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Differences in infection control and diagnostic measures for multidrug-resistant organisms in the tristate area of France, Germany and Switzerland in 2019 – survey results from the RH(E)IN-CARE network

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STS contributed to idea, design and method of this work, collected, analysed, and interpreted the data from the Swiss site, and substantially revised the manuscript. TL, SD, BJ collected and analysed the data from the French site and substantially revised the manuscript. NTM, JR and HG collected and analysed the data from the German site. VME contributed to analysis and interpretation of the data and was a contributor in writing the manuscript. NTM contributed to idea, design and method of this work, interpreted the data, and wrote the first draft of the manuscript together with STS. All authors read and approved the final manuscript.

Summary

BACKGROUND: Multidrug-resistant organisms (MDROs) are a public health threat. Single-centre interventions, however, are likely to fail in the long term, as patients are commonly transferred between institutions given the economic integration across borders. A transnational approach targeting larger regions is needed to plan overarching sets of interventions. Here, we aim to describe differences in diagnostic and infection prevention and control (IPC) measures in the fight against MDROs.

METHODS: In 2019, we systematically assessed diagnostic algorithms and IPC measures implemented for detection and control of MDROs at three tertiary academic care centres (Freiburg; Strasbourg; Basel). Data were collected using a standardised data collection sheet to be filled in by every centre. Uncertainties were clarified by direct contact via telephone or email with the data supplier. Internal validity was checked by at least two researchers independently filling in the survey.

RESULTS: All centres have established a primarily culture-based, rather than a nucleic acid amplification-based approach for detection of MDROs (i.e., vancomycin-resistant Enterococci [VRE], methicillin-resistant *Staphylococcus aureus* [MRSA], extended-spectrum beta-lactamase-producing *Enterobacteriaceae* [ESBL], carbapenemase-producing and carbapenem-resistant Gram-negatives [CPGN/CRGN]). IPC measures differed greatly across all centres. High-risk patients are screened for most MDROs on intensive care unit (ICU) admission in all centres; only the French centre is screening all patients admitted to the ICU for VRE, MRSA and ESBL. Patients colonised/infected by MRSA, quinolone-resistant ESBL *Klebsiella* spp. and CPGN/CRGN are isolated everywhere, whereas patients colonised/infected by VRE and ESBL are usually not isolated in the German centre.

CONCLUSIONS: In contrast to the French and Swiss centres, the German centre no longer uses isolation measures to control VRE and quinolone-susceptible ESBL. Overall, the French centre is more focused on intercepting MDRO transmission from outside, whereas the German and Swiss centres are more focused on intercepting endemic MDRO transmission. These findings point to important challenges regarding future attempts to standardise IPC measures across borders.

ABBREVIATIONS

CPGN	carbapenemase-producing Gram-negatives
CRGN	carbapenem-resistant Gram-negatives
EBSL	extended-spectrum beta-lactamase-producing *Enterobacteriaceae*
EBSL-QR	non-*Klebsiella* spp. quinolone-resistant EBSL
EBSL-QS	quinolone-susceptible EBSL
EBSL-QR-K	*Klebsiella* spp. quinolone-resistant EBSL
ICU	intensive care unit
IPC	infection prevention and control
MDRO	multidrug-resistant organism
MRSA	methicillin-resistant *Staphylococcus aureus*
NAAT	nucleic acid amplification
VRE	vancomycin-resistant enterococci

Background

Multidrug-resistant organisms (MDROs) are a recognised public health threat and constitute an enormous economic burden given their tremendous negative impact on patient morbidity and mortality [1–3]. The incidence of hospital-acquired MDRO infections has not decreased in Germany [4–6], France [7, 8] and Switzerland [9] over past years. The economic integration of the metropolitan areas of Freiburg (Germany), Strasbourg (France) and Basel (Switzerland) within the German-French-Swiss tristate area since creation of the European Economic Area in 1993 has created an increased potential for trans-border transmission of MDROs and other pathogens such as SARS-CoV-2. Currently, 100,000 cross-border commuters per day are traveling between the three countries. In doing so, MDROs and other pathogens can be transmitted both between hospitals upon patient transfers and among traveling and commuting individuals, independently of their acquisition in hospitals or communities. Previously, patients admitted from high-prevalence regions abroad have been found to be colonised with an MDRO more often than domestic patients [10].

Differences in epidemiology, healthcare systems, sociocultural context and, most importantly, in MDRO detection and infection prevention and control (IPC) measures persist not only among these three countries, but also within single member states of the European Economic Area [10–14]). Although supranational European associations have offered guidelines for detection and infection prevention and control (IPC) measures targeting a given MDRO, the harmonisation of such measures across Europe remains an immense challenge [15]. Thus, given the expected increase in trans-border transmissions and the delayed development of new antimicrobial treatments [16], a transnational approach targeting larger regions is of utmost importance to fight the spread of MDROs. This is why we created the RH(E)IN-CARE network in the German-French-Swiss tristate area to develop consensus documents about MDRO detection and infection control measures. Here, we aim to describe the existing differences in the measures for detection and control of MDRO infections in the three leading institutions of the German-French-Swiss tristate area.

Material and methods

To systematically assess diagnostic algorithms and IPC measures implemented for detection and control of different MDROs, we created two questionnaires consisting of 10 (partially interdependent) diagnostic and 16 (partially interdependent) IPC measures. Detection measures were queried for endemic infections with vancomycin-resistant Enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), extended-spectrum beta-lactamase-producing *Enterobacteriaceae* (ESBL) and carbapenemase-producing (CPGN) and carbapenem-resistant Gram-negatives (CRGN). Endemic IPC measures were queried for VRE, MRSA, ESBL susceptible to quinolones (ESBL-QS), non-*Klebsiella* spp. ESBL with quinolone resistance (ESBL-QR) as well as *Klebsiella* spp. ESBL with quinolone resistance (ESBL-QR-K) and CPGN/CRGNs for normal wards and intensive care units (ICUs). The prevalence rates of these MDROs in the different countries in 2019 are depicted in table 1. The questionnaires were answered in 2019 by the resident experts of three tertiary academic care centres, namely the Medical Centre - University of Freiburg, Germany, the Hôpitaux Universitaires de Strasbourg, France and the University Hospital Basel, Switzerland (hereafter simply referred to as German, French and Swiss centres, respectively). The questions were answered with either “yes” or “no”, if not indicated otherwise. If necessary, the answers were expanded with additional information.

Results

All three centres have established a primarily culture-based approach, rather than a nucleic acid amplification (NAAT)-based approach, for the detection of MDROs (table 2) for screening purposes. The German and Swiss centres culture VRE in an unselective medium as a first step and a selective medium as a second step, whereas they culture MRSA, CPGN and CRGN in a selective medium from the start (table 2). The French centre, however, uses unselective culture medium as a first step for medical diagnosis of all MDRO infections, and a selective culture medium for outbreak investigations or MDRO screening. Subsequently, phenotypic and NAAT-based approaches are employed to confirm resistance (table 2). Only the Swiss centre uses agglutination to confirm MRSA resistance genes (table 2). Of note, in the case of suspected outbreaks the German centre complements its normally primarily culture-based approach with a faster primarily NAAT-based approach (table 2). The French and Swiss centre collect strains of all surveyed MDROs for further typing, whereas the German centre no longer types and collects VRE and ESBL (table 1). Altogether, the German and Swiss approaches are more similar to one another than to the French approach (table 2). Overall, one needs to be aware that there are differences between countries in classification systems, as has been pointed out previously for the German-Dutch border region [17]. Therefore, our survey collected only resistance patterns based on EUCAST clinical breakpoints and detection of carbapenemases

All three centres have established protocols for screening for MDRO infections and colonisation, for isolating affected patients and other IPC measures. The established

Table 1: Prevalence rates of multidrug-resistant organisms in France, Germany and Switzerland in 2019.

MDRO	VRE*			MRSA			ESBL†			CRGN†		
Country	D‡	F‡	CH§	D‡	F‡	CH§	D‡	F‡	CH§	D‡	F‡	CH§
Prevalence rates in 2019 in %	26.3	0.7	14.3	6.7	11.6	7.4	12.2	30.2	10.5	0.9	1.0	1.7

VRE = vancomycin-resistant Enterococci; MRSA = methicillin-resistant *Staphylococcus aureus*; ESBL = extended-spectrum beta-lactamase-producing *Enterobacteriaceae*; CRGN = carbapenem-resistant Gram-negatives; D = Germany; F = France; CH = Switzerland * Data based on *E. faecium*; † data based on CR *K. pneumonia*; ‡ data retrieved from ECDC Surveillance atlas – antimicrobial resistance; § according to anresis.ch

IPC protocols of every centre reflect the local procedures adapted to the local context. However, they are based on national recommended measures mandatory for the whole country in France and Germany. In Switzerland, mandatory recommendations have not been issued on a national level. The setup of the IPC teams in each countries differs. In France, 1 full-time equivalent (FTE) IPC nurse per 400 beds and 1 FTE IPC doctor or IPC pharmacist is recommended per 800 beds. In Germany, the recommended number of IPC nurses and doctors is also calculated based on the number of beds; however, beds are classified into three categories (A, B, C) according to risk, with intensive care beds being the highest (category A) and normal wards without invasive procedures being the lowest (category C). Briefly, 1 FTE IPC nurse per 100 level A beds, per 200 level B beds and per 500 level C beds is recommended, and 1 FTE IPC doctor is recommended per 1000 level A beds, per 2000 level B beds and per 5000 level C beds. In Switzerland, no clear recommendations are made at this point.

Detailed information on antimicrobial stewardship programmes in the different centres were beyond the scope of the survey. For a better understanding of the basic setup of the three centres, they are described very briefly. In France, healthcare institutions must have a referent for antibiotic therapy (a clinical doctor). In France and Germany, the pharmacy department monitors the consumption of the most used antibiotics and reports this routinely. The microbiology laboratory monitors the number of MDROs and reports routinely. In every hospital there is a committee that is in charge of the production of local antimicrobial therapy guidelines. Furthermore, in France and Germany there are national reporting systems in place to facilitate benchmarking between the healthcare facilities.

Whereas all three centres screen at least a subset of patients for MRSA, ESBL and CPGN/CRGN infections, the German centre screens ESBL to a lesser extent than the French and Swiss centres, screening being restricted to ESBL-QR-K and ESBL-QR only (table 3). In addition, the German centre does not screen at all for VRE (table 3). All three centres screen high-risk patients for selected MDROs on admission to normal wards and ICUs, with more extensive screening for ICU patients (table 2). Notably though, only the French centre indiscriminately screens all patients for VRE, MRSA and ESBL on admission to the ICU (together with the Swiss centre for ESBL), with periodic re-screening for MRSA and ESBL (table 3). All three centres screen patients upon contact with CPGN/CRGN, with differing protocols for other MDROs (table 3). Swiss centres normally screen after short-term contacts, whereas the German centre requires a minimum contact time of 12 h for all MDROs, the Swiss centre 24 h for ESBL and the French centre requires a minimum contact time of 12 h only for VRE and CPGN (table 3). Moreover, all three centres isolate most patients carrying MDROs in both normal wards and in ICUs, preferring isolation in single-bed rooms (table 2). Importantly, this does not include patients infected by VRE and ESBL-QR in the German centre and by ESBL strains of *Escherichia coli* in the Swiss centre in accordance with a recent analysis by their resident experts (table 3) [17, 18].

Additional infection control measures are applied to varying degrees in the three centres, namely (i) dedicating medical devices and consumer goods to an MDRO-colonised

Table 2: Diagnostic measures for multidrug-resistant organisms (MDROs) in the Germany-France-Switzerland tristate area.

MDROs	VRE			MRSA			ESBL			CPGN			CRGN		
Hospital	**D**	**F**	**CH**	**D**	**F**	**CH**	**D**	**F**	**CH**	**D**	**F**	**CH**	**D**	**F**	**CH**
1. Culture-based diagnostic approach	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.1 Unselective culture medium as first step	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Yes	No	No	Yes	No
1.2. Selective culture medium as first step	No	No*	No	Yes	No*	Yes	No	No*	Yes	Yes	No*	Yes	Yes	No*	Yes
1.3. Selective culture medium as second step	Yes	No	Yes	Yes	No	Yes	Yes†	No	No	Yes	Yes	No	Yes	Yes	No
1.4. Phenotypic confirmation of resistance	Yes	No	Yes	Yes	No	Yes	Yes†	Yes	Yes	Yes	No	Yes	Yes	No	Yes
1.5. NAAT for confirmation of resistance genes	No	Yes	Yes	Yes	Yes	No‡	No	No	No	Yes	Yes	Yes	Yes	Yes	No
1.6 Agglutination for confirmation of resistance genes	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No
2. NAAT-based diagnostic approach	No	Yes§	No	Yes¶	No	No	No	No	No	Yes‡	Yes§	No	No	No	No
2.1 Cultural confirmation	N/A	No	N/A	Yes	No	N/A	N/A	No	N/A	N/A	No	N/A	N/A	No	N/A
3. Collection of strains for further typing	No	Yes	Yes	Yes	Yes‖	Yes	No	Yes‖	Yes	Yes	Yes	Yes	Yes	Yes‖	No

CH = Swiss tertiary care centre in Basel (University Hospital Basel, Switzerland); D = German tertiary care centre in Freiburg (Medical Centre - University of Freiburg, Germany); F = French tertiary care centre in Strasbourg (Hôpitaux Universitaires de Strasbourg, France). CPGN = carbapenemase-producing Gram-negatives; CRGN = carbapenem-resistant Gram-negatives; EBSL = extended-spectrum beta-lactamase-producing *Enterobacteriaceae*; MRSA = methicillin-resistant *Staphylococcus aureus*; NAAT = nucleic acid amplification; VRE = vancomycin-resistant Enterococci * Selective culture medium is used as first step for epidemiology; † VITEK (bioMérieux, Nürtingen, Germany) antimicrobial susceptibility testing is performed to detect ESBL; ‡ not routinely; § to confirm phenotypic detection; ¶ NAAT-based diagnostics are used mostly in suspected outbreaks, when diagnoses need to be fast; ‖ stored for 6 months.

patient, (ii) cohorting staff, (iii) flagging their medical documents and (iv) enhanced environmental cleaning after their discharge (table 3). However, none of the three centres performs selective digestive tract decontamination and only the Swiss centre uses antiseptic body-washing with chlorhexidine (table 3). The German and Swiss centres perform enhanced environmental cleaning after patient discharge for all MDROs, whereas the French centre does so only for CPGN/CRGN (table 3). Overall among all three centres, CPGN/CRGN is targeted by the most IPC measures, MRSA by slightly fewer, and VRE and ESBL by noticeably fewer IPC measures.

Discussion

Overall, the IPC and diagnostic measures differ significantly even between countries and cities that are located very close to each other. Also within the same country there are sometimes regional differences in IPC measures implemented; however, the extent of regional differences varies from country to country. In France, for example, as a politically centralised country, national guidance has a strong impact and local differences are only slightl. Germany as a federally organised country does enforce national guidance, but federal states have some authority to adapt this guidance locally. With regards to IPC, however, federal differences are marginal, since implementation of national recommendations is required by the binding German Infection Protection Act (IfSG). In contrast, in Switzerland there is little national coordination and regional differences are significant.

Differences between IPC measures implemented in the three centres are likely driven by the political system and degree of centralisation/coordination of strategies to control MDROs in the different countries, differences in the local epidemiology driving institutions towards more or less strict implementation of measures, and allocation of resources and policies for detection methods, infrastructure and staffing.

Table 3: Measures to control infection with multidrug-resistant organisms (MDROs) in Germany-France-Switzerland tristate area.

MDROs		VRE			MRSA			ESBL*					CPGN/CRGN		
								QS*	QR*	QR-K*	All*				
Hospital		**D**	**F**	**CH**	**D**	**F**	**CH**	**D**	**D**	**D**	**F**	**CH**	**D**	**F**	**CH**
1. Screening yes/no	NW	No	No†	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No†	Yes
	ICU	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No†	Yes
1.1 Admission screening all	NW	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	ICU	No	Yes	No	No	Yes	No	No	No	No	Yes	Yes	No	No†	No
1.2 Admission screening high-risk	NW	No	No†	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No†	Yes
	ICU	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No†	Yes
1.3. Periodical screening	NW	No	No‡	No	No	No	No	No	No	No	No	No	No	No‡	No
	ICU	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No	No
1.4. Contact screening	NW	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes
	ICU	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes
1.5. Contact period	NW	≥12 h	≥12 h	>0 h	≥12 h	N/A	>0 h	≥12 h	≥12 h	≥12 h	N/A	≥24 h	≥12 h	≥12 h	>0 h
	ICU	≥12 h	≥12 h	>0 h	≥12 h	N/A	>0 h	≥12 h	≥12 h	≥12 h	N/A	≥24 h	≥12 h	≥12 h	>0 h
2. Isolation yes/no	NW	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes‡	Yes	Yes	Yes
	ICU	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes§	Yes	Yes	Yes
2.1. Single-bed room isolation	NW	No	Yes	Yes	Yes¶	Yes¶	Yes	No	No	Yes	Yes¶	Yes§	Yes	Yes	Yes
	ICU	No	Yes	Yes	Yes¶	Yes¶	Yes	No	No	Yes	Yes¶	Yes§	Yes	Yes	Yes
2.2. Cohorting in multi-bed rooms	NW	N/A	Yes¶	Yes¶	Yes‖	No	Yes¶	N/A	N/A	Yes‖	No	Yes§,¶	No	Yes¶	No
	ICU	N/A	Yes¶	Yes¶	Yes‖	No	Yes¶	N/A	N/A	Yes‖	No	Yes§,¶	No	Yes¶	No
2.4. Multi-bed room plus organisational isolation	NW	No	No	No	Yes**	Yes‖	No	N/A	N/A	Yes**	Yes‖	Yes§,¶	No	No	No
	ICU	N/A	No	No	Yes**	Yes‖	No	N/A	N/A	Yes**	Yes‖	Yes§,¶	No	No	No
3. Handling of medical devices and consumer goods	NW	No	Yes	Yes	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
	ICU	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
4. Cohorting staff	NW	No	Yes¶	Yes††	No	No	Yes††	No	No	No	No	Yes††	No	Yes¶	Yes††
	ICU	No	Yes¶	Yes††	No	No	Yes††	No	No	No	No	Yes††	No	Yes¶	Yes††
5. Antiseptic body washing	NW	No	No	No	No	No	Yes‡‡	No	No	No	No	No	No	No	No
	ICU	No	No	No	No	No	Yes‡‡	No	No	No	No	No	No	No	No
6. Selective digestive tract decontamination	NW	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	ICU	No	No	No	No	No	No	No	No	No	No	No	No	No	No
7. Enhanced environmental cleaning	NW	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	ICU	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
8. Flagging of patients	NW	No	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	ICU	No	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes

CH = Swiss tertiary care centre in Basel (University Hospital Basel, Switzerland); D = German tertiary care centre in Freiburg (Medical Centre - University of Freiburg, Germany); F = French tertiary care centre in Strasbourg (Hôpitaux Universitaires de Strasbourg, France). CPGN = carbapenemase-producing Gram-negatives; CRGN = carbapenem-resistant Gram-negatives; EBSL = extended-spectrum beta-lactamase-producing *Enterobacteriaceae*; ICU = intensive care unit; MRSA = methicillin-resistant *Staphylococcus aureus*; NAAT = nucleic acid amplification; NW = normal ward; QR = non-*Klebsiella* spp. quinolone-resistant EBSL; QS = quinolone-susceptible EBSL; QR-K = *Klebsiella* spp. quinolone-resistant EBSL; VRE = vancomycin-resistant Enterococci * Only the German centre distinguishes between QS, QR and QR-K ESBL; † only if patient had contact with an health system in another country; ‡ yes in chronic haemodialysis centres; § for non-*Escherichia coli* ESBL; ¶ preferred choice (depending on capacity); ‖ if 2.1. not possible; ** if 2.1. and 2.2. are not possible; †† not in endemic situations; ‡‡ using chlorhexidine, if decolonisation is attempted.

Overall, the different IPC measures in place at the three centres are complex, thus standardisation and simplification of IPC measures may increase compliance within institutions and transferability to other institutions across borders. Only the French centre collects strains for all the surveyed MDROs for further typing. In addition, it applies admission and periodic re-screening of patients to a higher degree than the German and Swiss centres. Thus, the French centre acquires more epidemiologically analysable data on MDRO transmission routes. For instance, admission screening allows community-acquired MDRO infections to be distinguished from hospital-acquired infections. In contrast, the German and Swiss centres must rely predominantly on the typing of collected strains for epidemiological insights and forfeit some epidemiologically analysable data by not collecting certain MDRO (VRE, ESBL, CRGN) strains. More and more cost-efficient routine whole genome sequencing techniques [18, 19] might be adopted in all three surveyed centres in the future. This will offer access to even more comprehensive epidemiological information, which in turn might improve the prevention and control of MDRO spread [18, 19].

The tighter focus in the French centre on screening patients for MDROs on admission might allow isolation of patients carrying MDROs acquired in the community within France or in hospitals outside France. This might intercept the spread of such MDROs within the French centre. However, although the French approach is evidence-based, as MDRO outbreaks in hospitals often originate in the domestic community [20] or abroad [10, 21], it is also restricted, because it is limited to patients admitted to the ICU. Additionally, costs of screening all patients admitted to a hospital are significant and when prevalence rates are low in domestic patients it does not seem feasible or justified at the time. However, it has been argued that admission screening for MDROs, improve overall patient health and survival [22] and reduce treatment costs [23]. In particular, the German centre refrains from admission screening for VRE and ESBL-QS, putatively predisposing to outbreaks of these MDROs. The German and Swiss centres might intercept MDRO outbreaks following admission, relying to a higher degree on (i) contact screenings, (ii) patient isolation and (iii) environmental cleaning after discharge. Furthermore, the German and Swiss centres may additionally concentrate on antimicrobial stewardship programmes, which have been argued to be effective in preventing MDRO outbreaks [24]. However, their detailed investigation in the surveyed centres was beyond the scope of this study.

Although antiseptic body washing and/or selective digestive tract decontamination have been shown to possibly prevent MDRO colonisation of vulnerable patients in clinical settings, they have not yet been conclusively found to assist long-term decolonisation of MDRO-infected patients [25–28]. In agreement with these findings, the three surveyed centres have not adopted MDRO decolonisation attempts as part of the standard infection control measures, except for attempts in the Swiss centre. Inquiring about prophylactic infection control measures impeding *de novo* MDRO colonisation in the surveyed centres was beyond the scope of this study.

In summary, the diverging MDRO management approaches in the three leading centres of the German-French-Swiss tristate area pose many challenges for future harmonisation, pointing to important barriers to the control of MDRO transmission across borders. There are lessons to be learned from the EurSafety Health-net experience. This Dutch-German border network was able to decrease MRSA incidence-density by harmonising IPC guidelines [21]. We are hopeful that our newly created the RH(E)IN-CARE network provides the framework to discuss an optimal shared MDRO management focus for all three centres. Eventually, a harmonised MDRO management approach may constitute a decisive advantage in the fight against MDROs. The differences in epidemiology between the three countries (see table 1) create a risk of exportation of MDROs following patient transfers, for example VRE from Germany to Switzerland or MRSA from France to Germany. The RH(E)IN-CARE network provides the basis for work on a common policy for MDRO control. It might, however, be necessary to harmonise rules for diagnosis and management of MDRO-carrying patients to ensure better communication, quicker containment actions to prevent or stop cross-border MDRO spread between the three countries and perhaps allow a standardised cross-border notification in the future. Eventually, closer cooperation and standardisation of infection control procedures will also have a positive effect on transmission of all other infectious diseases, including viral diseases.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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