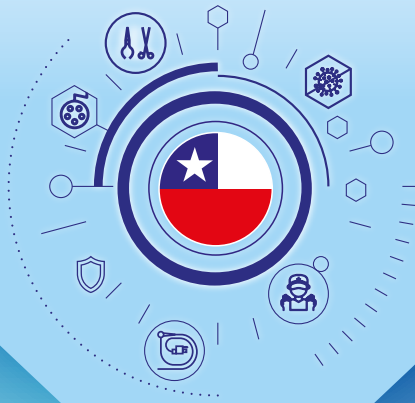




25th wfhss CONGRESS



SCIENTIFIC PROGRAM

20-23
NOV 2024
SANTIAGO-CHILE

WEDNESDAY 20 NOVEMBER

16.00 - 18.00

OPENING OF THE REGISTRATION AND EXHIBITION /
APERTURA DE LA INSCRIPCIÓN Y DE LA EXHIBICIÓN

18.00 - 19.00

OPENING CEREMONY / CEREMONIA DE INAUGURACIÓN

19.00 - 20.30

WELCOME RECEPTION IN THE GARDEN /
RECEPCIÓN DE BIENVENIDA EN EL JARDÍN

THURSDAY 21 NOVEMBER

07.45 - 08.30

OPENING OF THE REGISTRATION AND EXHIBITION /
APERTURA DE LA INSCRIPCIÓN Y DE LA EXHIBICIÓN

PLENARY ROOM - COSTANERA + VITACURA

08.30 - 08.45

CONGRESS INTRODUCTION
David Bellamy

08.45 - 10.30

SESSION 1 - VALIDATION / VALIDACION
Moderators: Christine Delebeque & Sandra Riveros

08.45 - 09.30

CONFERENCE 1
Economic comparison of steam sterilization quality assurance policies in German and in Chilean hospitals / Comparación económica de las políticas de garantía de calidad de la esterilización por vapor en hospitales alemanes y chilenos
Markus Auly (Switzerland)

09.30 - 10.00

CONFERENCE 2
Importance of process validation according to ISO / Importancia de la validación de procesos según ISO
Matias Pilasi Pendás (Chile)

10.00 - 10.30

CONFERENCE 3
Validation in real practice in your hospital - everything you need to know / Validación en la práctica real en su hospital: todo lo que necesita saber
Martin Veen (Netherlands)

10.30 - 11.30

COFFEE BREAK & VISIT EXHIBITION / PAUSA DE CAFÉ Y VISITA ÁREA DE EXHIBICIÓN

CORDILLERA

10.30 - 11.30

 **Holistic RUMED Solutions by MMM Group & RUMED Academy**

SALON PARQUE


Elevating Standards in Endoscope Reprocessing

PLENARY ROOM - COSTANERA + VITACURA

11.30 - 13.00

SESSION 2 - IMPROVEMENT OF THE PRACTICES: WHAT ARE THE OBSTACLES? / MEJORA DE LAS PRÁCTICAS: CUÁLES SON LOS OBSTÁCULOS
Moderators: Harry Oussoren & Cinthia Vera Fuentes

11.30 - 12.15

CONFERENCE 4
10 years of world experience, so what? / 10 años de experiencia mundial, ¿y qué?
Christine Delebeque

12.15 - 13.00

CONFERENCE 5: ROUND TABLE
Interactive session with experts and audience / Sesión interactiva con expertos y público
Damien Berg and Sandra Riveros

13.00 - 14.30 LUNCH - POSTERS AND EXHIBITION / ALMUERZO - VISITA PÓSTERS Y ÁREA DE EXHIBICIÓN			
	CORDILLERA	SALON MANQUEHUE	SALON PARQUE
13.00 - 14.30	 SHARING EXPERTISE	 Balancing Innovation and Sustainability: New Trends in Reprocessing Complex MD for Healthcare Professionals	 Small Changes, Big Impact - Driving efficiency through innovation
PLENARY ROOM - COSTANERA + VITACURA			
14.30 - 16.00	SESSION 3 - INNOVATION AND GREEN / INNOVACION Y ECOLOGIA <i>Moderators: Patricia Gutierrez & Matías Pilasi Pendás</i>		
14.30 - 15.00	CONFERENCE 6 Increasing Sterile Service Department Reprocessing Capacity to Support Sustainability Outcomes / Aumentar la capacidad de reprocesamiento del departamento de servicios estériles para apoyar los resultados de sostenibilidad <i>Sulisti Holmes (United Kingdom)</i>		
15.00 - 15.30	CONFERENCE 7 AI for Developing countries CSSDs, threat or opportunity / IA para Departamentos de suministro estéril en países en desarrollo , ¿amenaza u oportunidad? <i>Hamid Zare Shah Mers (Iran)</i>		
15.30 - 16.00	CONFERENCE 8: ROUND TABLE Interactive session with experts and audience / Sesión interactiva con expertos y público <i>Harry Oussoren and Patricia Jara Concha</i>		
16.00 - 16.45 COFFEE BREAK & VISIT EXHIBITION / PAUSA DE CAFÉ Y VISITA ÁREA DE EXHIBICIÓN			
	CORDILLERA	SALON MANQUEHUE	SALON PARQUE
16.00 - 16.45			 <small>We care about life</small>
PLENARY ROOM - COSTANERA + VITACURA			
16.45 - 18.15	SESSION 4 - FLEXIBLE ENDOSCOPY / ENDOSCOPIA FLEXIBLE <i>Moderators: Hervé Ney & Patricia Jara Concha</i>		
16.45 - 17.15	CONFERENCE 9 Establishing preconditions for effective duodenoscope reprocessing: an observational cohort study / Establecimiento de condiciones previas para el reprocesamiento eficaz de duodenoscopios: un estudio observacional de cohortes <i>Diana Bulkmans (The Netherlands)</i>		
17.15 - 17.45	CONFERENCE 10 Determination of residual endotoxins in endoscopic devices: implementation of a complementary monitoring tool for high-level disinfection (HLD) / Determinación de endotoxinas residuales en dispositivos endoscópicos: aplicación de una herramienta de monitoreo complementaria para la desinfección de alto nivel (DAN) <i>Troy Ejsmentewicz (Chile)</i>		
17.45 - 18.15	CONFERENCE 11 Flexible endoscopes: Importance of dry storage to prevent biofilm formation / Endoscopios flexibles: Importancia del almacenamiento en seco para evitar la formación de biopelículas <i>Michelle Alfa (Canada)</i>		

FRIDAY 22 NOVEMBER

08.00 - 08.30 | **OPENING OF THE REGISTRATION AND EXHIBITION / APERTURA DE LA INSCRIPCIÓN Y DE LA EXHIBICIÓN**
VISIT OF POSTERS AND EXHIBITION / VISITA DE PÓSTERS Y EXPOSICIÓN

PLENARY ROOM - COSTANERA + VITACURA

08:30 - 10.30 | **SESSION 5 - CLEANING AND DISINFECTION / LIMPIEZA Y DESINFECCION**
Moderators: Damien Berg & Silvia Araneda

08.30 - 09.00 | **CONFERENCE 12**
Good practice in reprocessing from the point of use / Buenas prácticas en el reprocesamiento desde el punto de uso
Patricia Guitérrez (Chile)

09.00 - 09.30 | **CONFERENCE 13**
Identification and prevention of surface alterations on surgical Instruments caused by waterborne minerals / Identificación y prevención de las alteraciones de la superficie de los instrumentos quirúrgicos causadas por minerales transportados por el agua
Matthias Tschoerner (Germany)

09.30 - 10.00 | **CONFERENCE 14**
Influence factors on instrument cleaning results - How to achieve a good result and what is good enough? / Factores que influyen en los resultados de la limpieza de instrumentos - ¿Cómo conseguir un buen resultado y qué es suficientemente bueno?
Gerhard Kirmse (Germany)


10.00 - 10.30 | **CONFERENCE 15**
Basics of safe endoscopic reprocessing / Fundamentos del reprocesamiento endoscópico seguro
Eric Smith (USA)

10.30 - 11.30 | **COFFEE BREAK & VISIT EXHIBITION / PAUSA DE CAFÉ Y VISITA ÁREA DE EXHIBICIÓN**

CORDILLERA

SALON MANQUEHUE

10.30 - 11.30 | 
Understanding and addressing two complex technical challenges for CSSD managers

 **Terragene®**
Artificial Intelligence in CSSD: Maximizing its Potential for Daily Efficiency

PLENARY ROOM - COSTANERA + VITACURA

11.30 - 13.00 | **SESSION 6 - EDUCATION / EDUCACION**
Moderators: David Bellamy & Patricia Guitérrez

11.30 - 12.00 | **CONFERENCE 16**
A Well-structured Sterile Services Department Training System for Sustainable Development in a Volatile Environment / Un sistema de formación en Centrales de reprocesamiento de dispositivos médicos bien estructurado para el desarrollo sostenible en un entorno volátil
Teddy LEE Chun Kin (Hong Kong)

12.00 - 12.30 | **CONFERENCE 17**
Educating CSSD: The self-regulating student Educar en / CRDM : El alumno autorregulado
Martijn Gerritsen-Ter Brugge (The Netherlands)

12.30 - 13.00 | **POSTER AWARDS SESSION / SESIÓN DE ENTREGA DE PREMIOS POSTER**

13.00 - 14.30 | **LUNCH - POSTERS AND EXHIBITION / ALMUERZO - VISITA PÓSTERS Y ÁREA DE EXHIBICIÓN**

		SALON MANQUEHUE	SALON PARQUE
13.00 - 14.30			
PLENARY ROOM - COSTANERA + VITACURA			
14.30 - 16.30	SESSION 7 - PACKAGING AND STERILIZATION / EMPAQUE Y ESTERILIZACION <i>Moderators: Tillo Miorini & Andrea Leisewitz Velasco</i>		
14.30 - 15.00	CONFERENCE 18 Sterilization Wrap - Check List for CSSD Manager / Esterilización de empaques flexibles - Lista de comprobación para el gerente de la CRDM <i>Menno Dufour (France)</i>		
15.00 - 15.30	CONFERENCE 19 Practical experience in implementing the validation of sterile barrier systems according to ISO 11607 at CSSD in Germany / Experiencia práctica en la aplicación de la validación de sistemas de barrera estéril según la norma ISO 11607 en la CRDM de Alemania <i>Rainer Stens (Germany)</i>		
15.30 - 16.00	CONFERENCE 20 Exploring differences between steam penetration in a B&D test pack and in a channelled instrument / Explorando de las diferencias entre la penetración del vapor en un paquete de prueba B&D y en un instrumento canulado <i>Francesco Tessarolo (Italy)</i>		
16.00 - 16.30	CONFERENCE 21 Influence of the load positioning during a steam sterilization cycle: An experimental and numerical study / Influencia del posicionamiento de la carga durante un ciclo de esterilización por vapor: Un estudio experimental y numérico <i>Simon Pletzer (Austria)</i>		
16.45 - 17.30	COFFEE BREAK & VISIT EXHIBITION / PAUSA DE CAFÉ Y VISITA ÁREA DE EXHIBICIÓN		
CONGRESS DINNER / CENA DEL CONGRESO			

SATURDAY 23 NOVEMBER

08.00 - 09.00

OPENING OF THE REGISTRATION AND EXHIBITION / APERTURA DE LA INSCRIPCIÓN Y DE LA EXHIBICIÓN

VISIT OF POSTERS AND EXHIBITION / VISITA DE PÓSTERS Y EXPOSICIÓN

PLENARY ROOM - COSTANERA + VITACURA

09.00 - 10.30

SESSION 8 - MISCELLANEOUS / VARIOS

Moderators: Hervé Ney & Millaray Fonseca Chandia

09.00 - 09.30

CONFERENCE 22

Precision in Practice: Instrument Management as a Key to Cost Control and Safety Improvement /

Precisión en la práctica: La gestión de instrumentos como clave para el control de costos y la mejora de la seguridad

Juana Baez Hernández (Spain)

09.30 - 10.00

CONFERENCE 23

Change management: a critical part of leadership success / La gestión del cambio: una parte esencial del éxito del liderazgo

Roel Beltran Castillo (Australia)

10.00 - 10.30

CONFERENCE 24

Optimizing CSSD Operations with QR Code Tracking / Optimización de las operaciones de CRDM con el seguimiento de códigos QR

Nathkrittta Sookchum (Thailand)

10.30 - 11.00

COFFEE BREAK & VISIT EXHIBITION / PAUSA DE CAFÉ Y VISITA ÁREA DE EXHIBICIÓN

11.00 - 12.00

SESSION 9 - QUALITY AND RISK MANAGEMENT / CALIDAD Y GESTIÓN DE RIESGOS

Moderators: Harry Oussoren & Katherine López Tirado

11.00 - 11.30

CONFERENCE 25

Nonconformity and risk management on product / No conformidad y gestión de riesgos en el producto

Norma Hermann (Switzerland)

11.30 - 12.00

CONFERENCE 26

Transportation Environment of Contaminated Instruments before Reprocessing / Ambiente del transporte de instrumentos contaminados antes de su reprocesamiento

Karin Bundgaard (Denmark)

12.00 - 12.45

FLAG CEREMONY / CEREMONIA DE LA BANDERA

END OF THE CONGRESS / FIN DEL CONGRESO

ECONOMIC COMPARISON OF STEAM STERILIZATION QUALITY ASSURANCE POLICIES IN GERMAN AND IN CHILIAN HOSPITALS

Markus Auly

None
Neuheim /
Switzerland

▶ AIM

There is a big difference in the steam sterilization quality assurance systems between countries who are relying on and consequently also mandating process validation and parametric release (mainly Europe) versus countries that are not used to validating processes but are mandating certain steam sterilization indicators for batch release. The goal of this study is to directly compare two exemplary countries of each of the respective approaches - Germany and the WFHSS host country Chile - by describing their legal requirements, their typical practices, associated workflows and the economic burden that these quality systems put on hospitals. By generating more transparency about both systems we are hoping to support decision makers and policy shapers in taking technically and economically beneficial decisions in the future.

▶ METHODS

Survey-questionnaires and semi-structured interviews were used to collect information from CSSD managers in both countries about the steam sterilization quality systems they have in place. This was put in context with the guidelines in force that are defining the legally mandated minimum requirements in both countries.

From the above information the following scenarios were defined:

- 1) Germany legally required minimum,
- 2) German typical additional measures
- 3) Chile legally required minimum
- 4) Chile typical additional measures
- 5) Chile extensive additional measures

Total yearly costs were calculated for all these based on prices received from surveys/interviews, from respective market leading indicator / equipment manufacturers and from public market information in Chile: <https://www.mercadopublico.cl>

▶ RESULTS

The total annual costs for the scenarios (based on a 8 STU steam sterilizer with 10 batches/day/365 days a year)

- | | |
|--|-----------------------------|
| 1) Germany legally required minimum | - 2'000 - 3'000 USD / year |
| 2) Germany typical additional measures | - 3'500 - 5'500 USD / year |
| 3) Chile typical minimum | - 6'000 - 8'000 USD / year |
| 4) Chile typical additional measures | - 8'000 - 12'000 USD / year |
| 5) Chile extensive additional measures | - > 12'000 USD / year |

▶ CONCLUSIONS

The study shows that there are significant differences in the total cost of quality assurance between the legally required minimum in both countries. These difference become even bigger due to effects of extreme cases of «over-compliance» which was found to be much more common in Chile than in Germany. For all comparable scenarios the policies based on process validation and parametric release had a lower yearly total cost per sterilizer. With the given price structures the validation-based systems have the higher cost-effectiveness than the indicator-based systems. These results suggest that besides safety and workflow considerations also the economy of a CSSD is highly impacted by the regulations in place as well as by the decision of CSSDs to simply fulfill or widely overfulfill these regulations.

INCREASING STERILE SERVICE DEPARTMENT REPROCESSING CAPACITY TO SUPPORT SUSTAINABILITY OUTCOMES

Sulisti Holmes

National Services
Scotland
Edinburgh /
United Kingdom

▶ AIM

Research shows that the shift from single use to reusable medical devices can have positive financial and environmental impacts¹. However, the reprocessing infrastructure and challenges have not been considered in most studies.

By using novel technologies, this proposed study focuses on exploring solutions to increase Sterile Service Department (SSD) reprocessing capacity, thereby overcoming barriers constraining the sustainability agenda.

▶ METHODS

A national working group was set up to explore the potential move from single use to reusable instruments reprocessed in SSD in the first instance. A national survey was issued to understand the current SSD landscape, infrastructure capacity, workforce and challenges. A medium-size SSD operating 24/7 with lack of spare capacity and limited space for extension was selected to be the pilot site. Information on cycle performance, machine utilisation/performance/operation were gathered using a smart monitoring tool, while workload schedule and resource allocation were transferred from the tracking system. All of this data was imported into a discrete event simulation tool (ProModel[®] Process Simulator) to analyse system flow/bottlenecks and predict 3 outcomes for:

1. As-is performance (test for accuracy using previous year data)
2. Resilience testing: volume increase without staff increase.
3. Volume increase for 20% with staff increase

▶ RESULTS

The survey results identified SSD challenges such as limited capacity and space, workforce, inconsistent training, aging facilities and equipment, breakdown of equipment, barrier to reprocessing due to design/materials. Capacity challenge was identified by 71% of respondents. Therefore, the priority focussed on exploring methods to increase SSD capacity in the existing facility.

The results from simulation exercise as follow:

1. An as-is model with output of 348,000 items per year was created with 95% accuracy;
2. A small output increase (6%) with output of 369,000 items per year was achievable with existing staffing;
3. The expected increase of 20% volume (417,000 items/year) was achievable but required a staffing increase of 15% to maintain current efficiency levels.

Items refer to all trays, supplementary and ward packs.

▶ CONCLUSIONS

The simulation process allows SSD to experiment with different operating scenarios in order forecast workloads and capacity, uncover and prevent bottlenecks in operations, and optimise capacity planning and scheduling (staff and machines), while streamlining production flows. In a facility with the perception of a lack spare physical capacity, it is possible to create a 20% increase in production, with a combination of a 15% staff increase, removal of process inefficiencies and resource re-allocation. Simulation data can inform the best areas of staff deployment and machines scheduling.

By adjusting to the current operating model, SSD could free up physical capacity to absorb additional workloads to support sustainability agenda.

▶ REFERENCES / ACKNOWLEDGEMENTS

¹Keil, M. et.al.2023. The impact of switching from single-use to reusable healthcare products: a transparency checklist and systematic review of life-cycle assessments. Eur. J. Public Health. 33(1): 56-63. doi: 10.1093/eurpub/ckac174

▶ **AIM**

In This presentation, I will try to analyze the dynamic relationship between artificial intelligence in central sterile service departments and the impact of it in healthcare quality in developing countries by researching potential benefits and challenges associated with AI. I will try to provide an insight that whether AI in CSSD may be a threat or can be opportunity for having an advanced sterilization practice. The aim is understanding of the implication and ethical concentration and potential solutions related to the insertion of AI in CSSD in the context of developing countris.

▶ **METHODS**

The method I use is the background check of AI in other industries and analyzing existing data that we can collect from other medical industries. I will try to define the expert's visions and the strategies can be engaged in quality assurance of sterilization handled by AI, and it will be affected on human resource.

Comparing existing models of enterprises that they are using AI in the departments which that in past were handling by human is also the part of method

▶ **RESULTS**

The potential benefits of AI in cost are undeniable. We can use this technology with Zero% mistake percentage instead of human, but there are too many challenges associated with AI adaptation. We will need to draw many recommendations and instructions to the hospitals to prevent any potential challenges that we didn't measure also AI must be tried in developed countries before other countris. Because of the fewer gaps between hardware's and the knowledge and existing professionals to prevent problems, and we should collect cases studies such as successes story and fail stories to improve guidelines for future.

▶ **CONCLUSIONS**

In conclusion, I believe that the integration of AI into Central Sterile Service Departments in developing countries should be done with caution and that success stories from developed countries should be used. The potential efficiency of artificial intelligence in quality control, data management and cost savings is a key factor for its quick implementation. Meanwhile, we need to have international cooperation, knowledge exchange and strategic partnerships with AI and medical industries to overcome the challenges with a global approach to the sterilization improvement movement. The future of CSSDs in developing countris depends on our ability to guide the ethical application of AI technology in classroom activities and ensure that we have a path to reap the benefits of all CSSDs.

ESTABLISHING PRECONDITIONS FOR EFFECTIVE DUODENOSCOPE REPROCESSING: AN OBSERVATIONAL COHORT STUDY

Diana Bulkmans

*Co-Author
Rotterdam /
Netherlands*

▶ AIM

The use of contaminated duodenoscopes in endoscopic retrograde cholangiopancreatography (ERCP) has caused numerous healthcare-associated infection outbreaks. Despite adherence to reprocessing protocols, duodenoscopes often remain contaminated. Moreover, there's a lack of evidence outlining the prerequisites for adequate duodenoscope cleaning, disinfection, drying and storage to prevent contamination. This study aims to identify risk factors involved in the reprocessing procedures of duodenoscopes that could affect the rates of contamination.

▶ METHODS

Cultures from duodenoscopes with a disposable cap design collected between February 2022 and December 2023 were included. Contamination was determined by the presence of microorganisms originating from the gut or oral cavity (MGO). Data on the use of duodenoscopes, reprocessing lead times and staff involved in the reprocessing were retrieved from electronic medical records. Risk factors were identified based on reprocessing guidelines and the literature. These included a delay of more than 30 minutes in initiating manual cleaning, manual cleaning duration of five minutes or less, drying time less than 90 minutes, experience level of reprocessing staff, and storage duration exceeding 7 days. A generalized linear mixed-effects model was employed to investigate the impact of these risk factors on duodenoscope contamination.

▶ RESULTS

A total of 307 duodenoscope cultures from eight different duodenoscopes were collected. Contamination with MGO was identified in 58 (18.9%) of the cultures. Throughout the study period, the duodenoscopes were reprocessed 1,296 times. Manual cleaning durations of five minutes or less were associated with higher odds of contamination (aOR = 1.61, 95% CI: 1.10-2.34, $p = 0.01$). Interestingly, the use of duodenoscopes was associated with reduced odds of contamination (aOR = 0.80, 95% CI: 0.64-0.995, $p = 0.045$). Factors such as a delay of 30 minutes in initiating manual cleaning, drying times less than 90 minutes, storage times exceeding 7 days, and the experience of reprocessing personnel did not show a clear association with contamination rates.

▶ CONCLUSIONS

This study highlights substantial knowledge gaps regarding the risk factors for duodenoscope contamination. Delays in reprocessing initiation and incomplete drying, traditionally considered as risk factors, were not associated with an increased risk of contamination in this study. However, a manual cleaning duration of five minutes or less was associated with an increased risk of contamination with MGO. Future research should explore whether more rigorous monitoring of reprocessing times could lead to a reduction in contamination rates.

DETERMINATION OF RESIDUAL ENDOTOXINS IN ENDOSCOPIC DEVICES: IMPLEMENTATION OF A COMPLEMENTARY MONITORING TOOL FOR HIGH-LEVEL DISINFECTION (HLD)

Troy Ejsmentewicz

*Translational Medicine,
Fundación Arturo López
Pérez (falp)
Santiago /
Chile*

▶ **AIM**

Gastrointestinal endoscopy is effective and safe for the detection, diagnosis and treatment of gastrointestinal diseases. Guidelines for reprocessing endoscopes should be continually reviewed to prevent infections. Most of these guidelines focus on eliminating live bacteria, without considering the residual membranes, nucleic acids, proteins and polysaccharides of dead microbes as a potential source of nonspecific inflammatory reactions or endotoxemia. The objective of this work was to develop a biological tool based on live human peripheral blood mononuclear cells (PBMCs) exposed to residual washing waters from routine reprocessing protocols and the measurement of interleukin 1-beta by real-time PCR to evaluate the compliance level and performance of the High Level Disinfection (HLD) protocol implemented in our institution.

▶ **METHODS**

Wash water was collected directly from each device using 40 ml of sterile saline, before and after applying the HLD protocol. PBMCs were obtained from healthy volunteers, cultured, and directly exposed to wash water for 1 h at 37 °C and 5% CO₂. Total RNA was isolated and 100 ng was used for retrotranscription and real-time PCR to detect IL-1b mRNA levels. A pilot study to evaluate the optimal dose and correlation with the ATP bioluminescent assay used as routine testing considered 8 randomized devices collected after colonoscopy (4) and upper gastrointestinal endoscopy (4). Furthermore, to evaluate the sensitivity and linearity of our biological tool, we have proposed the analysis of 36 endoscopes that will be cleaned using a standardized (18) and non-standardized (18) HLD protocol. LPS and saline solution were used as positive and negative controls for each assay, respectively.

▶ **RESULTS**

The pilot study demonstrated that the bioluminescence assay performed before applying a HLD protocol reached a mean ATP value of 5029 RLU (min-max: 388-13280), and after the reprocessing protocol, the mean value decreased significantly to 28 RLU (min-max: 1-126) ($p=0.0056$, t-test). The presence of IL-1b mRNA was mainly correlated in water samples collected from devices used for colonoscopy. The biological assay was able to detect a two-fold increase in IL-1b compared to the negative control, and higher mRNA levels correlated with samples before the HDL protocol. All cases (8 of 8) after reprocessing were negative. We are currently still evaluating sensitivity and linearity using deliberately poorly cleaned endoscopes.

▶ **CONCLUSIONS**

We have developed a laboratory method based on cell and molecular biology to evaluate the presence or absence of remanent microbiological debris after applying a High-Level Disinfection protocol for reprocessing endoscopes used during routine clinical procedures in our center. Our method is able to detect the activation of early pro-inflammatory genes, such as IL-1b, allowing us to assess the risk of unexpected complications, such as local or systemic inflammation and the compliance level of the institutional standardized operational procedure.

▶ **REFERENCES / ACKNOWLEDGEMENTS**

Funding: ANID-FONDECYT Grant N°1221415 and an internal grant from Fundación Arturo López Pérez FALP-LMT-2024

IDENTIFICATION AND PREVENTION OF SURFACE ALTERATIONS ON SURGICAL INSTRUMENTS CAUSED BY WATERBORNE MINERALS

Matthias Tschoerner

*Chemische Fabrik
Dr. Weigert GmbH & Co. Kg
Hamburg /
Germany*

▶ **AIM**

During the reprocessing of medical devices, in particular on surgical instruments, unwanted surface alterations and discolorations may occur. Some surface alterations and discolorations arise from waterborne minerals during the cleaning and disinfecting process when traces of these are able to dry on the surface.

Also known from steam sterilization, surface alterations and discolorations may occur when the water used for feeding the steam generator has a too high content of waterborne minerals.

▶ **METHODS**

To get a closer understanding of the nature of these alterations, instruments with characteristic discolorations from the clinical routine of different hospitals were used for further studies.

As methods of surface analysis the energy dispersive X-ray spectroscopy (EDX) and X-ray photoelectron spectroscopy for chemical analysis (ESCA) were used to investigate chemical nature of these discolorations. First, the overall elemental composition of the deposits were analyzed by energy dispersive X-ray spectroscopy. For further characterization of the deposits the X-ray photoelectron spectroscopy for chemical analysis was used which enables not only an elemental analysis but also an interpretation of the possible compounds. To get an idea on the thickness of some discolorations was subject to an iterative investigation of sputtering of the surface by means of ESCA measurements. These iterative investigations were ended when the surface of the instrument was reached and subsequently the composition of the plain instrument material were analyzed.

Further physical-mechanical investigations were made to find out if such surface alterations and discolorations are adherent to the surfaces or detach during mechanical stress. For this purpose, the surfaces were analyzed and documented by high resolution electron microscopy before and after stress to discolored surfaces.

▶ **RESULTS**

The results of the analysis of the different surface alterations found in the clinical day to day work directs them to their chemical and physical nature, their origin from specific water minerals, and their point of appearance in the processing cycle.

Depending on the chemical and physical nature and their adherence to the surface a crosslink to their hygienic importance is possible.

▶ **CONCLUSIONS**

The results lead to possible origins for the discolorations described. Such surface alterations are not tolerable, since, according to general accepted recommendations, no visible soiling, deposits or other residues have be recognized on the medical device after cleaning e.g.¹, furthermore, residues may have an adverse effect on the sterilization success.

The description of discolorations and surface alterations of surgical instruments and methods to identify their nature will help to find possible causes within the processing procedures and to define measures to avoid them.

Further measures will be presented which may be applied to eliminate identified discolorations from the instruments by corrective actions.

The importance of using appropriate water qualities is highlighted.

▶ **REFERENCES / ACKNOWLEDGEMENTS**

¹Workgroup Instrument Reprocessing: Reprocessing of Instruments to Retain Value; 11th edition 2017; www.a-k-i.org

INFLUENCE FACTORS ON INSTRUMENT CLEANING RESULTS – HOW TO ACHIEVE A GOOD RESULT AND WHAT IS GOOD ENOUGH?

Gerhard Kirmse

Aesculap Ag
Tuttlingen /
Germany

▶ **AIM**

Meanwhile it is widely agreed that a good cleaning result is essential for a safe and efficient reprocessing but strategies and methods vary largely and many times we are lacking evidence. Therefore a systematic review of influence factors is performed in laboratory setting to delineate the most important factors and the most promising approach.

▶ **METHODS**

Design and evaluation of cleaning methods still show deficiencies. Therefore validation is the method of choice to ensure proper cleaning results but experience has been disappointing in several aspects. Most often, commercially available Crile clamps are used however, these are relatively easy to clean.

In addition the type of soil and its dry time shows a large influence and blood on its own is by far not the most difficult challenge. Therefore influence factors of soil and dry time were evaluated in a laboratory study. In parallel influence factors of machine cleaning results were evaluated in a multifactorial design study.

Three test methods for cleaning success are compared in terms of sensitivity, accuracy, handling and efficiency. Finally all these results are combined in a process and quality control strategy.

▶ **RESULTS**

The comparison of the test soils confirms that blood is relatively easy to clean and shows very little effect of extended dry time, while mixtures of blood with disinfectants and other body fluids represent a harder challenge, which increases over time.

On the basis of these results, a washer-disinfector test series is performed. PCDs contaminated with either blood or Browne test soil are cleaned in various positions of the washer-disinfector with different cleaners and processes. Process variables, such as pre rinse, temperature, dosage, holding time, pressure, and water quality are then tested. Pressure turns out to be the most influential factor. Other strong influence factors as position and loading depend on the users.

From the test methods used (BCA protein test with elution, TOC test with elution, fluorescence) BCA has been evaluated as most useful but it is cumbersome to test larger quantities of instruments or process challenge devices (PCDs).

The test method of PCDs was further developed by a camera system, which allows a quantitative, quick evaluation of a large number of PCDs with a good correlation to protein test, especially at low values.

▶ **CONCLUSIONS**

The methods and results allow a targeted optimization of cleaning processes.

First a cleaning process should be evaluated and optimized starting with the most promising factors based on PCDs. The optimized process is then challenged with manual factors and tested for stability, standard variation and safety margin. Results are afterwards confirmed by testing clinically used instruments (Validation).

During routine operation visual inspection of instruments is an important tool but not sufficient as joints, lumen and crevice cannot be fully evaluated. Therefore, simplified test should be used, however they have to be qualified.

By such an approach, cleaning results can be largely improved with reasonable resources, however methods, standards and limits need further discussion and development.

▶ **REFERENCES / ACKNOWLEDGEMENTS**

Dr. Gerhard Kirmse and Silke Haibt-Winandi are employees of Aesculap AG, Germany

ENHANCING PATIENT SAFETY THROUGH EFFECTIVE REPROCESSING: A HOLISTIC APPROACH TO HUMAN ERROR REDUCTION

Eric Smith
*Olympus America Inc.
Center Valley /
United States*

▶ **AIM**

The reprocessing of medical devices plays a critical role in maintaining patient safety and limiting healthcare-associated infections. However, human errors in the reprocessing workflow can compromise the effectiveness of the disinfection and sterilization protocols, increasing the risks to patients. Recognizing and mitigating these errors are critical for upholding the standard of reprocessed medical devices.

▶ **METHODS**

A comprehensive review that examines existing literature and practical insights to explore human errors within the reprocessing of medical devices, along with strategies to offset them. Employing a standardized approach, common error types, their root causes, and evidence-based interventions are considered.

▶ **RESULTS**

Human errors can occur at various stages of the reprocessing workflow, which includes the point of use/pre-cleaning, manual cleaning, disinfection, drying, packaging, sterilization, and storage processes. Contributing factors include inadequate training, fatigue, distractions, and dependence on memory. Mitigation strategies involve a blend of technical innovations, standardized protocols, refined training programs, ergonomic enhancements, and the integration of automation and technology.

▶ **CONCLUSIONS**

Addressing human errors in reprocessing requires a multifaceted strategy that targets both individual behaviors and systemic influences. By implementing evidence-based best practices and fostering a culture of safety, healthcare facilities can mitigate the risks associated with improperly reprocessed medical devices. Further research is needed to evaluate the effectiveness of different error reduction strategies and their impact on patient outcomes.

▶ **REFERENCES / ACKNOWLEDGEMENTS**

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A WELL-STRUCTURED STERILE SERVICES DEPARTMENT TRAINING SYSTEM FOR SUSTAINABLE DEVELOPMENT IN A VOLATILE ENVIRONMENT

Chun Kin Lee
Hong Kong Hospital
Authority
Hong Kong

▶ AIM

Strategic staff training is one crucial element in SSD management and services development for the delivery of comprehensive sterile services.

In 2021-2023, the NWCSSD's attrition rate of supporting and supervisor colleagues was 20% and 21%, respectively. In addition to the newcomers as replacements, maintaining a well-structured department training system is crucial for sustainable service development in such a volatile environment.

A Quality Index (QI) monitors and quantifies service quality. [QI = (number of product defect) / (workload in washing area)]

▶ METHODS

Training modules in NWCSSD were distinctively designed based on job functions and staff experiences, ensuring an all-rounded step-by-step coverage of skills and knowledge.

All newly joined colleagues were required to participate in the Preceptorship Scheme, matching each with an experienced preceptor for nine weeks—a one-to-one mentoring process aimed at achieving effective trainer-trainee communications and prompt problem-solving. The Train-the-Trainer Program was launched to target all the qualified preceptors in the scheme to ensure training quality. Concepts of leadership, effective feedback, constructive feedback and praising were introduced to the preceptors for successful impartation of knowledge to their trainees.

On top of personalized preceptorship, a 6-week Tier 1 in-house training was scheduled quarterly to provide all newly joined colleagues with a macroscopic view of the department. Course content involved (i) Infection control and OSH issues, (ii) SSD workflow, (iii) Basic decontamination process and (iv) Storage management. Participants who successfully passed the final written assessment would be awarded a certificate upon course completion, acknowledging their qualifications as SSD staff. Existing colleagues with two years' experience would also take part in the course to refresh memories.

Sterile Supplies Supervisors or above were recruited into the weekly-based Tier 2 in-house training for professional enhancement in sterilization science. The course syllabus ranged from advanced theories on decontamination science to operation and quality management.

On the other hand, the current Supporting staff receive routine training each Friday. Sections involve disseminating good practices, sharing nearly missed cases, and reminding staff about workplace safety.

Besides, Four-week Autoclave Operator Trainings were also arranged voluntarily to enrich supporting staff's knowledge on (i) Sterilization theories, (ii) Sterilization area and sterile store workflow, (iii) Components of steam sterilizers, (iv) Re-validation, (v) Environmental control and (vi) OSH issues encountered by autoclave operators.

▶ RESULTS

The average QI (2021 - 2023) during this period is 0.26% (Range from 0.14% to 0.49%, Standard Deviation 0.09%). A departmental Key Performance Indicator, Quality Index (QI), has been adopted for monitoring service performance.

▶ CONCLUSIONS

Applying the QI and constantly refined training syllabus, NWCSSD has become a sustainable training centre to equip all staff with the essential skills and concepts at work. All training courses arranged had achieved 100% full completion by their participants, benefiting both the department's production performance and staff's competencies.

▶ **AIM**

As of last year we've made innovative steps making the CSSD course more flexible, accommodating the needs of the local Hospitals. By implementing new techniques we also made our students more ready for the modern age of CSSD.

▶ **METHODS**

We've created a modular, online, learning system fitted for our students. We've worked out ten subjects over a two year course. These subject apply directly to the core activities the student shows in their workplace. Next to these subjects, we tied in the soft skills the students will require, as well as the mandatory courses required for a community college program (Language, Math, Citizenship).

Students who wish to complete one of the modules, can do so by completing some assignments fitting the development goals they assigned for themselves. As teachers we suggest multiple assignments (making video's, writing essays, presentations, games etc.), but students are also encouraged to come up with their own assignment. As long as the goals are met. This is in line with our vision, which follows the Self Termination Theory¹ of Deci & Ryan, and the works of Zimmerman².

At the core of these modules are competency based interviews. At these interviews the students have the chance to defend their product choices, show technical insights in their workplace and can elaborate on their development. They also get the chance to talk about their future goals.

▶ **RESULTS**

As of this schoolyear the participation of our students have become higher. They get to develop themselves. They are at the helm of their own future in the CSSD. In a workplace that is subjected to innovation we need a workforce that can keep up with the high demands of the OR. Students who graduate need to keep up their skills by themselves³ and be able to do so.

We also have the chance to help our hospitals recruit more flexible. Instead of one start of the schoolyear, we have five jump-off points. Our continuing contact with the teaching hospitals gives us the encouragement we are on the right path. We get the chance to visit once, twice a year (and they also can come to us) and this is where we get our feedback.

▶ **CONCLUSIONS**

We have classes where new students roll in, and old ones move out. This creates a class where the CSSD information is everflowing from student to student, within the walls of the college. We create everlasting content that is echoing through schoolyears. We make podcasts, and videos. Our classroom is adorned with posters from bacteria as well container labels from former alumni.

Lastly it's great to point out, the content we create is freely available on the internet. It's on an open source network. Of course it's in our native tongue, but we believe information should be given to all who want to use it!

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EXPLORING DIFFERENCES BETWEEN STEAM PENETRATION IN A B&D TEST PACK AND IN A CHANNELLED INSTRUMENT

▶ **AIM**

Explore whether significant differences exist between steam penetration in a B&D test pack and in a channelled instrument.

▶ **METHODS**

Experiments were performed in an 8-unit (614 L) steriliser equipped with a degassing system and fed with osmotic water. An infrared sensor¹ and a NCG sensor² were installed to monitor, respectively, the vapour fraction at the end of a 70 cm long tube and the amount of non-condensable gases (NCGs) in the steriliser chamber during the exposure phase.

A B&D test pack (stated values 134^o-137^oC, 3.5 min)³, compliant with ISO 11140-4:2007, was positioned in the chamber in every cycle. A chemical indicator (CI) strip, obtained from a new B&D test pack (same brand and lot) was inserted up to the closed end of a stainless steel challenge tube (8 mm internal diameter, 50 cm long, and with 1 mm thick walls). The challenge tube represented a channelled instrument [1] and was positioned inside the chamber.

A range of sub-atmospheric, trans-atmospheric and supra-atmospheric processes were run introducing different amounts of NCGs in the steriliser chamber either by varying the pressure of the vacuum-points in the conditioning phase or injecting air (0-1500 mL) at the beginning of the come-up ramp, or changing the number of pulses in the preconditioning phase. All processes shared a 3.5 minutes-long exposure phase at 134.5^oC.

Load amount included empty chamber (only B&D test pack and challenge tube) and full load (8 nets of 15 kg metallic unwrapped load each + B&D test pack and challenge tube).

▶ **RESULTS**

A total of 76 combinations of processes and loads were tested. All resulted in a pass of the B&D test pack, but only sub-atmospheric and trans-atmospheric processes with deep vacuum-points or a limited amount of injected air resulted in a colour change of the CI positioned in the 50 cm long challenge tube. Supra-atmospheric processes never produced a colour change of the CI in the challenge tube regardless of the number of pulses in the preconditioning phase (tested up to 40 pulses).

NCG sensor data documented that the more profound the vacuum-points in the preconditioning phase the lower the amount of NCGs in the exposure phase. Air injections in the come-up ramp also elevated the NCG amount in the exposure phase. Supra-atmospheric processes resulted in a low content of NCGs in the steriliser chamber only when several pulses were used.

The infrared sensor detected higher vapour fractions when deeper values of vacuum-points were achieved and no air was injected. Supra-atmospheric processes never resulted in high vapour fractions despite the low NCG amount in the chamber. Heavier loads favoured higher vapour fractions in channels.

▶ **CONCLUSIONS**

B&D test pack does not provide relevant information about steam penetration in channelled loads. Channels, even with relatively large diameter, and limited length, are challenging to be penetrated by steam and demand for low NCG amounts in the chamber and deep vacuum-points during sub-atmospheric or trans-atmospheric conditioning.

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INFLUENCE OF THE LOAD POSITIONING DURING A STEAM STERILIZATION CYCLE: AN EXPERIMENTAL AND NUMERICAL STUDY

Simon Pletzer

*Graz University Of
Technology, Institute Of
Thermal Engineering
Graz /
Austria*

▶ **AIM**

The objective of this study was to examine the impact of the spatial arrangement of medical instruments within table-top autoclaves. Previous studies^{1,2} have already demonstrated that the orientation of hollow loads (horizontally or vertically) can exert a substantial influence on the sterility of medical devices.

▶ **METHODS**

Temperature measurements were conducted within multiple loads during a sterilization cycle. These loads were uniformly distributed on two separate trays in the entire chamber. Given the limitation of temperature measurements to singular points, a comprehensive three-dimensional computational fluid dynamics (CFD) model of the entire sterilizer (including the chamber, heater, and loads) was developed.

▶ **RESULTS**

The simulated data demonstrates excellent temporal and spatial alignment with the experimental results. Notably, the loads located at the front of the lower tray exhibited the fastest heating, whereas those positioned at the edge of the upper tray needed more time for heating. Consequently, it is advisable to prioritize placing heavier medical devices at the forefront of the lower tray to optimize heating efficiency and ensure sterilization.

▶ **CONCLUSIONS**

Utilizing CFD, recommendations regarding the placement of loads inside autoclaves can be established, underscoring the significant potential of computational models in both the advancement of current autoclave designs and the development of new ones. Furthermore, these models provide researchers, companies and users valuable insights into the complex physical processes occurring within steam sterilizers, offering high-resolution temporal and spatial details.

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PRECISION IN PRACTICE: INSTRUMENT MANAGEMENT AS A KEY TO COST CONTROL AND SAFETY IMPROVEMENT

▶ **AIM**

To achieve efficient management and control of the instruments through a coded and continuously updated inventory, detailing the cost of each instrument, associated repairs/replacements, and maintaining its usage history, enabling the assessment of its productivity, as well as real investment needs.

To improve healthcare quality by enhancing patient and professional safety through continuous computerized monitoring of the various phases of the process related to the processing and use of instruments, enabling immediate action upon detected incidents, and most importantly, actively contributing to their prevention.

▶ **METHODS**

To achieve these objectives, the University Hospitals of the Ribera Group use two integrated computer systems:

Trazins: Traceability Software. A system for managing surgical instruments and traceability where all surgical instruments are inventoried and coded using a unique datamatrix and alphanumeric code, along with associated costs. This tool records all processes applied to surgical instruments in the Central Sterilization Unit (washing/disinfection, assembly, and sterilization), including the results of quality controls for each process.

Cynara: Digital Clinical History. A digital clinical history computer system that records every episode of primary and hospital care associated with a medical record number, identifying the professionals responsible or involved in each process. This is where the instruments used in an intervention are registered (generating a unique code per intervention) by reading the barcode on the identification label of each instrument or instrument set. Automated reading prevents registration errors and improves efficiency.

▶ **RESULTS**

Effective tool for the control and management of surgical instruments: Trazins system allows real-time knowledge of the hospital's immobilized material value concerning instruments, essential for decision-making regarding future investments.

Increased safety and protection for the patient: Integration allows verification of all instruments used in a specific surgical process, along with the results of quality controls they underwent. It also facilitates the identification of all subsequent surgical processes in which they were used.

Enhance the professional's security: Having real-time access to the results of their management means gaining confidence and being prepared for immediate action in response to errors or problems.

Obtaining Multidirectional Traceability in an Instant: Integration between Trazins and Cynara enables the reconstruction of the usage history of a specific product with all associated variables instantly, thanks to the database created in the Ribera Group Hospitals

▶ **CONCLUSIONS**

Integration leads to improvements in:

Safety and Healthcare Quality: Ensured by a control system that guarantees safety at each stage and its traceability.

Cost/Expense Control and Management: Real-time knowledge of inventory levels, quantification, and productivity enables decisions based on objective and measurable needs.

Legal Framework: The unique identification of surgical instruments anticipates compliance with European regulations, which will require manufacturers to implement this type of identification for Class IIb products starting May 25, 2025, not ruling out the obligation to retain these records for healthcare institutions.

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CHANGE MANAGEMENT: A CRITICAL PART OF LEADERSHIP SUCCESS

▶ **AIM**

To share experience in change management Central sterilization Services. Positive outcomes and lessons learned in the implementation process of critical changes in the department. From major renovations, minor equipment changes to staffing restructuring, among others, CSS Leadership must find effective approach to successfully implement these changes.

▶ **METHODS**

One model of change management approach is the ADKAR which is an acronym that focuses on five outcomes that an individual or institution needs for a change to be successful. Awareness of the need to change, Desire to support and participate in the change, Knowledge of how to change, Ability to implement the required skills and behaviour and Reinforcement to sustain the change.

Dr. John Kotter however, in observing one hundred companies identified eight steps that has been used in teaching change management.

Harrison et al. 2021, did a review of change management used in healthcare that included a 2012 research studies. The review also highlights the potential to integrate other models for change management with models commonly applied for improvement and implementation to support positive changes in healthcare.

Experiences in three major hospitals in a first world country will be shared, drawing lessons learned on the models of change within the CSSD.

▶ **RESULTS**

There is no perfect model in healthcare but the ability to flex and adapt to changes within the models will determine the level of success. Engagement with the team that are impacted most and recognizing champions of change in specific areas are critical to success. The complexity and nature of reprocessing requirements, constant fast paced advances in surgical interventions impacting medical device reprocessing outcomes, change management in CSSD has potentially evolved the infection control risks associated with our ability to address rapidly changing medical and surgical interventions.

▶ **CONCLUSIONS**

CSS team, determines the outcome and success of positive changes envisioned by its leaders. High level engagement within impacted teams, from conception to final implementation and maintaining these positive changes is an ongoing process. This is critical to our ability as reprocessing professionals to keep at pace with changes in standards and technological advances surgical interventions that impacts on our ability to provide safely reprocessed medical devices

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▶ **AIM**

This project aims to leverage the insights gained from QR code tracking to optimize equipment utilization, minimize waste generation, and promote a more sustainable and efficient CSSD operation.

▶ **METHODS**

To optimize CSSD operations, this project proposes a QR code tracking system. Each piece of equipment or surgical set will be tagged with a unique QR code. Staff will scan these codes at various stages of the sterilization and distribution process, recording critical information such as the item's status, who handled it, and the timestamp. This method streamlines equipment tracking, ensuring accurate and efficient management of equipment usage, sterilization cycles, and inventory levels. and quality control purposes, enhancing overall operational efficiency and safety within the CSSD.

▶ **RESULTS**

The findings of the project demonstrated significant improvements in several key areas. The use of QR code tracking led to a notable reduction in equipment search times, with an average decrease of 20%. This directly translated to increased staff productivity by allowing them to dedicate less time searching for equipment. Furthermore, 80% of staff members reported satisfaction with the new system, highlighting its user-friendliness, time-saving benefits, and improved equipment visibility.

▶ **CONCLUSIONS**

The implementation of QR code tracking in the CSSD department proved to be a successful strategy for optimizing operations. This resulted in a significant decrease in equipment search times, leading to increased staff efficiency. Additionally, the system fostered a more positive work environment through its user-friendly interface and improved equipment tracking capabilities. Overall, the research demonstrates the effectiveness of QR code technology in enhancing the efficiency and productivity within the CSSD department.

▶ **REFERENCES / ACKNOWLEDGEMENTS**

Optimizing Concept

REVOLUTIONIZING HOSPITAL STERILIZATION: HARNESSING AI, INDUSTRIAL INSIGHTS AND DIGITAL TRANSFORMATION

Karin Bundgaard

*Clinical Nursing Research
Unit, Aalborg University
Hospital & Department Of
Clinical Medicine, Aalborg
University
Aalborg /
Denmark*

▶ **AIM**

To develop an evidence-based standardized method for transporting and storing surgical instruments between operating room and reprocessing site to ensure their optimal condition for future use. International infection control guidelines recommend prompt reprocessing of sterilizable medical equipment immediately following surgical procedures^{1,2}. Furthermore, that transportation and storage of surgical instruments between operating theater and reprocessing site should occur in a moist environment. These precautions should help reduce the risk of instrument degradation. Prolonged exposure to a dry environment is known to make instruments challenging to clean using standard reprocessing protocols and increases the risk of corrosion. Traditionally, in Europe, the transportation environment for instruments has been kept dry to minimize the risk of corrosion. Conversely, in the UK and America, moist transportation environments are chosen to ensure efficient cleaning outcomes. However, limited research supports these recommendations and studies conducted in controlled laboratory conditions suggest the necessity to systematically reassess these recommendations under current clinical practice settings^{3,4}.

▶ **METHODS**

Data were collected at a large university hospital where two surgical departments' utilization of new basic instrument sets was monitored in a real-life setting. One department transported instruments under dry conditions, while the other under moist conditions. After approximately 10 and 100 reprocessing cycles, the instrument sets of the two departments were assessed and compared concerning cleaning efficacy (occurrence of protein residue) and preservation of instrument value (occurrence of corrosion). The BCA Protein Assay Kit was used for analyzing for protein residue and visual inspection and microscopy were used to test for corrosion. The evaluation involved a comparative analysis between the two groups based on the following key parameters:

- The effectiveness of cleaning
- The occurrence and extent of corrosion and surface changes
- The severity of any observed surface alterations

Additionally, laboratory tests were conducted comparing the behavior of various test soils under dry and moist conditions for different time periods in order to compare laboratory and clinical results.

▶ **RESULTS**

Data collection will be concluded in May 2024 and findings will be presented at the WFHSS 2024 in Santiago, Chile.

▶ **CONCLUSIONS**

This study carries significant socio-economic implications by offering evidence-based insights into how to decrease the incidence of corrosion on reusable surgical instruments, and thereby prolong their lifespan. By reducing corrosion formation, hospitals can achieve substantial savings on the purchase of new instruments and allocate resources more effectively towards other critical healthcare needs. Moreover, the study contributes valuable knowledge regarding the most effective way for transporting and storing instruments for ensuring their cleanliness. This understanding directly correlates with reducing the risk of potential cross-contamination between patients during surgical procedures. Ultimately, the implementation of optimal transportation and storage environment enhances patient safety by minimizing the probability of post-operative infections, thereby safeguarding the well-being of individuals undergoing surgical interventions.

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