

The impact of sink removal and other waterfree interventions in intensive care units on water-borne healthcare associated infections

Low Jia Ming Consultant Department of Neonatology National University Hospital of Singapore Hosted by Jane Barnett jane@webbertraining.com

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28 licensed beds

Level 3 – 15 Level 2 – 13

NICU & special care nurseries



Move to Water Free ICU care

"Water less or water free activities is the removal of hand hygiene sinks from patient rooms coupled with the conversion of the use of routine patient care activities and bathing with a waterless product or sterile water."

Hopman et al, 2017



What is down a sink?



Garvey MI et al, JHI 2017

UV light shows the unseen splashes created by standing urination

https://youtu.be/ejl7vrDUIcs?si=Is-10xlw1nfKzt2A



Scope of Talk

- 1. Tap = potential source of infection
- 2. Evidence for water free care
- 3. Journey towards water free care



Evidence of water sinks as potential source of outbreak

- Patient rooms with sink drains have been shown to contain a higher bacterial colonization.*
- Contaminated sinks can facilitate colonization and infection of multi-drug resistant (MDR) bacteria, especially in ICUs.
- Growing awareness has led to interest in <u>water-free patient care</u> systems to reduce infection risks.

Walker JT, Jhutty A, Parks S, Willis C, Copley V, et al. Investigation of healthcare-acquired infections associated with Pseudomonas aeruginosa biofilms in taps in neonatal units in Northern Ireland. J Hosp Infect. 2014; 86(1):16-23



Hospital Wastewater: A Reservoir for Infections

- Splash zones around sinks can spread pathogens via droplets and aerosols.
- Contaminated sinks, U-traps, and plumbing serve as reservoirs for water-borne infections.
- Biofilm growth in hospital plumbing further enables bacterial persistence and dissemination.



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Pathogenic Bacteria Rapidly Colonise Sinks of NICU: Results of A Prospective Surveillance Study



Prospective Surveillance Study. J Hosp Infect. 2025; supported by NCID Catalyst Grant



Heavy Colonization of Established NICU



Established NICU

Heatmaps showing the distribution of bacteria within sinks in the established neonatal intensive care unit (NICU) and new NICU in Phase 1.



Heavy Colonization of Established NICU



New NICU

- Pseudomonas species -
- Pseudomonas aeruginosa -
 - Acinetobacter species -
- Stenotrophomonas maltophilia -
 - Chryseobacterium species -
- Enterobacter Cloacae Complex -
- Coagulase-negative Staphylococcus -
 - Klebsiella pneumonie -
- A.Calcoaceticus-baumannii complex -
 - Pantoea Species -
 - Serratia marcescens -
 - Elizabethkingia species -
 - Burkholderia cepacia complex -

Heatmaps showing the distribution of bacteria within sinks in the established neonatal intensive care unit (NICU) and new NICU in Phase 1.



New NICU colonized within a month



Heatmaps showing the distribution of bacteria within sinks in the new neonatal intensive care unit (NICU) in sampling Phase 1 - 3.



Stopping sink use reduced bacterial bioburden

- Milk prep room sinks had significantly higher bacterial loads than patient care sinks (40.67 vs. 1.768; p = 0.025).
- Klebsiella pneumoniae and Enterobacter cloacae complex dominated milk prep room sinks.
- Handwashing sinks were mainly colonized by Burkholderia cepacia, Serratia marcescens, and Elizabethkingia species.
- Stopping sink use significantly reduced bacterial bioburden (16.34 vs. 1.49; p = 0.0094).



Proposed Strategy – High-Risk Areas





The impact of sink removal and other water-free interventions in ICUs on water-borne healthcareassociated infections: a systematic review

- 7 studies (332 beds): 6 in adult ICUs, 1 in neonatal ICU.
- 71.4% implemented water-free interventions after an outbreak.
- Preliminary evidence seem to suggest that sink removal helps stop outbreaks and reduce hospital-onset pulmonary NTB cases.

Low JM, Chan M, Low JL, Chua MCW, Lee JH. The impact of sink removal and other water-free interventions in intensive care units on water-borne healthcare-associated infections: a systematic review. J Hosp Infect. 2024.



Systematic Review – Impact of Water-Free Interventions on Infections

- Implicated pathogens used as primary end-point: MDR gram negative bacteria (57.1%), MDR P. aeruginosa (28.6%), pulmonary NTM (14.3%)
- Median post-intervention monitoring: 12 months (range: 9–29 months)
- Longest follow-up: 10 years (neonatal ICU study)
- Studies with tap removal and water-free measures saw a **reduction** in gram-negative infections:
 - **41.0** → **9.9** per **10,000** patient-days (p < .0001)
 - 9.15 → 2.20 per 1,000 days
 - Colonization rate: 26.3 \rightarrow 21.6 per 1,000 ICU admission days (p = .02)
- Pathogen incidence densities dropped 1.2–4.2 times across units
- Longer ICU stays showed greater reduction, suggesting a dose-response effect

Low JM, Chan M, Low JL, Chua MCW, Lee JH. The impact of sink removal and other water-free interventions in intensive care units on water-borne healthcare-associated infections: a systematic review. J Hosp Infect. 2024.

	Interventions used											
First author, year of publication		Specific water-free interventions										
	Sink removal	Water-less bath products	Bottled water for consumption	Bottled water used for oral care	Sterile water used for rinsing of catheters	Bottled spring water used for dissolving oral medication and oral care	Shaving with filtered water	Designated 'contaminated' sink outside of patient and medication preparation areas for disposal of wastewater	Designated 'contaminated' sink followed by alcohol- based disinfection for hand hygiene	Use of modified pre- existing connections in patient areas for intermittent dialysis ^b	Educational rounds to reinforce compliance to water-less care	Dedicated storage space >1 metre from sinks
Scharer, 2023	x	xa	x			x	x	x	х	x		
Baker, 2021	x	х	x	x	x	x		X				
Catho, 2021	x	х		x				x	x		x	x
Tracy, 2020	x	xc										
de-Las-Casas- Cámara, 2019	x											
Shaw, 2018	x	х						x			х	
Hopman, 2017	xd	х	x	x		x			xe			

Low JM, Chan M, Low JL, Chua MCW, Lee JH. The impact of sink removal and other water-free interventions in intensive care units on water-borne healthcare-associated infections: a systematic review. J Hosp Infect. 2024.



Improvement in rate of sepsis – Water Free ICU care?

While we are cautious to attribute the reduction in late onset sepsis (LOS) rate among very low birth weight (VLBW) babies solely to Water Less NICU care, we believe it is an important contributor to reduction in LOS for VLBW babies.

✓ The quality of cleaning and disinfection remained constant

- ✓ Antibiotic guidelines did not alter
- ✓ No significant changes in procedures and staff numbers that could influence patient management took place



Improvement in rate of sepsis – Water Free ICU care?

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In a high-risk NICU setting, the **targeted avoidance of tap water** is a reasonable approach to reduce the incidence of these infections till alternative therapeutic strategies emerge.



Improvement in rate of sepsis – Communication & Team work

- Neonates have needs unique from adults
- Communication between stakeholders nurses, doctors and respiratory therapist
- Engagement of key stakeholders Infection Control Team, Microbiologists, Infectious Diseases experts, Neonatologists, subspecialty teams
- Daily NICU safety huddle



What we have done – Hand Hygiene

- Staff & healthcare visitors education
- Alcohol based hand-rub for hand hygiene (unless gross soilage)
- Disinfection with alcohol-based hand scrub for proceduralist before line insertions
- Parents orientation
- Closure of existing sinks & no more handwashing with water



What we have done – Milk Preparation

- Removal of aerator head, closure of wash basins in milk preparation area
- UV sterilization of milk bottles
- Installation of splash guards between wash basin & milk preparation area
- Use of electric milk warmer
- Discard milk as biochemical waste instead of down the drain



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What we have done – Bathing

01

Change in bathing practices

 Use irrigated bottled water in older babies with gross contamination from stools etc
Use of anti-bacterial body

cleaning wipes for preterms Use of antibacterial wipe for body wipes prior to insertion of central lines

02





What we have done so far – Bathing

- 3 types of wipes used regularly:
- Pigeon Wipes Used for diaper change
- Readybath wipes used for sponging/skin preparation preoperatively
- Mikrozid wipes used for equipment wipe-down (non-alcohol based)





Chlorhexidine &

HANDRUB

schülke *

Ethanol Solution

Chlorhexidine Gluconate Solution IP 2:5% v/v lequivalent to 0:5% w/v Chlorhexidine Gluconati Ethanol IP 70% v/v With Emollients and Moisturiser Glour: Carmoisine Topical Antiseptic Solution

Net Content: 500 mL

What we have done – Surveillance

- Feedback loop: Regular timely active surveillance & audit of VLBW sepsis rates*
 - > 2 VLBW sepsis/infection with the same bacteria in < a month would trigger off an outbreak investigation



What we have done – Wash Basin

- Scheduled monthly maintenance program to monitor and ensure reduction of biofilm in sink drains and Ptraps
- Strategic closure of wash basin for routine hand hygiene
- Additional disinfection of sink
 - 250 ml of sodium hypochlorite 5000ppm is poured down sinks (in patients' rooms / communal cubicles and toilets).







What we have done – Incubator & Ventilator

- Reduced incubator humidity to prevent "rain out"
- Incubator cleaned every 8 hours with Mikrozid
- Cannula/ventilator tubing monthly change
- Incubator in use monthly change

Positive attitudes towards water-free ICU

- Cross-sectional study on healthcare workers in NICU in Singapore
- 88.6% (101/114) response rate ~2/3 were nurses
- 90.1% reported a positive attitude
- Main challenges
 - Perceived compromise of personal (46.5%) and patient (22.8%) hygiene
 - 43.6% reported an increase in skin-related conditions
 - 10.9% (11/101) had to visit a doctor; 64.0% (7/11) had pre-existing skin conditions



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Buvaneswarran S, Chua MCW, Amin Z, Wang X, Low JM. Knowledge, attitudes, practices, and perceived challenges for healthcare workers on waterless intensive care unit (ICU) care at a neonatal ICU in Singapore. *J Hosp Infect*. 2024.





In our experience, it has been found that **Water Free ICU** is a step in direction for *sustainable infection control in the NICU* Healthcare Workers on the Frontline: Assessing Risks from Hospital Water and Embracing Innovative Solutions



10 mins estimated time to complete

Our team is also currently working on innovative technologies like **BioShield**, a sustainable solution under development to reduce biofilm formation in hospital wastewater systems

Ch'ng Jun Hong's lab from NUS



Low Jeen Liang, Kinsey Yiu, Ch'ng Jun Hong





NCID catalyst grant

RA/microbiology team - Kee Bee Leng, Sally SL NG & Donald Chiang, Ho Pei Yun

Patients & families, NICU/NHD & Paediatric department, Infection Control team, ID team, Microbiological laboratory

Co-Is/Collaborators:

- A/Prof Zubair Amin (NUH)
- Prof Paul Anantharajah Tambyah (NUS)
- Dr Yvonne Ng Peng Mei (NUH)
- Dr Rick Ong (NUS)
- Dr Kwan Ki Karrie Ko (GIS)
- Dr Shawn Vasoo (NCID)
- Dr Lee Jan Hau (KKH)
- Dr Ch'ng Jun Hong (NUS)
- Dr Santosi Buvaneswarran (NUH)
- Dr Mae Chua (NUH)
- Sister Wang Xia (NUH)
- Chan Ming (CGH)
- Low Jeen Liang (NUS)
- Kinsey Yiu (Oxford)





paeljm@nus.edu.sg

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MAY

- 5 ... It Might Be Gloves. It's Always Hand Hygiene *(Special Lecture for World Hand Hygiene Day)* With Miranda Deeves, Claire Kilpatrick, and Dr. Neil Wigglesworth, World Health Organization
- 15 ... Non-Ventilator Hospital Acquired Pneumonia With Prof. Michael Klompas, US
- 22 ... COVID-19 Preparedness What Went Wrong? What Are the Next Steps? The Point of View of a Biomedical Engineer

With Prof. Davide Piaggio, UK

JUNE

- 2 ... IPAC Considerations in Global Emergencies With Dr. Bois Marufov, Canada
- 3 ... Persuasive Conversations With Ryan Mullen, Canada
- 18 ... Oral Care Practices and Healthcare-Acquired Pneumonia
 - Teleclass With Prof. Brett Mitchell, Australia
 - 19 ... Carbapenem Resistant *A.baumabnii* Outbreak on a Burn ICU in a Non-Endemic Setting With Prof. Peter Werner Schreiber, Switzerland
 - 26 ... Do We Still Need to Talk About Antibiotic Resistance With Prof. Jean-Paul Zahar, UK

JULY

- 10 ... Challenges to Maintaining Asepsis in Patient Care Settings Beyond the Operating Department With Prof. Dinah Gould, UK
- Afro-European Proposal for a Screening Protocol for *Candida auris* Colonization

Teleclass With Juliette Severin, Netherlands

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