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## **CLEANING NEONATAL UNITS IN LOW-RESOURCE SETTINGS: A HOT-TOPIC IN WAITING?**

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**ABSTRACT**

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4 Globally, about three-quarters of births now occur in healthcare facilities, with the  
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6 proportion being 50% for sub-Saharan Africa, where healthcare-associated  
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8 infections among newborns are typically 3 to 20 times higher than in facilities in high-  
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10 income countries. As this trend continues, the demand for specialised neonatal care  
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12 also rises, with dedicated units often only available in tertiary referral hospitals in the  
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14 case of low-and-middle-income countries. Preventing nosocomial infections among  
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16 vulnerable newborns requires effective and feasible control strategies and  
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18 interventions. The role of cleaning and cleaners in reducing risks and maintaining a  
19  
20 clean safe environment has until very recently been neglected at policy, programme,  
21  
22 practice, and research levels. There is now an opportunity to reposition cleaning  
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24 within global and national initiatives related to Water, Sanitation and Hygiene,  
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26 Infection Prevention and Control, and Antimicrobial Resistance. The evidence base  
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28 should also be strengthened on cost-effective bundles of cleaning interventions,  
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30 particularly in the context of low-resource settings. Here increasing overcrowding  
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32 and shortages of staff and supplies present major threats to neonatal survival and  
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34 well-being and heighten the case for optimising the use of low-cost, back-to-basics  
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36 interventions like cleaning.  
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1 The heady world of global health advocacy has, until very recently, underplayed  
2 routine basics for the delivery of care, such as water, sanitation and hygiene (WASH)  
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4 practices in healthcare facilities (HCFs). The neglect of these specific basics has  
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6 applied at all levels – from policy to programmes to practice and to research, and  
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8 extended to the associated workers, such as cleaners<sup>1</sup> and sewage workers,<sup>2</sup> who  
9  
10 often suffer stigma and occupational risks. This is perhaps all the more surprising  
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12 given the longstanding evidence base on infection prevention and control (IPC),  
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14 much of which is crucially dependent on WASH infrastructure – such as providing  
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16 water for sterilization equipment and for essential hand washing.<sup>3</sup> With the launch of  
17  
18 the United Nations Secretary-General’s call to action in 2018 for universal and  
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20 sustainable access to safe WASH in HCFs,<sup>4</sup> the matter has become a “*hot topic*.”  
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22 Data are emerging to show the shortfall in standards, with the latest global report  
23  
24 showing, for example, that an estimated 896 million people in 2016 were served by  
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26 HCFs with no water service \*, virtually all in low-and-middle income countries  
27  
28 (LMICs).<sup>5</sup> Robust figures are still lacking for many countries, especially regarding  
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30 hand hygiene facilities, waste management and environmental cleaning, but where  
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32 available, the gap in need is enormous. In Eastern and South-Eastern Asia, for  
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34 instance, two-thirds of HCFs were without functional hand washing facilities either at  
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36 points of care or in the toilets, and 13% had no water service\* at all, with serious  
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38 consequences for every other use of water.<sup>5</sup>  
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51 Efforts to address the gap are gathering momentum. United Nations’ agencies are  
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53 leading the implementation of a global roadmap to improve WASH services in  
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59 \* No water service, meaning they either used water from an improved source more than 500 metres  
60 from the premises or an unimproved source, or had no water source at all.  
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1 HCFs,<sup>6</sup> and the UN Special Rapporteur on the Human Right to Safe Drinking Water  
2 and Sanitation identified the provision of WASH in HCFs as a central vehicle for  
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4 advancing human rights.<sup>7</sup> Further indications of achieving the status of a *hot topic* on  
5  
6 a global stage are the new World Health Resolution ratified by member states at the  
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8 May 2019 World Health Assembly and the subsequent action plans to increase  
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10 investments in and strengthen systems around maintaining WASH in HCFs.<sup>8</sup> The  
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12 significance of this latest development lies partly in the explicit reference in the  
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14 Resolution to IPC and antimicrobial resistance (AMR) alongside WASH, so helping  
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16 to improve the connectivity between actors and actions across these three and at all  
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18 levels – from the coalface of patient care to policy initiatives. The three areas of  
19  
20 concern share a common outcome of huge importance – healthcare-associated  
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22 infections (HAIs),<sup>9</sup> and require joined-up thinking and action.<sup>10</sup> But progression of  
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24 WASH, IPC & AMR to the status of *hot topics* also carries a risk – that the essential  
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26 sub-components slip from view, both at the point of patient care and from the  
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28 systems which are meant to ensure the quality of the care. The purpose of this paper  
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30 is to highlight one such activity in HCFs which has not yet received the attention  
31  
32 warranted – cleaning of the healthcare environment. Here we focus on newborns  
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34 and on all levels of neonatal care, as the risk of HAIs in LMICs is universally high in  
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36 this patient sub-group and dedicated neonatal intensive care units (NICUs) are often  
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38 lacking, except in tertiary referral centres.<sup>11</sup>

## 51 **WHAT IS THE NEONATAL BURDEN AFFECTED BY CLEANING?**

52 Neonates accounted for the 47% of deaths worldwide amongst under five children in  
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54 2018.<sup>12</sup> The vast majority of these 2.5 million deaths annually occur in LMICs, with  
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56 the risk of dying almost 50 times higher in the highest-mortality country than in the  
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1 lowest mortality country. Targeting this high-risk group is thus an urgent policy  
2 priority, particularly regarding the three major causes of neonatal deaths, which are  
3 preterm birth complications, severe infections, and intrapartum complications.<sup>13</sup>  
4 Sepsis is estimated to account for up to half of all deaths among hospital-born  
5 babies.<sup>14</sup> The exact contribution to these deaths from HAIs is unknown but projected  
6 to be substantial, especially in LMICs.<sup>9</sup> Globally, about three-quarters of births now  
7 occur in HCFs with the proportion being 50% for sub-Saharan Africa, where HAI  
8 rates are typically found to be between 3 and 20 times higher than in facilities in  
9 high-income countries.<sup>14</sup> Moreover the HAIs occurring in these under-resourced  
10 settings are often caused by antibiotic-resistant bacteria, whose transmission is  
11 exacerbated by inadequate WASH, poor adherence to standard precautions for  
12 infection control, and overcrowding in the intrapartum and postpartum  
13 environment.<sup>15-17</sup> Although these challenges can be faced in every clinical area of a  
14 health institution, neonatal care understandably represents area for special attention,  
15 as neonates are at increased risk because of their poor immune defences, related to  
16 gestational age, colonization of mucous membranes and skin with nosocomial  
17 microorganisms, frequent exposure to antibiotics, invasive procedures, and physical  
18 contact with healthcare workers & parents.<sup>18</sup> Moreover, as the proportion of  
19 deliveries in HCFs further increases in LMICs, so will the demand for neonatal care,  
20 placing a further strain where dedicated units are currently lacking and where many  
21 families cannot afford to seek care at higher levels. A key opportunity for preventing  
22 concomitant rises in HAIs in newborns and in mothers lies in the reduction of the  
23 bioburden of potential pathogens in the healthcare environment through effective  
24 IPC, including cleaning.<sup>1</sup> Although many high-income countries <sup>19</sup> have long followed  
25 national guidelines on IPC in NICUs, in settings with limited resources where  
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1 neonatal care facilities fall far short of international standards, especially regarding  
2 equipment, many practices needed to be adapted, but arguably standards of  
3 something as basic as cleaning should be universal.<sup>20</sup>  
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## 9 **WHY IS CLEANING A CORE ELEMENT OF IPC?**

10 The role of cleaning within the WHO Guideline on Core Components of IPC<sup>21</sup> falls  
11 under the section on the built environment, materials and equipment, so  
12 emphasising formites. The physical environment, however, presents both a direct  
13 infection risk to newborns and mothers, and an indirect risk through contamination of  
14 hands and surfaces. While the main focus of attention in infection control is usually  
15 placed on hand hygiene, it is well-known that the transmission of hospital pathogens  
16 is not purely attributable to this route.<sup>22</sup> Hospital environmental surfaces (especially  
17 in the near-patient environment, such as mattresses, bed-rails and incubators) form  
18 a reservoir of pathogens and play an important role in the endemic and epidemic  
19 transmission of certain HAI pathogens, with hands or medical equipment often acting  
20 as the mode of transmission between such reservoirs.<sup>23,24</sup> The potential for  
21 contaminated environmental surfaces to facilitate HAIs depends on several factors,  
22 including: frequency by which organisms contaminate environmental surfaces; ability  
23 of pathogens to remain viable on surfaces; location of pathogen reservoirs;<sup>25</sup> hand-  
24 touch frequency of surfaces; adequate level of contamination required to pose a  
25 transmission risk; and pathogen infectivity index.<sup>26</sup> Specifically in neonatal units, it  
26 has been argued that surfaces contain delicate microbial ecosystems, heavily  
27 influenced by contact with their fragile residents—premature and sick neonates—  
28 who are innately vulnerable to opportunistic infections.<sup>13</sup> It is impossible to operate  
29 these environments in complete sterility, as the infants themselves, the milk they  
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consume, the adults caring for them, and the multiple pieces of equipment required for their care all represent fertile vectors for microbial transmission. Thus, cleaning regimens are necessary to prevent the retention and spread of virulent microbial pathogens in this sensitive environment.<sup>27</sup>

Whilst poor hand hygiene is not the only driver of transmission, the evidence base on its direct importance is considerable stronger than that linking hands and environmental cleaning. The history of hand hygiene research goes back over two centuries,<sup>28</sup> and there is strong body of work on the effectiveness of multi-modal intervention strategies which have a strong educational component.<sup>29</sup> Recent research in low-income country HCFs has shown the large contribution to poor hand hygiene compliance from recontamination before an aseptic procedure in delivery units, and highlights how this mode of transmission could be broken with training and by reducing the environmental burden with effective cleaning.<sup>30</sup> Moreover, the link between cleaning and the reduction of important nosocomial pathogens, such as MRSA, has been demonstrated in a number of studies,<sup>31-33</sup> although there has yet to be a large-scale robust trial in a LMIC setting.<sup>1</sup> These links, in turn, through-up questions on the practice of cleaning and particularly the practitioners.

## **WHO CLEANS WHAT?**

In many LMIC facility settings, the responsibility for cleaning the near-patient environment (such as beds, cots or drip stands) does not always rest with the ward cleaners, but with the nurses, who also undertake decontamination of clinical equipment.<sup>11,15</sup> This overlapping of cleaning responsibilities may not only create confusion, but also the neglect or missed opportunities for cleaning some ward

1 items.<sup>34</sup> Furthermore, IPC training for non-clinical workers is often inadequate, with  
2 no formal training at all for ward cleaners. A study across maternity facilities in four  
3 LMICs, for example, found that less than a third of the sites provided any form of IPC  
4 training for non-medical staff, including cleaners.<sup>1</sup> Of those facilities providing  
5 training, it was found that this was not comprehensive, reaching only a small number  
6 of cleaners and was generally limited to training in hand washing and surface  
7 cleaning. This reflects a wider omission of cleaning staff in the published literature  
8 and in IPC and environmental hygiene guidelines, such as in the WHO Essential  
9 Environmental Health Standards in Health Care, often referred to as the gold  
10 standard.<sup>35</sup> What literature does exist points to marginalised workers, with low  
11 salaries, lack of recognition, and with little control over their role, responsibilities and  
12 work environment.<sup>36-37</sup> Studies of other cadres have found these issues to affect  
13 workers' job satisfaction, performance and health.<sup>38</sup> This neglect is perpetuated due  
14 to the low societal value attached to cleaning, frequently seen as menial, dirty work.  
15 Cleaning is often reserved for individuals from disadvantaged socio-economic  
16 groups.<sup>1</sup> This becomes more complex in cultures where birth is seen as 'polluting',<sup>39</sup>  
17 with marginalised individuals performing what is regarded as a stigmatizing role.

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44 Training of cleaning staff is highly relevant not only to the prevention of HAIs, but  
45 also to relationships with healthcare professionals – fostering recognition of cleaning  
46 staff as valued members of the workforce, as well as supporting cleaners to  
47 recognise the importance of their own role in infection prevention.<sup>40</sup> As noted earlier,  
48 IPC training for non-clinical workers is often inadequate, with none for ward  
49 cleaners.<sup>1</sup> The value of training has recently been demonstrated in a ground-  
50 breaking cluster randomized trial (the REACH study) which tested a training  
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intervention for cleaning staff in 11 Australian hospitals, and found improvement in cleaning behaviour and reduction in one type of HAI.<sup>41</sup>

Although training of cleaners is undoubtedly a key starting point, there is also a need to acknowledge wider systems change in order for reduced infection risks to be realised. As suggested in the WHO Core Components for IPC Programmes,<sup>21</sup> a good programme needs to work throughout the system and involve organisational and cultural change, and be integrated in wider quality improvement initiatives.<sup>42</sup> The routine availability of resources (including cleaning materials) as well as staffing and workload (ratio of cleaners to floor area or number of patients) impacts on the ability of workers to maintain a clean and safe environment. These structural factors need to be addressed alongside the basics of training, ongoing supportive supervision, availability of cleaning policies and protocols, and fair working conditions, including salaries.

## **ARE THERE SIGNS OF PROGRESS?**

In the last 12 months, there have been a number of developments which are helping to highlight the neglect of cleaning and of cleaners as frontline health workers and to ensure the integration of environmental cleaning in WASH, IPC and AMR initiatives. Firstly, in terms of data and monitoring, the main international and national platform for WASH in HCFs, the WHO/UINCEF Joint Monitoring Programme,<sup>5</sup> has broadened its remit to include key factors relevant to IPC, including waste management and environmental cleaning. Although the number of countries currently providing data is very low, the JMP support process and resources will change this. The latest round showed, for example, that in 2016, in seven out of 21 countries with data, fewer than

1 three quarters of HCFs had supplies of disinfectant for cleaning. A second helpful  
2 development relates to 2020 being the international year of the nurse and midwife,  
3 with heightened attention given to their roles, training and resource needs.<sup>43</sup> As  
4 noted earlier, these health professionals are crucial to IPC and play a direct role in  
5 maintaining hygiene of the environment and often also supervise ward cleaners.<sup>1</sup>  
6  
7 Thirdly, the international emphasis on achieving Universal Health Coverage and on  
8 quality care as a human right,<sup>44</sup> combined with initiatives to end disrespect and  
9 abuse at the time of delivery in HCFs,<sup>45</sup> provide an opportunity to reposition cleaning  
10 and cleaners as key to providing a respectful environment for women, babies and  
11 indeed healthcare workers. Finally, the potential of improving the training of cleaners  
12 has been enhanced recently through the release of a cleaners' training package and  
13 guidelines for cleaning. TEACH CLEAN is a publicly-available training intervention  
14 specifically for LMICs, created by The Soapbox Collaborative, a small evidence  
15 based non-governmental organization, and based on international guidelines for  
16 environmental hygiene.<sup>46</sup> The package was piloted in the Gambia in 2016, and has  
17 been used by other agencies in India and Cameroon. Key features of the package  
18 include participatory methods and pictorial guidelines to facilitate learning for hospital  
19 cleaners who typically have low education and literacy levels. The TEACH CLEAN  
20 package is acknowledged in several international sources, including the  
21 implementation plans for the 2019 World Health Resolution on WASH in HCFs<sup>47</sup> as  
22 well as recent guidelines issued by CDC and ICAN on "Best Practices for  
23 Environmental Cleaning in Healthcare Facilities: in resource-limited settings".<sup>40</sup>  
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## 56 **WHAT GAPS REMAIN?**

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Whilst some progress has been made in acknowledging the role of cleaning and cleaners within the priority areas of WASH, IPC and AMR, there is clearly room for further research and implementation efforts to address key gaps. Firstly, there is a lack of evidence and practical advice on cleaning products in neonatal units. For example, in LMICs with frequent overcrowding<sup>18,48</sup> and high turnover of babies, as well as high ambient temperatures and humidity favouring rapid bacterial growth, there is a key unanswered question about the frequency and cleaning products to use.<sup>35</sup> Detergent-based cleaning reduces surface bioburden but does not necessarily eliminate pathogens. Conversely, disinfectants kill pathogens but can be expensive, environmentally unfriendly, and may result in tolerance among habitually exposed pathogens.<sup>49</sup> Whatever the product used, all sites rapidly become re-contaminated after cleaning. Rebound of bacterial growth to pre-cleaning levels have been reporting to occur within 3 – 8 hours after cleaning,<sup>50</sup> raising important questions for research about the cost-effectiveness and feasibility of alternative frequencies of cleaning in high risk contexts such as neonatal units.

A second gap relates to measuring cleanliness. Although visual inspection is the most widely used method, this has a relatively poor correlation with the more important measure of microbiological cleanliness, which is the main parameter of interest for transmission of HAIs.<sup>1</sup> An internationally-recognized definition of a “clean” hospital surface is one from which the total Aerobic Colony Count is less than 2.5 cfu/cm<sup>2</sup>.<sup>51</sup> In practice, this is typically measured by the use of agar-coated dipslides physically pressed on a surface and then incubated under standard microbiological conditions. Further research is needed to improve the feasibility of this approach in LMICs and for incorporation into routine hospital monitoring practices. Local

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feedback to hospital cleaning staff on the microbiological success of their cleaning efforts could be a powerful motivator for sustaining their performance.<sup>52</sup>

Finally, robust evaluations are needed of the cost-effectiveness of “bundles of cleaning interventions” in reducing the transmission of HAIs in high risk populations, such as in neonatal units. This gap in robust evaluations also applies more generally to WASH and IPC interventions.<sup>15</sup> But with the continuing increase in institutional deliveries in LMICs and thus the care needed for vulnerable newborns, interventions for the prevention of nosocomial infection must be prioritised.<sup>53</sup> The potential from back-to-basics, relatively low-cost practices and practitioners such as cleaning and cleaners, could make this a hot topic in this final decade in the run-up to achieving the international development goals for newborns – everywhere.

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