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# Revamping Infection Control through International Non-governmental Support in Autoclaving Training for Low Capacity Hospitals in the Sub-sahara

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***Author's contribution***

*The sole author designed, analyzed, interpreted and prepared the manuscript.*

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## ABSTRACT

**Introduction:** The control of infection in hospital setting cannot be overemphasize nor undermined, even in poor resource settings with low human capacity especially in insurgency prone regions of the world.
**Aim:** The manuscript reported the lessons learnt and practical changes emanating from technical workshop model provided by International Non-Governmental organization such as ICRC. The autoclaving model was for Hospitals located in insurgency prone regions and compared with minimum international standards and requirements.
**Materials and Methods:** It entails steps for developing a capacity for infection control through sponsored training and retraining in autoclaving techniques, instrumentation handling, storage and transport within hospital premises with limited or poorly trained personnel. Lessons learnt were summarized, and pictorial descriptions of steps were highlighted.
**Results:** The Central sterilization unit was set up, and motivation was given in the form of stipends (money) to enhance continuity and sustainability. In addition, control standards for monitoring the

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quality of their work in autoclaving was impacted to the staffs during the technical workshop and currently serves as resource model for training workers from surrounding health centres in remote suburbs where insurgency have been subjugated relatively.
**Discussion:** The workshop had proven that hospitals with staff shortfall in sub-Sahara Africa and regions ravaged by war, militancy or insurgency could be equipped with standard autoclaving techniques and instrumentation handling skills by training non-health professional as well as equipping support staffs. This model of technical support allows for inaccessible health facilities to gain focal and modern medical, scientific techniques, capacity building in autoclaving and instrumentation handling. It allows the use of local firewood for energy supply where electricity supply is not sustainable for continuity. This model also provides minimum infection control standards for poor resource hospital and may be used in mobile health missions in remote settings.
**Conclusion:** Therefore interventions such as Autoclaving using model pressure pots should be part of strategies employed in reducing and controlling infections and sterilization of instruments during NGOs health mission projects.

*Keywords: Infection control; sterilization; auto-claving; insurgency; international non-governmental organization.*

## 1. INTRODUCTION

Autoclaving is the use of pressure chamber at a sustained high temperature and above ambient air pressure to sterilize medical instruments. Autoclaves are used in industrial settings as well. Many autoclaves are used to sterilize equipment and supplies by subjecting them to high-pressure saturated steam at 121°C (249°F) for around 15–20 minutes depending on the size of the load and the contents [1]. The autoclave was invented by Charles Chamberland in 1879 [2], although Denis Papin created a precursor known as the steam digester in 1679 [3]. The name comes from *Greek* auto-, ultimately meaning self, and Latin *clavis* meaning key, thus a self-locking device. Other sterilization methods are chemical vapor sterilization, dry heat, irradiation, and soaking in glutaraldehyde and hydrogen peroxide solution of appropriate preparation and duration [4].

In ensuring quality control, chemical indicators on medical packaging and autoclave tape change color once the correct conditions have been met, indicating that the object inside the package, or under the tape, has been appropriately processed. Autoclave tape has a marker that steam or heat can activate, indicated by dye color change which means that the time, pressure and temperature was adequate and instrument have been processed, but may not infer complete sterility. A more difficult challenge device, named the Bowie-Dick device after its inventors, is also used to verify a full cycle. This contains a full sheet of chemical indicator placed in the center of a stack of paper. It is designed specifically to prove that the process achieved full temperature and time required for a normal minimum cycle of 134°C for 3.5–4 minutes.

Autoclaving is currently one of the current method of sterilization and usually handled by technicians who are academically, technically and professionally qualified, however in sub-Sahara Africa there is shortage of professional staff and modern autoclaving techniques. The situation amounts to use old ancient and inefficient method of autoclaving which cannot guarantee sufficient control of infection and clean wound handling. Such inefficient methods includes use of chlorinated water or (Hypochlorite), Glutaraldehyde, saflon, cetrimide and Chlorhexidine which have different limitation towards organism and spores that can be destroyed. Often the high turnover of patients does requires more medical instrument for immediate use. On the background of these conditions, infection control may worsen further by shortage of staff and insurgency in sub-Saharan Africa. International Non-governmental organization can provide technical support and training to remote health facilities during their projects as well as provision of maintainable medical instruments such as this model of intervention from ICRC (International Committee of Red Cross). The article reported this form of infection control thought this Autoclaving workshop model; the different activities and steps learnt for Autoclaving and instrumentation handling, thereafter establishing Central sterilization Unit in Biu General Hospital located in North-Eastern Nigeria, sub-Sahara Africa, which serves as a source for resource persons to other health units in surrounding insurgency ravaged districts undergoing stabilization.

## 2. MATERIALS AND METHODS

Biu General Hospital is located In North-eastern Nigeria, Insurgency prone region, it is a Regional hospital for Southern Borno State serving Biu Local government and surrounding insurgency ravaged local governments as well. It has a capacity of 200 beds and extra 50 beds for malnutrition centre supported by ICRC. It out-patient care estimate of 100 persons averagely on a market day. It also has two comprehensive centres: HIV care and Tuberculosis/RIF resistant detection centre supported by international partners. It also had 6 departmental in-patient wards in-addition to 6 malnutrition wards been served by 4 permanent doctors and 2 non-permanent physician and 2 malnutrition consulting doctors respectively. In-addition there is one for eye care and another for dental care serving the dental and eye centres respectively. However there about 110 health assistant and volunteers which has the buck of staff strength in the Hospital.

The technical training session involved medical doctors along with 2 to 3 support staff (non-professional and nursing staff) of each ward temporarily relieved from duty. The wards included were maternity ward, Male surgical ward, female medical /surgical ward, theatre, Accident and emergency and postnatal ward. The training session included about 30 staff in the workshop. The setting involved using of Power point presentation, and hand-On Practical session. Each Staff was allowed to demonstrate their old method, thereafter the new method. Participants were constructively criticized by others or their peers.

The Hand On Practical session was foremost initiated by the resource persons of ICRC, followed-up with demonstrations by participating staff.

After a thorough visit and inspection of practice by the support organization(ICRC), Notably,the medical/technical staff observed old methods and practice such as use of green cloth for autoclaving in theatre, use of Chlorinated (Bleech) solution for sterilizing instruments in the wards, poor to Non- cleaning of hospital ward surfaces with weak solutions such as chlorhexidine, poor storage of surgical instrument, poor recording of wound dressing procedures. Noticeably, Some staff lacked skills or technical know-how on basic knowledge on instrument autoclaving, storage, transportation due to greater part of these staffs are health assistants and volunteers. The model therefore confronted few among many challenges faced by the under- studied facility (Biu General Hospital), and these challenges are not farfetched in most centres located in sub-Sahara Africa.

## 3. RESULTS

In ensuring maintenance, sustainability and continuity, some steps were eventually centralized to create the CSSD for all the wards except the theatre which had its own separately. Three focal persons were selected based on anticipated commitment and dedication that may be required. The persons became pioneers of the central sterilization unit of the hospital till today. The lesson learned from this Model was that sterilization can be standardized despite limited resources in low capacity hospitals.

**Lessons Learned: Figs. 1-13**

- Immediate Clearing of contaminated instruments in Separate Buckets by Non Professional staff equipped with PPE [5,6,7].
- Segregation and classification of instrument into plastics and metals
- Soaking in prepared Hexanios decontaminating solution for 15 minutes (Bucket color should be RED) to indicate highly contaminated stage.
- Washing with brush while opening all closed instrument to remove hidden contaminants in Soap water perform in transparent color Bucket to enable observation for change of water.
- Transfer to rinsing bucket with clear water using blue or transparent buckets.
- Air-Dry on clean instrument on dry and clean drapes on table.
- Transfer to Autoclaving room for wrapping with two clean white papers using the American Envelop style using clean sterile gloves, head cap and face mask.
- Label wrap properly for proper procedural instruments set identification.
- Label with control tape for proper and adequate sterilization of instruments.
- Place wraps in autoclaving pot and seal adequately, do not overload, fill with water to manufacturer limit.
- Place Pot on Stove or gas cooker, heat adequately and monitors pressure closely, preventing the red line on pump indicator.
- Do not leave the Autoclave pot during Use and ensure wraps are not wet before cooking.

- Place all dry but sterile packs (Wraps) in clean separate bucket until Use.
- At least 4 (20 litres) buckets needed for each ward to fulfil the steps describe above and one must be red colour.

**Basic Requirement for Establishing MINI-CSSD in Low resource settings**

Three Enthusiastic and committed trained staff for shifting. They may or may not be certified depending on the settings.

A cleaned table for materials handling
A record book
A small gas cooker
A small open space for wood stoke in-case of No Light

Supply of Sterile gloves and insulating glove (Fig. 9).

Supply of clean dry paper wrappers for packaging

Three buckets (red, blue and white)

A cabinet for storing sterile packs before distribution
A sustainable supply of Bowie-Dick test paper for quality control and assurances (Fig. 10).
A continuous supply of water.

Chairs for staff.

A room space for staff and storage room space.
Detergents and brushes (Fig. 8).

Supply of Hexanios and Surfanios solutions.

A clean supply of towel and hand sanitizers.

**Practice for Changed (Figs. 14-19)**

Stop soaking instruments in Bleach solutions.

Always put on PPE for safety and prevent recontamination of washed hospital instruments.

## 4. DISCUSSION

Every hospital setting is unique, and has its' limitation. In insurgency prone areas of the world, where religious, economical or cultural differences show great strain on the fabric of the social amenities of the people, the picture is gloomy. The issues that emanate from such situations include limited medical professional staff as noticed in reported facility. Some staff may migrate from conflict regions to other peaceful parts of the country, such that the available staffs including volunteers may not be educated enough or trained to perform hospital procedures such autoclaving despite their long working experience in hospital. These issues would not guarantee standard infection control practice. The Figs. 14 -19 represent old practices that may require change: Such practices include contamination of instrument during use, poor decontamination and sterilization techniques such as soaking in antiseptics, wrong usage due to poor training or no professionalism amidst scare resources. Situations such as these calls for assistance from international health organization [8] such as FHI (Family health international), ICRC (International committee of red cross), WHO (World health organization), UNICEF (united nation children emergency funds) for capacity building for all the training needed in regards to infection control.

**Fig. 1. Demonstration of decontamination of instrument by staff wearing water proof gloves**

**Fig. 2. Demonstration of sterilization by ICRC Nurse using the Pressured autoclave pot**

**Fig. 3. Packaging technique American Envelop style by A Chief Nurse (Participant) supervised By ICRC Staff**

**Fig. 4. Packaging technique practice by Chief Chief Nursing officer (Participant) American Envelop style**

**Fig. 5. Washing instrument wearing Non-disposable water-proof Gloves in soap solution after soaking in Hexanious solution for 15 min**

**Fig. 6. Air-Drying of instruments, been made ready for packaging**

**Fig. 7. Buckets prepared for decontamination, desinfection with hexanios (RED), Washing In soap Solution (White), rinsing (White). The red colour indicated high contaminaed instrument while white bucket would indicated how dirty is the soap solution and rinsing water necessitates for a change**

**Fig. 8. Brush for washing**

**Fig. 9. Proper gloves for hexanios usage**

**Fig. 10. Proper packaging and labelling using bowie-dick test paper**

**Fig. 11. Proper loading of the autoclave pot/ storage of sterile packs in cabinet**

**Fig. 12. Proper cooking with pressure monitoring and usage of wood fire as low cost alternative energy by non-health professional support staff (participants)**

**Fig. 13. The male surgical ward staff (non health professional) practicing the new technique using hexanios for decontamination of instruments,some days after the workshop**

**Fig. 14. Unsterile technique wound dressing dressing material already soaked with blood (before workshop training)**

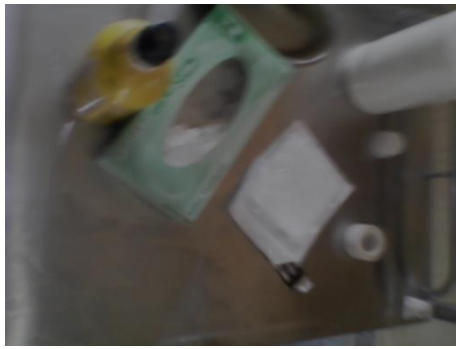

**Fig. 15. Unprofessional handing of dressing material/wrong material for wound care they were placed on the floor including gauze. (before workshop)**

**Fig. 16. Unclean area for wound care**

**Fig. 17. Old technique to disinfecting (Before workshop) instruments were placed in unclear solution**

**Fig. 18. Old ways to clean instrument in chlorine bleach (Before workshop)**

**Fig. 19.Suturing needle in wrong solution left inside the instrument after use.by non- health professional support staff prior to training workshop**

**Fig. 1-19. Materials for establishing mini cssd for non professionals**

*A well ventilated room, A cabinet for storage of sterile packs (Fig. 11)*

In-fact, these organizations are capable to braze in through insurgency prone regions especially in developing countries possible due to their capacity to finance their activities and ensure their security relatively through close partnership with government apparatus and UN (United Nations) [9]. Therefore, it is advisable for local hospitals in dire straits located in sub-Sahara Africa to partner closely with international NGOs such as ICRC while executing their malnutrition project in the understudied facility.

The basic autoclave is similar to a pressure cooker; both use the power of steam to kill bacteria, spores and germs resistant to boiling water and powerful detergents. Disinfection (use of glutaraldehyde, iodophors, and chlorine compounds) is generally less lethal to pathogenic organisms than sterilization [10]. A hospital with no CSSD may use this system to provide infection control measures.

Furthermore, there were different stages in medical instrument sterilization that were included in the lessons learnt which could be categorize into decontamination, Sterilization and storage and establishment of centralize system [11]. Amongst lessons learnt from the technical support provided by International NGOs such as ICRC, the workshop model allows for transfer of adequate skills as depicted in Figs. 1-13. The American packaging style was taught and which allows staff inspect, assemble, and packaging clean, but not sterile, instruments and materials such as cottonwood balls and gauze. The sterile storage area need regulation in temperature and humidity [12,13], but may not be possible in low resource settings. Healthcare facilities may use different packaging options. The packaging material must allow penetration of the sterilant, provide protection against contact contamination during handling, provide an effective barrier to microbial penetration, and maintain the sterility of the processed item after sterilization [14].

The use of Bucket for transfer and storage allow for protection for recontamination as well as protection of staff from highly infectious contaminated instruments. Local bucket method used in this workshop is cost effective for low resource setting and prevent vent-related factors that contribute to the contamination of a product which include bioburden (i.e., the amount of contamination in the environment), air movement, traffic, location, humidity, insects, vermin, flooding, storage area space, open/closed shelving, temperature, and the properties of the wrap material [15,16] Suggestion from the experience showed that there is need for written standard for CSSD, there should be minimal best practice guide for CSSD, also minimal supplies resources were made available such as table, wrapping material, antiseptic solution, pressure autoclaving pots, gas cooker. Certification for trained personal was not available because it was not a training from formal education but workshop for poor resource setting however, there are schedules for staff work effectiveness through time shifting. There may not be continuous Video and visual for training in futures but continuous supervision. Quality control involves use of china Bowie-Dick test paper place on he wraps during the autoclave to ensure that sterility has been achieved [17,18].

There were standard Guidelines which were taught during the technical session through hands-on practical as reflected in ICRC manual [19] which is according to world Health organization minimum standards. The role of the doctors or nurses after training in this sort of model should be supervisory [20] so as to ensure that the new standards are carried out correctly for conditions with a shortfall of doctors and nursing staff. It allows for continuity and sustainability by disapproving old practices and habits and promoting the new idea6. In order to improve the quality and sustainability of skills transmitted to low resource setting in war or insurgency prone region in the world, the following may be adapted, there should be simple written standard for CSSD new centres, the list of minimal supplies resources and (Personal protective Equipments) PPE [5,6,7] as shown above may be adopted, quality of wound healing using the instruments should be guide for assurance in wound care and instrument sterilization. Support partners may give some form of certification to trained personal from their workshop, furthermore continuous training programs and adding Video and visuals for training in futures is advisable.

The model was a related to first-hand experiences by a physician [20] in a remote health facility located in Sub-Sahara Africa, ravage by militant Islamic insurgency before, during and after the workshops.

## 5. CONCLUSION

The support from International Non-Governmental organization cannot be

undermined in sub-Sahara Africa toward capacity development in hospital settings in regards to infection control7 and instrumentation sterilization using autoclaving pressure pots, resulting in reduction in morbidity, mortalities and ultimately early recovery of the patient.

## CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the author.

## ETHICAL APPROVAL

All staff provided permission for their pictures to be used for this article.

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## COMPETING INTERESTS

Author has declared that no competing interests exist.

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