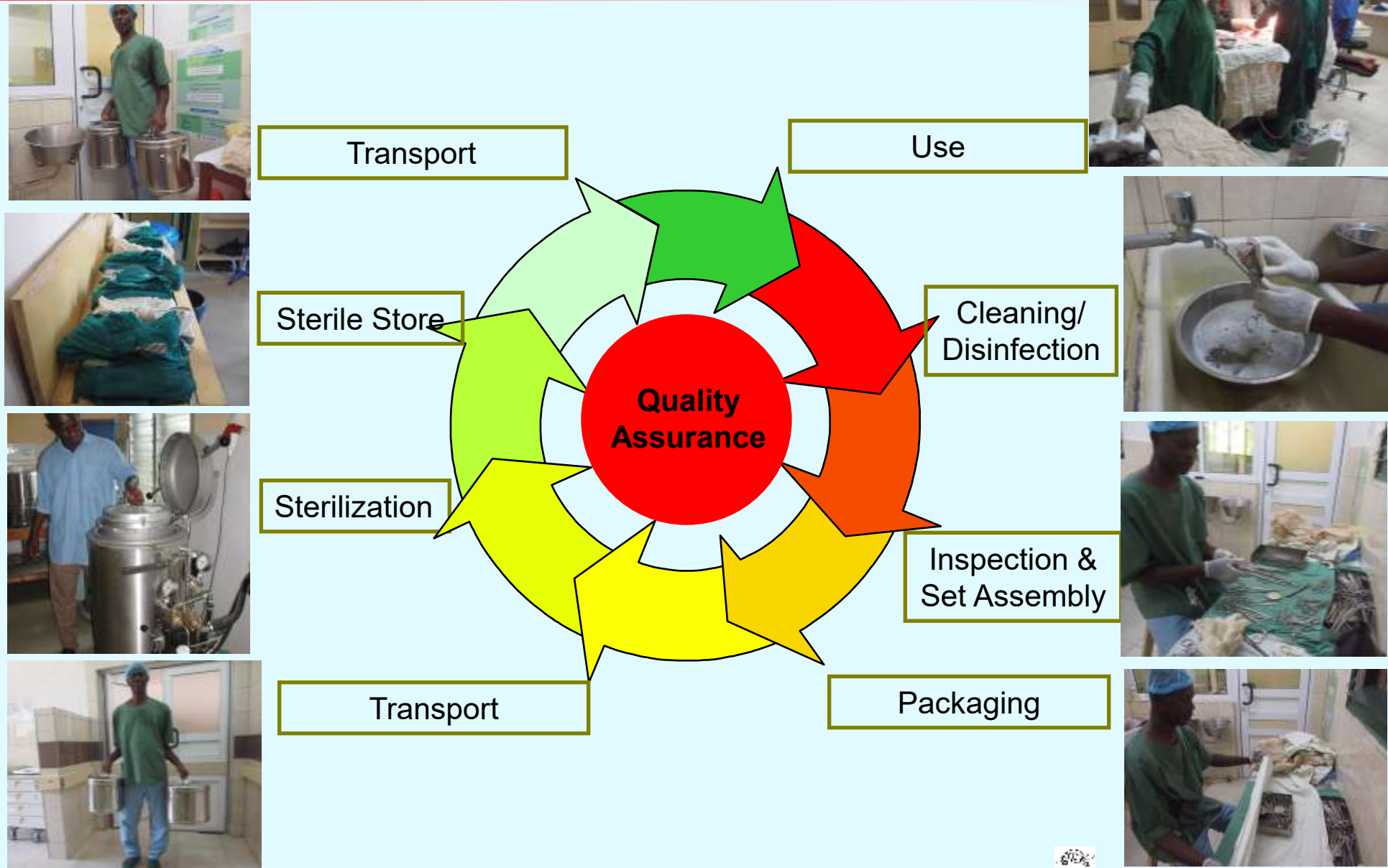
# Sterile Supply Cycle

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# Sterile Supply Cycle

## Need for Quality Assurance!





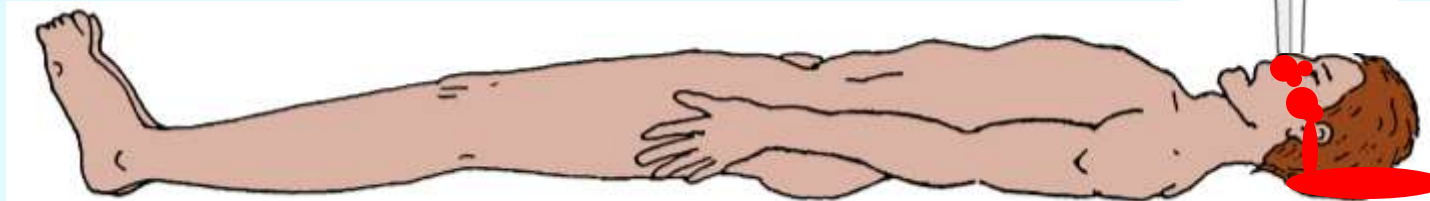
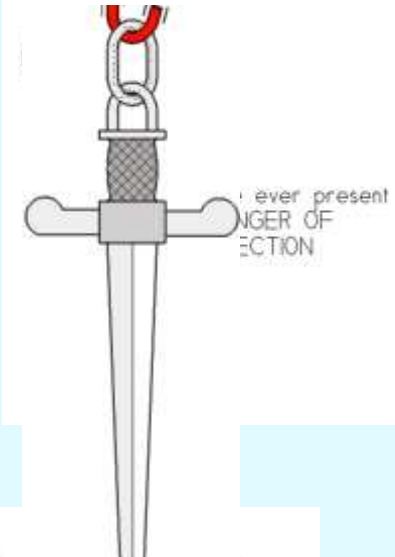
# Importance of doing a good job at each step

- Quality assurance for each activity!



Cleaning/  
Decontamination  
Packaging  
Loading  
Sterilizing  
Unloading  
Distributing  
Storin g  
Transportation  
Use

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# Typical CSSD of a rural district hospital



Benedict Hospital, Ndanda, Tanzania, 2019



Hopital Protestant de Mbouo, Cameroon, 2026



# Use of sterile supplies: The operating theatre:



Limited variety and less complex procedures with conventional surgery

No MIS instruments.

Therefore relatively easy cleaning and sterilization

Maria Theresa Hospital, Dodi Papase  
Ghana, 2026



# Use of sterile supplies: The operating theatre

## Record keeping paper based

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St. Martin de Porres Hospital  
Eikwe, Ghana, 2018



# Cleaning of instruments

## Manual only



Maria Theresa Hospital, Dodi Papase, Ghana. 2026



Benedict Hospital,  
Ndanda, Tanzania,  
2017



St. Martin de Porres Hospital  
Eikwe, Ghana, 2018



Washer/disinfectors prove to be complex, sensitive for breakdowns and expensive. And can be replaced by manual cleaning.



Ho Teaching Hospital, Ho, Ghana, 2026



Ho Teaching Hospital, Ho, Ghana, 2026 Manual cleaning only



# Advise against soaking of instruments in disinfectant prior to cleaning

## Important notice by WHO<sup>1</sup>

Soaking of instruments in 0.5% chlorine solution or any other disinfectant before cleaning is *not recommended* for the following reasons:

- It may damage/corrode the instruments
- The disinfectant may be inactivated by blood and body fluids, which could become a source of microbial contamination and formation of biofilm
- Transportation of contaminated items soaked in chemical disinfectant to the decontamination area may pose a risk to health-care workers and result in inappropriate handling and accidental damage
- May contribute to the development of antimicrobial resistance to disinfectants



Sodiumhypochloride

<sup>1</sup>World Health Organization and Pan American Health Organization. 2016. Decontamination of Medical devices for Health-Care Facilities. Geneva, Switzerland, World Health Organization. Page 46.

<https://iris.who.int/server/api/core/bitstreams/d128e952-f919-4462-bdb0-392312908782/content>



# Cleaning textile gowns, drapes and sheets for sterile packs: laundry machines

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Hopital Protestant de Mbouo, Cameroon, 2026



St. Joseph's Hospital Monrovia, Liberia 2014



# Cleaning: Manual laundry



Community Hospital,  
Serabu, Sierra Leone, 2012



Hopital Protestant de  
Mbouo, Cmeroon, 2026



St. Martin de Porres Hospital  
Eikwe, Ghana, 2005



Bugando Medical Centre,  
Mwanza, Tanzania, 2019



# Set assembly:

assuring correct set composition; paper based



St. Martin de Porres Hospital  
Eikwe, Ghana, 2018



# Set assembly:

Assuring correct set composition: until recently also in The Netherlands: paper based!



Ziekenhuis Gelderse Vallei, Ede, Netherlands, 2002

Utrecht Medisch Centrum, Netherlands, 2007



## Set assembly:

Instrumentation for  
conventional  
surgery; usually no  
MIS

Thus cleaning and  
sterilization requirements  
less complicated

Bungudu General Hospital,  
Bungudu, Nigeria 2011





Preparing/  
Cutting/

Packaging of  
gauzes

Community Hospital,  
Umuowa, Nigeria 2015



Ho Teaching hospital,  
Ghana 2026

Community Hospital,  
Umuowa, Nigeria 2015





# Packaging:

Virtually always: reusable : textile, drums, containers





# Packaging:

replacing filter of a container: double textile; reusable!





# Packaging: closing the pack:

Minimize using sterilization tape; use tape as label



Hospital Bungudu, Zamfara,  
Nigeria 2011

Princess Basma Hospital, Irbid,  
Jordan 2008

Jerash Hospital, Jerash,  
Jordan 2008



Hospital Bungudu, Zamfara,  
Nigeria 2011





# Sterilization

very basic

Absence of an  
autoclave: boiling!



Community Hospital, Serabu, Sierra Leone 2012

Pressure cooker  
type

St Joseph's Hospital,  
Monrovia, Liberia 2014



Solar powered pressure  
cooker type autoclave.  
Photo: Practica, The  
Netherlands. In Awassa  
Selem, Ethiopia, 2011





# Sterilization

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Basic autoclave automatic;  
without active air removal, no drying; very cheap

Basic autoclave automatic; air removal by above-atmospheric steam  
pulsing; drying by condensation of steam; used by ICRC and MSF



Maria Theresa Hospital, Dodi Papase, Ghana 2026



St. Joseph's Hospital, Monrovia, Liberia, 2015



# Sterilization

When context  
allows it;  
automatic sterilizers

St. Joseph's Hospital  
Monrovia, Liberia 2015





# Sterilization

when having advanced sterilizers, have manual sterilizer as backup



St Joseph's Hospital, Monrovia,  
Liberia 2015



# Sterilization:

## Quality control; sterilizer logbook



| Date     | Steri<br>cizer<br>No | Time<br>Start | Time<br>End | Indicator       | Load             | Result | Remark | Name      | Sign |
|----------|----------------------|---------------|-------------|-----------------|------------------|--------|--------|-----------|------|
| 20/03/18 | 1                    | 12:53 pm      | 1:50 pm     | ■ ■ ■ ■ ■ ■ ■ ■ | Boat & Dick pack | OK     |        | Group 2   |      |
| 30/03/18 | 2                    |               |             |                 | Boat & Dick pack |        |        | Sylvester |      |
| 31/03/18 | 1                    | 12:41         | 14:30       | ■ ■ ■ ■ ■ ■ ■ ■ | Boat & Dick pack | OK     |        | Jim Hing  |      |
| 31/03/18 | 2                    | 11 am         | 13:20       | ■ ■ ■ ■ ■ ■ ■ ■ | Maternity pack   | OK     |        | Sylvester |      |
| 1/4/18   | 1                    | 15:25         | 17:10       | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
| 2/4/18   | 2                    | 15:25         | 17:10       | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
| 11/04/18 | 2                    | 10:16         | 11:26       | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
| 01/04/18 | 2                    | 11:28         |             |                 | OP Drums         | OK     |        | Sylvester |      |
| 03/04/18 | 1                    | 9:10          | 11:31       | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
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| 05/04/18 | 1                    | 12:17         | 13:35       | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
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| 11/04/18 | 2                    | 16:00 pm      | 16:55 pm    | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
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| 13/04/18 | 2                    | 12:09         | 13:10 pm    | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |
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| 13/04/18 | 2                    | 10:12 am      | 11:12 am    | ■ ■ ■ ■ ■ ■ ■ ■ | OP Drums         | OK     |        | Sylvester |      |



# Sterile Storage

## shorter shelf life

When using  
double wrap textile:  
Open shelves: 1 week  
Closed cabinet: 2 weeks



Hopital Protestant de  
Bangwa, Cameroon, 2022



St Benedict Hospital, Ndanda  
Tanzania 2019



# Training: Users

Hopital Protestant de  
Mbouo, Cameroon, 2023





# Training: technicians



Children's Hospital, Umuowa, Nigeria 2015



Maria Theresa Hospital, Dodi Papase, Ghana, 2026



# Preparedness for hacks, crisis, disaster and war

Lessons learnt from Africa, ICRC/MSF

- Have scenarios ready, depending on severity of the situation (Code yellow, orange, red)
- Scenarios include range of surgical procedures to be available, and all equipment and services required to enable those procedures
- Collaborate with health facilities nearby to prepare for crisis situations
- Assure availability of equipment and materials suitable for the applicable crisis situation
- Autonomy for water, electricity, communication
- Autonomy of information/management systems; security
  - Regular Back-up
  - If cloud-based, ensure back-up; critical data: also independent of the cloud; stand-alone systems
  - Be prepared for paper-based systems
- Use of appropriate technology of equipment and materials in terms of:
  - Sophistication/complexity
  - Logistics
  - Complexity for training
  - Availability of essential spare parts
  - Maintenance; competent technicians
  - Finances



# Preparedness for hacks, crisis, disaster and war

Lessons learnt from Africa, ICRC/MSF

- Include requirements for crisis situations in the budget for your institutions
- Reusable equipment and materials are preferred above single use materials and equipment
- Ensure for adequate provisions for local maintenance and repairs; keep a stock of essential spare parts and materials.
- Ensure that all staff is prepared; create awareness and provide appropriate training!



# Book: Sterilization of Medical Supplies by Steam

Available in English, French, Polish, Turkish, Japanese, Spanish, Dutch, Norwegian, Russian, Latvian, Swedish

In total approx. 20.000 books in print

Since 2024:

- New Dutch edition with new chapter on sterilization control
- New English edition through SteelcoBelimed
- Italian Edition in preparation



The number indicates the latest edition and year of this edition. For information on various editions visit [www.heartware.nl/books](http://www.heartware.nl/books)

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# Friends that kept me going

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