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VIEWPOINTS

Are Contact Precautions "Essential" for the Prevention of Healthcare-associated Methicillin-resistant *Staphylococcus aureus*?

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The recently updated Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America, and the Association of Professionals in Infection Control practice recommendations for methicillin-resistant *Staphylococcus aureus* (MRSA) prevention in acute care facilities list contact precautions (CPs) for patients known to be infected or colonized with MRSA as an "essential practice," meaning that it should be adopted in all acute care facilities. We argue that existing evidence on benefits and harms associated with CP do not justify this recommendation. There are no controlled trials that support broad use of CP for MRSA prevention. Data from hospitals that have discontinued CP for MRSA have found no impact on MRSA acquisition or infection. The burden and harms of CP remain concerning, including the environmental impact of increased gown and glove use. We suggest that CP be included among other "additional approaches" to MRSA prevention that can be implemented under specific circumstances (eg outbreaks, evidence of ongoing transmission despite application of essential practices).

Keywords. contact precautions; MRSA; prevention; gowns; gloves.

The compendium of strategies to prevent healthcare-associated infections is a collaborative effort of the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America, and the Association of Professionals in Infection Control and is endorsed by the American Hospital Association and the Joint Commission [1]. Recent updates addressed in these valuable infection prevention recommendations include one on prevention of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission and infection in acute care hospitals [1], which we will henceforth refer to as "the compendium." We commend the authors for this carefully crafted guidance, which will help acute care hospitals as they continue efforts to prevent MRSA infections.

However, we are concerned that the inclusion of contact precautions (CP) for all MRSA-colonized or MRSA-infected patients as an "essential practice" (to be adopted by all acute care facilities) is not supported by current evidence and could have unintended adverse consequences. Of note, the compendium authors themselves concede that CP for all patients with MRSA may not be "essential" by devoting considerable attention to hospitals that have (or will) move on from routine use of CP for MRSA. In this Viewpoint, we explain why the practice of CP for those known to be colonized or infected with MRSA should instead be considered an "additional approach," to be applied not universally but rather for specific settings (eg, outbreaks or evidence of ongoing transmission despite application of essential practices). Several prominent healthcare epidemiologists recently proposed a similar "precision-based approach" involving patient- and context-specific application of contact precautions [2].

EVIDENCE APPRAISAL: BENEFITS OF CONTACT PRECAUTIONS FOR MRSA PREVENTION

As the compendium authors acknowledge, there are no controlled trials that directly assess the use of CP for those colonized or infected with MRSA meriting "essential" practice status. The reviewed compendium studies fall into the following categories.

MRSA Contamination of Healthcare Personnel and the Environment

These studies provide biological plausibility for the use of CP but are not sufficient to demonstrate whether use of gowns and gloves for patient encounters are more effective at preventing MRSA transmission or infection than a combination of

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other interventions (eg, standard precautions including improved hand hygiene, environmental cleaning, and chlorhexidine [CHG] bathing).

Observational Studies and Related Mathematical Models

A tremendous number of observational studies address the impact of CP on MRSA transmission or infection. This includes studies that both support CP for MRSA prevention (usually in concert with several other interventions, and in the setting of an outbreak or elevated rate of MRSA infection), and dispute CP for MRSA prevention (eg, in healthcare settings that discontinued CP without resultant increases in MRSA transmission or infection) [1, 3, 4]. These studies do not provide a definitive answer regarding the effectiveness of CP for MRSA prevention, given the absence of concurrent control groups and the inability to determine which of multiple concurrent interventions had an impact on MRSA transmission or infection.

Notably, in their discussion of observational data, the compendium authors suggest that the decline in hospital-onset bloodstream infections from MRSA between 2006 and 2016 may be related to the use of CP [1, 5]. This assessment does not include the context within which this decline occurred, specifically, a global decline in proportion of *S. aureus* infections from MRSA beginning in approximately 2005 [6, 7]. As described by Chambers et al, the epidemiology of MRSA since it emerged more than 60 years ago has been characterized by sequential "waves" of epidemic clones spreading across geographic areas [8]. It is difficult to assess the contributions of specific infection prevention practices implemented in acute care hospitals during the downward slopes of such epidemic waves. The authors also omit that the national decline in hospital-onset MRSA infections continued during a time when many hospitals began to stop using CP for MRSA-colonized patients. This trend is not new, and it continues. A 2021 SHEA Research Network survey found that roughly 1 in 3 hospitals no longer routinely use CP for MRSA prevention [personal communication, Daniel Morgan]. The relative importance of interventions such as CP within acute care hospitals remains unclear.

The largest observational study discussed in the compendium is the highly successful intervention within the US Department of Veterans Affairs (VA) healthcare system starting in 2007 [1, 9]. As the authors note, the VA MRSA prevention bundle did not only use CP for those known by clinical cultures to be colonized or infected with MRSA. In fact, most VA hospitals were already using CP in this manner. The VA bundle included screening of all hospital admissions for MRSA and, in addition to CP for all carriers, placed a renewed focus on hand hygiene and provided funding for a "MRSA prevention coordinator" (essentially an additional infection preventionist). In general, these practices elevated the infection prevention culture across the VA system. Thus, it represented a combination of 1 "vertical" intervention (vertical interventions being those focused on a single pathogen, in this case MRSA) and several "horizontal" interventions (horizontal interventions being those such as hand hygiene that impact all potential pathogens) [10].

Subsequent VA studies revealed that reductions in both hospital-onset Gram-negative bacteremia and candidemia began at the same time as the VA MRSA Prevention Initiative and resulted in reductions of similar magnitude as that of MRSA (43% for Gram-negative bacteremia, 77% for candidemia) [11, 12]. These findings support the importance of the horizontal aspects of the VA MRSA Prevention Initiative, and raise the question of what, if any, reduction was due to active screening and CP.

Modeling studies using VA data attempt to address this question; the one cited in the compendium suggests that CP alone reduced MRSA transmission by 47% [13]. If this were correct, then demonstrating in a controlled trial that expansion of CP is effective for MRSA prevention should be possible, at least if it is paired with an active screening program. However, controlled trials examining increased use of CP in association with active screening have not demonstrated effectiveness (Table 1) [14, 15]. Of note, many of the same authors of the VA modeling study cited previously also examined the cluster-randomized STAR*ICU study by Huskins et al, finding little evidence that CP reduced MRSA transmission [16]. An additional modeling study not cited in the compendium comes to a different conclusion, estimating that the screening and CP aspect of the VA initiative contributed only marginally to the overall reduction in MRSA infections [17]. Perhaps the aphorism attributed to George Box, that "all models are wrong, but some are useful," applies here.

A final important point about the interpretation of the VA MRSA Initiative: if one accepts that CP guided by active screening, as done in the VA system, was essential to a 66% reduction in MRSA infections and an almost 50% reduction in MRSA transmission, then why not include *both* CP and active MRSA screening as essential practices? We know that individuals identified by clinical cultures represent only a fraction of MRSA carriers [18]. The inclusion of CP only for those who happen to be identified as MRSA carriers by clinical cultures, as recommended in the compendium and in a recent Centers for Disease Control and Prevention statement [19], seems like a half-measure.

The compendium authors also mention the increase in hospital-onset MRSA bloodstream infections during the coronavirus disease 2019 (COVID-19) pandemic [20] as being associated with a decline in CP use, and a recently published study from the VA system reports an association between healthcare-associated MRSA infections and the removal of MRSA prevention practices [18]. However, the myriad changes in care practices during the COVID-19 pandemic led to increases in several healthcare-associated infections (most notably ventilator-associated events

Table 1. Cluster-randomized Controlled Trials for MRSA Acquisition that Included Contact Precautions

Trial	Intervention	Findings	Comments
STAR*ICU 18 ICUs [Huskins et al]	MRSA cultures obtained for all patients CP used for positive patient in intervention ICUs versus control Standard Precautions	No significant reduction in MRSA infection or acquisition	Gloves or CP were used for 92% of MRSA- or VRE-colonized or infected ICU days versus 38% of days for control ICUs
REDUCE-MRSA 74 ICUs [Huang et al]	MRSA screening and isolation; MRSA screening, isolation and decolonization; Decolonization of all patients with CHG and nasal mupirocin (no screening)	Universal decolonization reduced MRSA clinical cultures and all-cause bloodstream infections	Universal CHG and nasal mupirocin use had greater impact than targeted MRSA strategies
MOSAR 13 ICUs [Derdre et al]	6-m initial period focused on optimizing hand hygiene and CHG bathing MRSA screening performed followed by CP for carriers in intervention ICUs	No reduction in MRSA acquisition with MRSA screening	Initial hand hygiene and CHG bathing intervention significantly reduced MRSA acquisition
BUGG 20 ICUs [Harris et al]	Intervention ICUs: universal glove and gown use Control ICUs: CP for clinical cultures of MRSA or VRE	No impact on primary outcome of MRSA or VRE acquisition Reduction in MRSA when looked at alone (−2.98 acquisitions per 1000 person-days, 95% CI, −5.58 to −.38, $P = .046$)	For analysis of MRSA acquisition, the intervention and control groups did not have the same baseline rate of MRSA acquisition (regression to the mean)

Abbreviations: CHG, chlorhexidine; CI, confidence interval; CP, contact precaution; ICU, intensive care unit; MRSA, Methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

and central line–associated bloodstream infections), including in hospitals that were not using CP for MRSA prevention before the pandemic [21]. The relative impact of changes in CP use during the COVID-19 pandemic is not possible to independently evaluate with observational data, particularly during a time of unprecedented stress on healthcare and infection prevention programs. Regarding the findings of Evans et al, it is likely that VA hospitals able to maintain resource intensive MRSA-specific prevention practices differed in important but difficult-to-measure ways from those that could not, and in ways that may be associated with better horizontal infection prevention practices [18]. We are optimistic that with a significant decline in COVID-19 admissions, a resumed focus of evidence-based horizontal infection prevention and antimicrobial stewardship efforts will result in recovery of previously realized reductions in healthcare-associated MRSA infections.

Cluster Randomized Trials that Incorporate CP

No randomized trials assess the effectiveness of implementing CP for those colonized or infected with MRSA. However, several studies have examined the expansion of CP and measured outcomes including MRSA acquisition and infection. These studies were all performed in intensive care unit (ICU) environments, limiting their generalizability to other care settings. Nonetheless, these studies shed some light on the likely effectiveness of CP for MRSA prevention, and the evidence is underwhelming (Table 1).

Huskins et al, in the STAR*ICU cluster randomized trial in 18 ICUs, found that MRSA screening (with CP for all carriers, and gloves while awaiting test results) did not reduce MRSA infection or acquisition events. This is despite the use of gloves or CP for 92% of MRSA- or vancomycin-resistant enterococci (VRE)-colonized ICU days (vs 38% on control ICUs) [14]. Huang et al in the 74-ICU "REDUCE MRSA" cluster randomized trial found that universal decolonization (CHG and mupirocin) was superior to MRSA screening and CP at reducing MRSA clinical cultures and all-cause bloodstream infections [15]. Finally, Derde et al, in the 13-ICU cluster randomized trial (MOSAR), found no additional decrease in MRSA associated with screening-guided CP after an initial hand hygiene and CHG bathing intervention demonstrated a reduction in MRSA acquisition [22]. Thus, the results of the STAR*ICU, REDUCE-MRSA, and MOSAR studies, taken together, suggest that increased use of CP provides no benefit for MRSA prevention beyond other common infection prevention interventions (eg, hand hygiene improvement and use of CHG ± mupirocin) [14, 15, 16, 22].

The only study that demonstrated benefit from expansion of CP was the cluster randomized controlled trial by Harris et al that examined the effectiveness of universal use of gowns and gloves in all ICU patients (the "Benefits of Universal Gown and Glove" study) [23]. The primary endpoint in this study revealed no difference in MRSA or VRE acquisition or infection in the intervention arm, but a preplanned secondary analysis limited to MRSA found a statistically significantly greater reduction in MRSA acquisition events in the intervention units. Of note, the randomization process did not allocate the intervention and control units evenly with respect to baseline MRSA acquisition rates, with intervention units starting at a higher rate of 10 acquisitions/1000 patient days versus 7

acquisitions/1000 patient days in the control units. Intervention and control units had roughly the same acquisition rate during the intervention period (6 acquisitions/1000 patient days). Whether the difference in rate of change in MRSA acquisition between intervention and control units was due to regression to the mean, or to other factors related to the CP intervention (eg, high hand hygiene adherence on room exit in the intervention arm) requires further study [23].

EVIDENCE APPRAISAL: HARMS OF CONTACT PRECAUTIONS

The compendium authors devote one paragraph to the potential harms of CP [1]. Based on a single randomized trial that used the Institute for Healthcare Improvement global trigger tool to assess a subset of charts, they conclude that "current evidence does not indicate that CP lead to an increase in adverse events" [23]. Aside from concerns about the reliability and accuracy of the Institute for Healthcare Improvement global trigger tool to detect less severe adverse events, such as those related to nursing care [24, 25], there is only brief mention in the compendium to the impact of CP on patient satisfaction, anxiety, and the complications of bed management in those hospitals with shared patient rooms (leading to delays in bed assignment and longer stays in the emergency department) [26, 27, 28]. Prior studies indicate that isolated patients have fewer contacts with clinicians compared with control patients and are half as likely to be examined by attending physicians on rounds [23, 29, 30]. Tran et al also observed longer lengths of stay, higher hospital costs, and higher rates of 30-day readmissions among patients isolated for MRSA compared with nonisolated patients in a propensity-matched cohort study [31].

Increased need for CP can also negatively impact healthcare personnel (HCP) morale. "Personal protective equipment (PPE) fatigue" may become an issue when an increasing proportion of patients require PPE donning before room entry [29]. The additional time required for PPE donning and doffing also reduces time available for actual patient care. Reduced nurse-to-patient ratios have been associated with increased risk for healthcare-associated infections [32], and the increased time required by CP, combined with the reduction in HCP visits per hour [23, 30], may effectively reduce the availability of bedside care. Finally, as a larger proportion of inpatients are placed in CP for indications that have limited evidentiary support, HCP may be less likely to adhere to CP when it is more clearly indicated [33].

Infection prevention programs often have limited personnel and resources. Although we are not aware of a negative regulatory impact for hospitals that do not use CP for MRSA prevention, the inclusion of CP as an "essential" practice in the compendium expands the potential for regulatory risk for acute care facilities not including this as a strategy. The opportunity costs of universal CP for MRSA for programs with limited resources are likely significant and difficult to quantify.

ENVIRONMENTAL SUSTAINABILITY AND CONTACT PRECAUTIONS

The impact of climate-related health risks such as extreme heat events on communities already impacted by poverty and unsafe living environments will continue to increase [34]. Therefore, professional societies should consider health-equity implications of CP recommendations on already at-risk groups.

The US healthcare system is responsible for 8.5% of our nation's greenhouse gas emissions [35]. Thus, it is important to consider environmental impact and sustainability in any recommendation regarding use of CP because extending the routine use of CP to all patients infected or colonized with MRSA substantially increases the use of gowns and gloves.

Contact precautions typically rely on single-use polypropylene gowns and nitrile gloves, which are petroleum-derivative plastics. Estimating the percent of patients admitted to US hospitals who are colonized or infected with MRSA at 8% [36], the number of patient encounters per day (~100) [23, 29, 37, 38], the average 5.5-day length of stay [39], and more than 34 million US hospitalizations [40] each year, more than 1.5 billion gowns and gloves annually end up as waste for the implementation of MRSA CP alone. Accounting for the product life cycle, this is the equivalent of 576 000 metric tons of carbon dioxide emissions yearly, or the equivalent of an additional 128 000 gas-powered cars on the road [41, 42]. Reusable gowns (which constitute only 20% of isolation gowns used in US hospitals [43]) only partially mitigate the carbon footprint of contact precautions because they still generate 70% of the carbon dioxide emissions of their single-use cousins over the course of their life cycle [42]. In addition to carbon emissions, negative health effects can occur at all stages of the plastics life cycle [44], and evidence increasingly suggests that many plastic additives can act as endocrine disrupters and carcinogens [45]. Plastics that end up in the environment often wash to waterways and can create ocean garbage patches (one in the Pacific is now twice the size of Texas) that leach mutagenic and carcinogenic plastic by-products into the human food chain [46]. The perceived cost of gloves and gowns (mere pennies per use) omits the environmental externalities of production and disposal of these products. As stated earlier, the true cost of these environmental impacts is paid by vulnerable patient populations.

We suggest that future MRSA CP recommendations align with priorities of other healthcare organizations invested in efforts to improve patient safety while reducing harm, waste, and curbing the environmental impact of healthcare interventions. Deimplementation of CP in settings where its value and supporting evidence-base is low presents an excellent opportunity for organizations to reevaluate the positive and negative impacts of CP [47, 48].

A PATH FORWARD

CP for those known to be MRSA colonized or infected is one of many valuable practices in this compendium [1]. However, we

believe that recommending it as an *essential* practice is an unnecessary distraction and could easily be deemphasized to limit potential harms. A resource-intensive intervention with a burden on healthcare workers and associated harms should require a high level of evidence before requiring use in all acute care hospitals. This is particularly true in a compendium that is not a "living guideline" and that may not be updated for another decade.

Furthermore, by providing considerations for hospitals that no longer plan to use CP routinely for MRSA prevention, the compendium blurs the distinction between practices that are "essential" and those that are better understood as "additional." Specifically, they state that:

> "Although contact precautions remain an essential practice, considerations have been provided for hospitals that have strong horizontal prevention measures and neither ongoing MRSA outbreaks nor high or increasing rates of MRSA infection or hospital-onset MRSA-positive cultures and that choose to modify the use of contact precautions for some or all MRSA-colonized or MRSA-infected patients"

The word "modify" in this context is a euphemism for "discontinue" for the hospitals that have never used or moved on from routine use of CP for MRSA prevention [3, 4]. In other words, "CP is essential, unless it is not." There exists a perfect category in the compendium for practices that may be effective, but which are not necessary or feasible for every hospital to implement. That category is called "additional approaches." We respectfully recommend that CP be moved to this category, where it will join several other "additional approaches," some of which (eg CHG bathing) have much stronger supporting evidence.

Notes

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