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Less Contact Isolation Is More in the ICU: Not Sure

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2 Less Contact Isolation is more in the ICU: not Sure.

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1 The debate between the use of standard (SP) or contact precautions (CP) for stopping the
2 spread of multidrug-resistant organism (MDRO) has been controversial for years (1-5) and
3 still persists despite recent high quality cluster-randomized studies (6-9). SP are based on a
4 universal (also called “horizontal”) approach for all patients, whatever they are known as
5 MDRO carriers or not; SP include compliance with hand hygiene and cleaning the
6 environment. CP with a so-called “vertical” approach still include compliance with SP for all
7 patients, , additional control barriers for colonized patients, i.e. gloves and gown, and
8 placement in single room if possible. Identification of MDRO carriage through screening is
9 frequently associated with CP.

10

11 The introduction of alcoholic handrub (AHR) in the early 2000’s has been a major step for
12 improving compliance with hand hygiene in healthcare setting. Many studies demonstrated
13 that including AHR in a multifaceted strategy, based on education, observation and feedback
14 and other bundled measures are necessary for effective AHR implementation. Since CP and
15 SP both aim at interrupting transmission, SP now including AHR (as compared to
16 handwashing) has higher efficacy, likely closer to that of CP, thus fueling the debate between
17 CP and SP.

18

19 The epidemiology of MDRO is rapidly changing. MDRO comprise Methicillin-resistant
20 *Staphylococcus aureus* (MRSA), extended-spectrum betalactamase-producing
21 enterobacteriaceae (ESBL-PE), vancomycin-resistant enterococci (VRE), carbapenemase-
22 producing enterobacteriaceae (CPE), and carbapenemase-producing Gram negative bacilli,
23 *Pseudomonas aeruginosa* and *Acinetobacter baumannii* (CRAB). The latter, i.e. CPE,
24 carbapenemase-producing Gram negative bacilli, and VRE in some countries, are classified
25 as extensively-resistant in the late 2010’s.

26 In ICUs facing multiple endemic MDROs, placing a large proportion of patients into CP may
27 result in lower compliance for interrupting cross-transmission from each of these patients
28 (10). Priorities must be defined for selecting the most threatening MDRO, in terms of the
29 individual consequence of infection and the collective risk of dissemination, so relevant
30 infection control practices can be selected.

31

32 This complexification of epidemiology and control measures, together with legal mandates
33 issued in several countries may darken the central question for controlling MDRO spread:
34 what is the most effective method to interrupt MDRO cross-transmission? Hospital
35 epidemiologists are often facing difficult choices with CP having some benefit for many
36 preventing MDRO transmission and subsequent infection but also having negatives of cost,
37 environmental waste and healthcare worker dissatisfaction.

38

39 Many factors contribute to the dynamic of MDRO dissemination in the ICU, which should be
40 taken into consideration when designing a policy (Table). Some are of key importance:

- 41 - The MDRO under consideration and its local/regional and national epidemiology.
42 Several MDROs can be more easily transmitted suggesting that CP might be more
43 relevant for these bacteria: for example non-*E. coli* ESBL as compared to ESBL *E. coli*
44 (4, 11), or ESBL-PE (taken globally) as compared to MRSA (8). Other may have rapid
45 spread, i.e. VRE and CRAB, partially owed to their environmental reservoir; therefore
46 requiring enhanced environmental cleaning;
- 47 - Several success stories in controlling MDRO derived from a national policy, strictly
48 enforced by all healthcare facilities, such as CPE in Israel (12) or MRSA in the
49 Northern European countries and recently in the United Kingdom and France (13).
50 Statistical modelling and regional surveillance of VRE and CPE showed that some
51 HCFs may be hotspots for acquisition with subsequent dissemination in many other
52 facilities, thus demonstrating the role of a policy enforced in all healthcare structures
53 (14); Many of these national policies involved the use of active surveillance and CP in
54 their control measures;

- 1 - This is especially true at the beginning of an epidemic, where extended active
2 surveillance cultures and strict control measures including CP have the highest chance
3 to be effective. By contrast, an endemic situation with high prevalence at ICU
4 admission can only be curtailed, and SP may be preferred in this situation. Importantly,
5 any strategy ideally should be evaluated, by performing admission and discharge
6 screening;
- 7 - Compliance with hand hygiene for SP and CP actually is lower than that measured
8 through auditing, due to a Hawthorne effect (15). The first objective in low
9 compliance/low AHR consumption ICUs should be to improve hand hygiene practice,
10 before implementing CP;
- 11 - Resources are critical for effective implementation of any precaution, including the
12 availability of single room for CP. In ICU from developing countries, it may be decided
13 first to improve compliance with hand hygiene, while limiting CP to the most aggressive
14 MDROs.

15
16 Looking at the parameters to consider from the Table before deciding a control strategy, we
17 suggest that each ICU could implement its own policy, tailored to local epidemiology and
18 resources. Leadership and effective implementation of recommended measures are key for
19 success. For example, two multicenter ICU studies aiming at controlling MRSA were
20 published simultaneously in 2011 (6, 7). They used essentially the same control measures,
21 but resulted in different impact in controlling MDRO. Although both have methodological
22 concerns, the successful intervention was conducted using a behavioral approach, with
23 performance feedback and resolution of local challenges, in addition to technical measures
24 of screening and CP. This illustrates the importance of leadership and HCWs involvement in
25 conducting such intervention, possibly as important as the recommended precautions
26 themselves.

27
28 CP and SP do not include measures for cleaning the environment. There is growing
29 evidence that dry surfaces and humid areas may be reservoirs of MDRO. This has been
30 evidenced for a long time for VRE and CRAB, and in a lesser extent MRSA. Recent
31 publications showed that MDR-GNB, including CPE, may persist in humid reservoirs,
32 responsible for outbreak (16). Any strategy, SP or CP, to control MDRO spread should
33 include thorough environmental cleaning.

34
35 Although the MDRO epidemiology varies across ICUs, it is of critical importance to adhere to
36 a regional and national strategy. Local situation however, may help to select targeted MDRO
37 where CP has the highest chance to be effective, and other MDROs being tackled with SP,
38 taken into account a maximum number of patients to be placed into CP for higher efficacy.

39
40 In this very complex field, there are good arguments from both sides, SP or CP, for
41 controlling MDRO spread (1, 17). There is however some solid evidence. CP should be
42 enforced only if compliance with HH is high enough, e.g. > 40-50%, otherwise the first
43 objective should be to improve it. In case of already intermediate or high compliance,
44 implementing CP may be futile with very high compliance with hand hygiene. Moreover,
45 given its potential drawback, CP is probably less relevant for endemic situation. Local
46 resources should be devoted to the most cost-effective measures based on local
47 epidemiology, whilst respecting national guidelines

48
49 Conflict of interest

50 JCL and BG have no COI.

51 AH is editor for "up-to-date"

52
53

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2 **Table: Circumstances with likelihood of effective standard or contact precautions**

	In favor of standard precautions	In favor of contact precautions	Rationale
Patient			
Bacterial burden in the source patient	Asymptomatic	Diarrhea, UTI, wounds	The risk of cross-transmission and environmental contamination increases with the bacterial burden of the source patient, making CP and single room potentially more effective than SP
Care dependency, workload	Low	High	Higher workload and care dependency increase the number of contacts with the source patient, and the risk of cross-transmission
Patient's risk for infection	Healthy	Vulnerable	In an ICU with patients at high risk for infection, e.g. transplant ICU or burn ICU, placing colonized patients into CP has a higher chance be effective and reduce the risk for (severe) infection
MDRO Epidemiology			
Local epidemiology	Endemic	Sporadic, outbreaks	It is shown that the higher the number of patients placed into CP, the lower the adherence to control measures
Type of MDRO	Multiply-resistant	Extensively-resistant	CP has higher chance to be effective for some extensively-resistant MDRO in patients with difficult-to-treat infections than for patients at risk for infection with less resistant MO. In addition, adherence to a national policy, usually targeting more resistant MDRO, is key for success at the national level
Ease of transmission ("transmissibility")	Lower (ex, ESBL <i>E. coli</i>)	Higher (ex, ESBL non <i>E. coli</i> ; CRAB)	The frequency of transmission depends on the type of MDRO
Route of dissemination	Participation of the antibiotic selective pressure	Mostly by cross-transmission	Emergence of several MDRO variably depends on selective antibiotic pressure, e.g. ampC producing <i>Enterobacteriaceae</i> and exposure to 3GC or several resistance mechanisms in <i>P. aeruginosa</i> being induced due to antibiotics. CP may be less useful for patients with these MDRO
HCW practices			
Compliance with hand	High (> 70%) or low (<	Intermediate (40-70%)	High compliance with hand hygiene forms the basis for

hygiene	40%)		efficacy of SP. But in a situation with a low compliance with hand hygiene, most efforts must target improving compliance before instituting CP. The benefit of CP may be higher in intermediate compliance
AHR consumption of the ICU	High (> 150 mL/Pt.d)	Low (< 100 mL/Pt.d)	AHR consumption is a useful surrogate of hand hygiene in an ICU, additionally to compliance with hand hygiene
Resources			
Environment	Clean, spacious rooms	Crowded	Architectural, human and financial resources are critical to improve compliance with CP
Single room	Limited number	Available	Using single room for all patients in the ICU improves compliance with hand hygiene at room entry and exit, therefore increasing compliance with CP
Screening of patients	Limited	Available	To be effective, active surveillance cultures are required for identifying the whole reservoir of MDRO in patients to be placed into CP
Human workforce	Limited	Available	CP require time for healthcare workers to comply with donning and doffing protective equipment
Financial resources	Limited	Large	CP require financial resources to purchase protective equipment

1 Adapted from Kirkland K [1]

2

3 Abbreviations: UTI, urinary tract infection; CP, contact precautions; SP, standard precautions; ICU, intensive care unit, MDRO, multidrug-resistant organism; ESBL, extended-spectrum betalactamase; CRAB, carbapenem-resistant *Acinetobacter baumannii*;

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