Carbapenem-Resistant Enterobacteriaceae in Virginia Hospitals

Results from Laboratory and Hospital Infection Preventionist Surveys

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VDH VIRGINIA DEPARTMENT OF HEALTH
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Introduction

This report details the results of two surveys distributed by the Virginia Department of Health (VDH) in 2013 assessing carbapenem-resistant Enterobacteriaceae (CRE) laboratory capacity, prevention methods, and communication in acute care and long-term acute care hospitals. It is intended to provide awareness about CRE incidence in Virginia and to spur action in laboratories, hospitals, and public health toward improving CRE surveillance, prevention, testing, and communication practices. For those interested in reading directly about the implications of the survey results and suggested recommendations, please go directly to the Discussion section starting on page 19.

Background

Carbapenem-resistant Enterobacteriaceae (CRE) are drug-resistant bacteria that pose an urgent threat in healthcare settings because of their high mortality rate, resistance to many available antibiotics, and potential to disseminate resistance widely. The Centers for Disease Control and Prevention (CDC) estimates 9,000 CRE infections and 600 deaths occur in the United States each year, with mortality rates as high as 50% in hospitalized patients with CRE bloodstream infections.[1] CDC's *Antibiotic Resistance Threats in the United States, 2013* report classified CRE as an urgent threat requiring immediate, aggressive action, stating that CRE infections are resistant to all or nearly all available antibiotics.[1] Public health's role in responding to the CRE threat is to know what the CRE trends are in the state/region and to educate and coordinate CRE prevention and control efforts.

Currently there are no regulations in Virginia that require reporting of all CRE infections, although the Virginia Department of Health (VDH) has clarified that a CRE suspected or confirmed to have an unusual resistance mechanism [i.e., a mechanism other than *Klebsiella pneumoniae* carbapenemase (KPC), such as VIM, NDM-1, or OXA-48] is considered an organism of "unusual occurrence of disease of public health concern" and should be reported to the health department. Given that the most common resistance pattern seen in the United States is KPC and resistance mechanism testing is not always conducted on CRE isolates, the true incidence and prevalence of CRE in Virginia is unknown. As of the end of 2013, four cases of CRE with unusual resistance mechanisms (one OXA-48 and three NDM-1) have been reported to the Virginia Department of Health.

Methods

In an effort to assess the CRE burden in Virginia, as well as to learn more about the laboratory testing and infection prevention practices associated with CRE infections and colonizations, VDH and partner organizations DCLS (Division of Consolidated Laboratory Services) and APIC-VA (Association for Professionals in Infection Control and Epidemiology, Virginia chapter) developed two surveys, distributing one to all laboratories and the other to hospital infection preventionists (IPs) in the state. Questions for the IP survey were adapted from CDC's 2012 CRE Toolkit.[2] The lab survey (Appendix A) was distributed electronically to DCLS's sentinel labs and the IP survey (Appendix B) was distributed electronically to IPs at 95 Virginia hospitals. Only one response was submitted per laboratory or hospital, unless the facility had both an acute care and long-term acute care hospital, in which case separate responses were requested for each hospital setting. The lab survey was open for three weeks from June 17, 2013 to July 5, 2013 and the IP survey was open for four weeks from October 7, 2013 through November 1, 2013.

[1] Centers for Disease Control and Prevention. (2013). Antibiotic Resistant Threats in the United States, 2013. Available at http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf.

[2] Centers for Disease Control and Prevention. (2012). Guidance for Control of Carbapenem-Resistant Enterobacteriaceae (CRE) – 2012 CRE Toolkit. Available at http://www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf.

Laboratory Survey Results

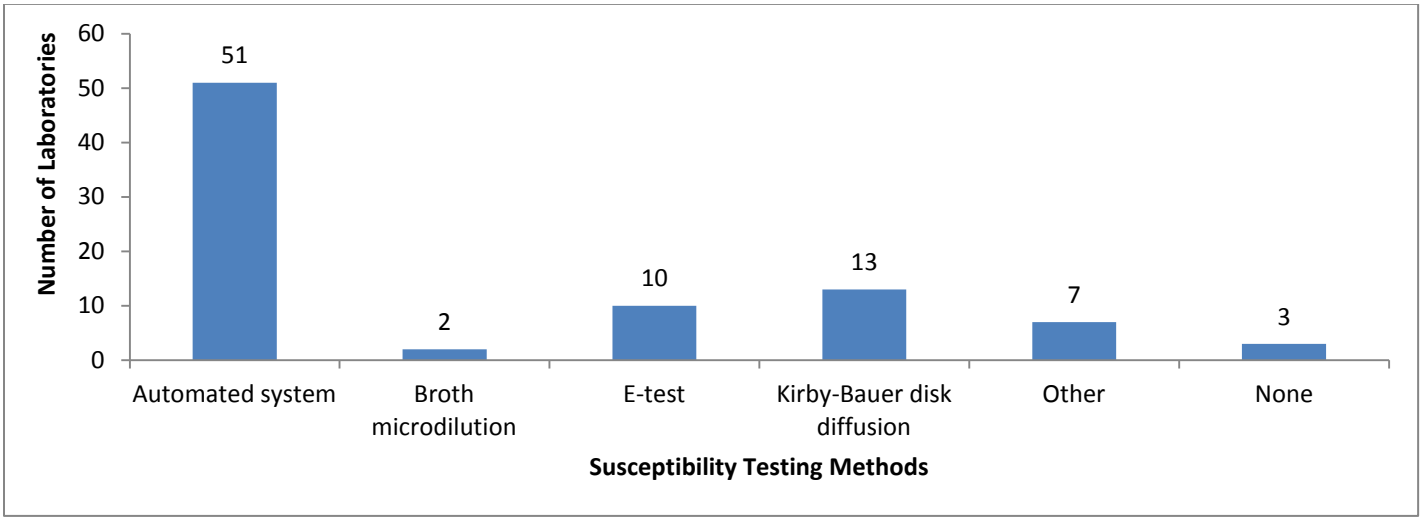
1. Demographic Information

Responses were received from all 58 laboratories sent the survey (100% response rate). Forty-nine (84%) were hospital laboratories, four (7%) were independent private laboratories, and five (9%) were categorized as "other" laboratories, such as outpatient laboratories and a tissue bank laboratory. All but one laboratory reported that they conduct antimicrobial susceptibility testing for gram-negative bacilli. The one laboratory that did not conduct this kind of testing indicated: "It is not necessary for our purpose, we don't treat patients."

2. Laboratory Testing Capacity

Laboratories were asked to report the methods they or their reference laboratory used when testing a suspected CRE specimen. The majority of labs (88%, n=51) reported using an automated testing system, with Vitek 2 and Microscan identified as the two most common systems used (Figure 1).

Figure 1: Carbapenem susceptibility testing methods used by laboratory/reference laboratory for suspected CRE*



* Respondents could select more than one answer

When conducting Enterobacteriaceae susceptibility testing, 70% (n=41) of laboratories normally used meropenem for testing carbapenem resistance, followed by ertapenem and imipenem at 57% and 55% respectively (Figure 2a). Only one laboratory reported normally using doripenem when testing for carbapenem resistance. With respect to other antibiotics used for Enterobacteriaceae susceptibility testing, the majority of laboratories reported normally using ceftriaxone (72%, n=42) in addition to several other third-generation cephalosporins (Figure 2b). Other cephalosporins used for testing included cefazolin (first-generation) and cefepime (fourth-generation).

Figure 2a: Carbapenems normally used for Enterobacteriaceae susceptibility testing*

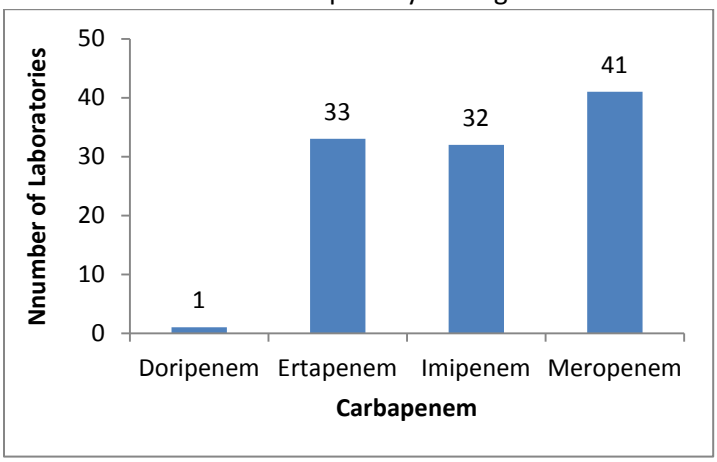
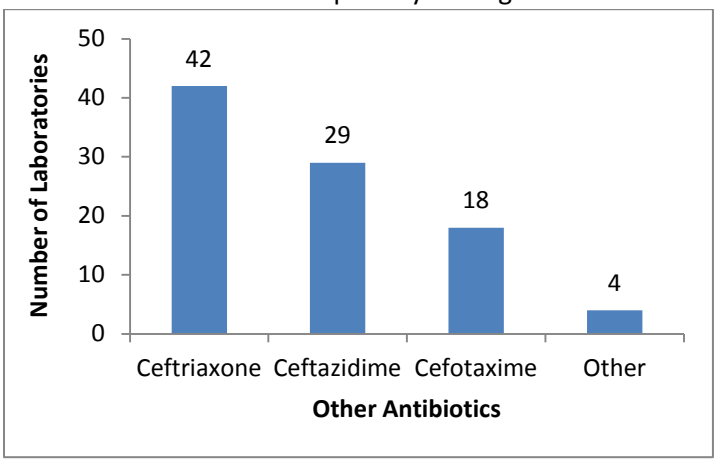


Figure 2b: Other antibiotics normally used for Enterobacteriaceae susceptibility testing*



* Respondents could select more than one answer

Laboratories were asked to define the susceptibility breakpoints they or their reference laboratory use when testing for carbapenem resistance (Table 1). Only seven laboratories (14%) reported using breakpoints that match the current Clinical Laboratory Standards Institute (CLSI) breakpoints for all the carbapenems they test with (assessed by using ≤0.25 mcg/ml as a proxy for the ≤0.5 mcg/ml CLSI breakpoint recommendation for ertapenem).

Table 1: Carbapenem susceptibility breakpoints used by laboratory/reference laboratory when testing Enterobacteriaceae

Carbapenem	Minimum Inhibitory Concentration Breakpoint				
	≤0.25 mcg/ml	≤1 mcg/ml	≤2 mcg/ml	≤4 mcg/ml	Do not test
Imipenem	4	10*	10	15	12
Meropenem	6	14*	8	13	10
Ertapenem	4**	16	17	1	13
Doripenem	1	2*	3	0	45
Total	15	42	38	29	80

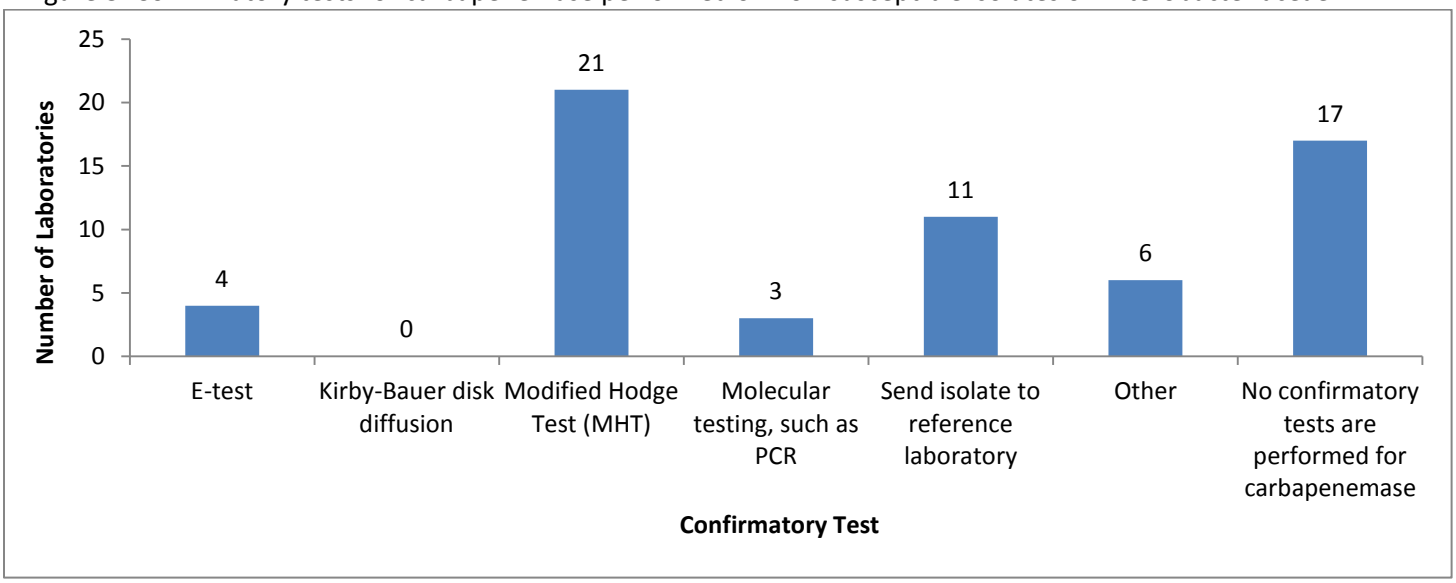
* Current CLSI breakpoints at the time of survey administration (CLSI M100-S23)[3]

** The CLSI M100-S23 breakpoint for ertapenem is ≤0.5 mcg/ml, which was not specifically asked in this survey. Instead, ≤0.25 mcg/ml was analyzed as a proxy for ≤0.5 mcg/ml.

Laboratories were then asked to specify which confirmatory tests for carbapenemase were performed on non-susceptible Enterobacteriaceae isolates (Figure 3). Twenty-one laboratories (36%) used the Modified Hodge Test while 11 laboratories (19%) send their CRE isolates to a reference laboratory for confirmatory testing. Seventeen laboratories (29%) indicated that no carbapenemase confirmatory tests are performed for their CRE isolates, three of which use the current CLSI breakpoints for the carbapenems they test with and therefore do not need to run confirmatory tests. Only three laboratories (5%) indicated they performed molecular testing such as PCR to confirm carbapenemase production. Other confirmatory testing methods mentioned were indirect carbapenemase, repeat Microscan if the isolate was resistant to all antibiotics, and using the ATCC® 700603 *K. pneumoniae* strain in Microscan. Two laboratories specified they were currently validating the CHROMagar method.

[3] Clinical Laboratory Standards Institute. (2013). M100-S23: Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Third Informational Supplement.

Figure 3: Confirmatory tests for carbapenemase performed on non-susceptible isolates of Enterobacteriaceae*



* Respondents could select more than one answer

3. Information Management

Laboratories described some of the capabilities of their information management systems in regards to pulling records with carbapenem resistant information for three specific organisms: *Enterobacter* spp., *E. coli*, or *Klebsiella* spp (Table 2). More laboratories reported having the ability to pull an organism's sensitive-intermediate-resistant (S-I-R) interpretations from their information management systems than having the ability to pull organisms flagged as carbapenem non-susceptible. Eleven laboratories (19%) reported their information management systems were not able to pull records based on being flagged as carbapenem non-susceptible, the MICs recorded, or SIR interpretations recorded.

Table 2: Ability of the laboratories' information management systems to pull records for *Enterobacter* spp., *E. coli*, and *Klebsiella* spp.*

Organism	Carbapenem non-susceptible organisms are flagged	Minimum Inhibitory Concentrations (MICs) are recorded	Sensitive-Intermediate-Resistant (SIR) interpretations are recorded	System cannot do any of these functions
Enterobacter spp.	25	29	35	11
E. coli	26	29	34	11
Klebsiella spp.	27	28	34	11

* Respondents could select more than one answer for each organism

Laboratories also indicated whether their information management systems could be queried to provide a list of cultures based on specific query groups (Table 3). The majority of laboratories were able to query their systems for cultures based on species, specimen type, and S-I-R interpretation.

Table 3: Ability of the laboratory management system to be queried for cultures for any of the following groups (n=54)

Query Group	Yes	No	Don't Know
"Flagged" carbapenem non-susceptible organisms	23	22	9
MIC	23	16	15
S-I-R	33	11	10
Species	39	9	7
Specimen type (e.g., blood, urine, etc.)	38	9	7

4. CRE Incidence

Using the most current full year of data available, laboratories were asked to approximate how many individual patients with CRE they identified (not counting duplicate isolates from the same patient). The largest proportion of laboratories (26%, n=15) reported identifying 1-3 individual patients (Figure 4). All laboratories that answered the question used data from 2012, except for one laboratory that did not specify the year its data came from.

Again using their most current full year of data, laboratories were asked to report the percentage of CRE isolates identified as *Klebsiella* spp., *Enterobacter* spp., or *Escherichia coli*. Responses ranged from 0-100%, with the largest proportion of laboratories (38%, n=22) indicating that 100% of their isolates have been identified as one of these three organism options (Figure 5).

Figure 4: Number of individual patients with CRE identified by laboratories in their most current full year of data

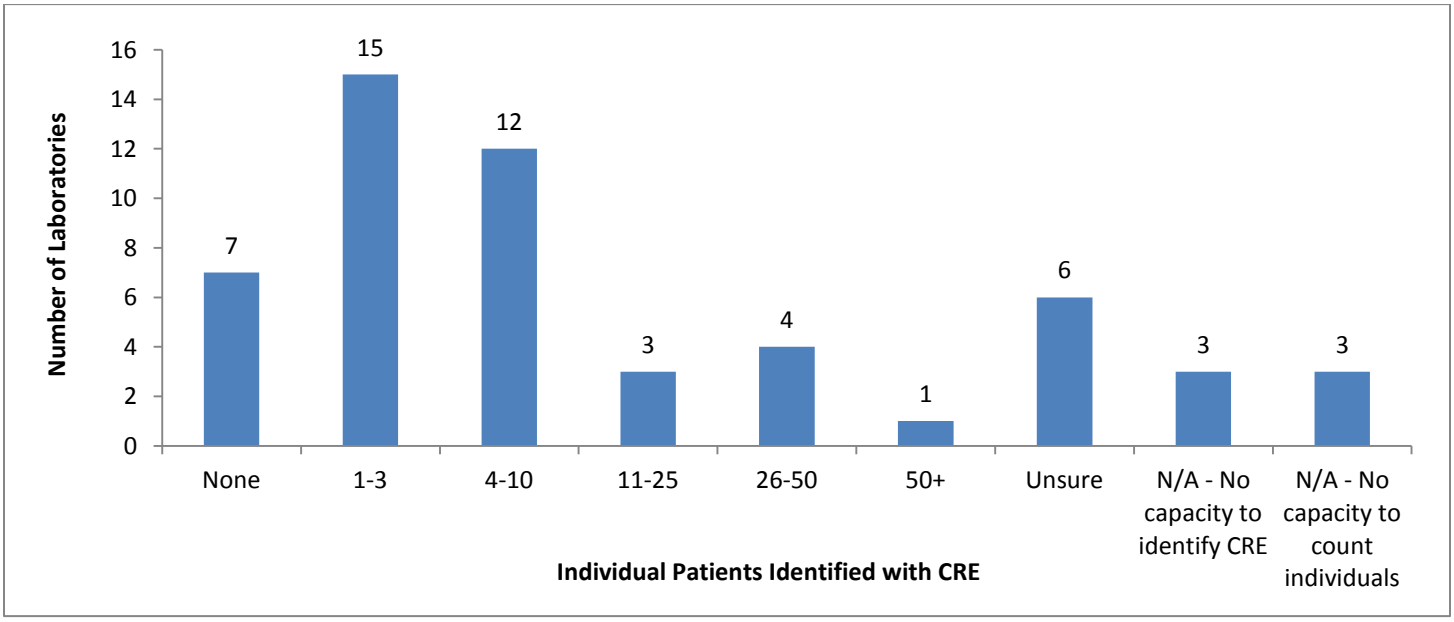
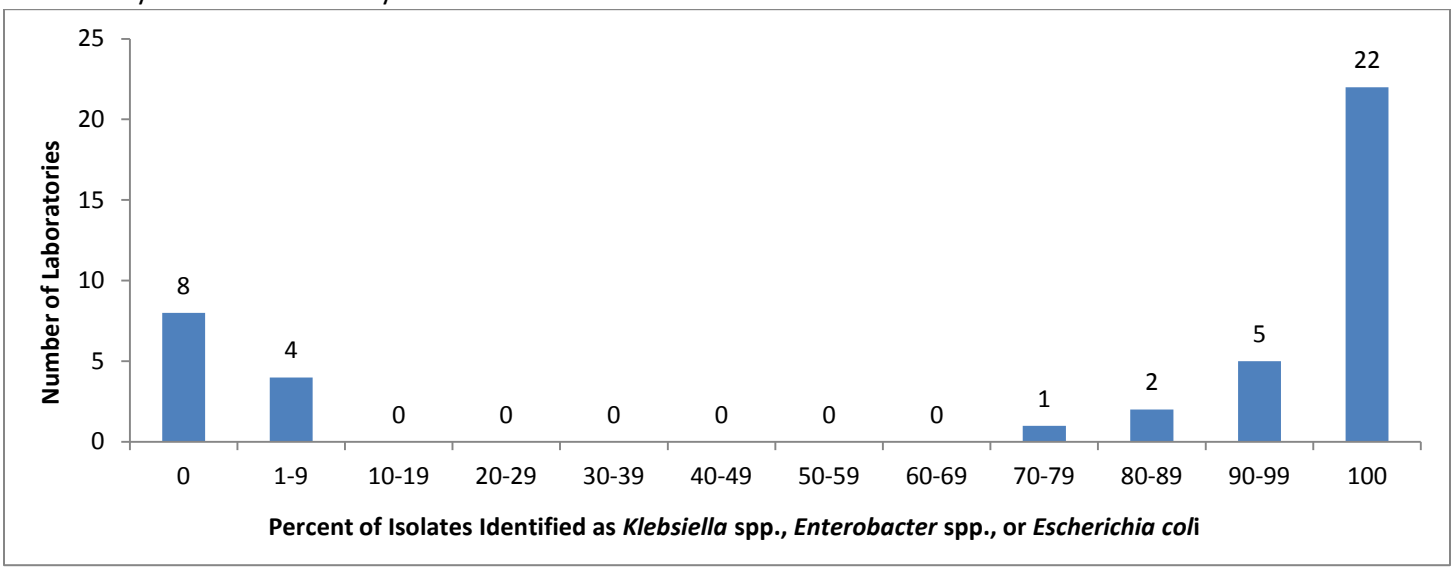


Figure 5: Percentage of CRE isolates identified as *Klebsiella* spp., *Enterobacter* spp., or *Escherichia coli* using laboratory's most current full year of data



5. Methods Validation

Ten laboratories (17%) reported previously validating their methods for detecting carbapenem-resistant or carbapenemase-producing *Klebsiella* spp. and *Escherichia coli* from rectal swabs, as outlined by CDC protocol.[4] The majority of labs (71%, n=41) had not validated their methods and 7 (12%) responses were missing.

Overall, 27 labs (47%) reported they would be able to implement CDC's validation methods in an outbreak situation. Among the ten laboratories that had previously validated their methods, nine said they could implement them in an outbreak situation. Of the 41 labs that had not previously validated their methods, 18 reported they would be able to implement CDC's validation methods in an outbreak situation, and 14 did not know if they could implement them.

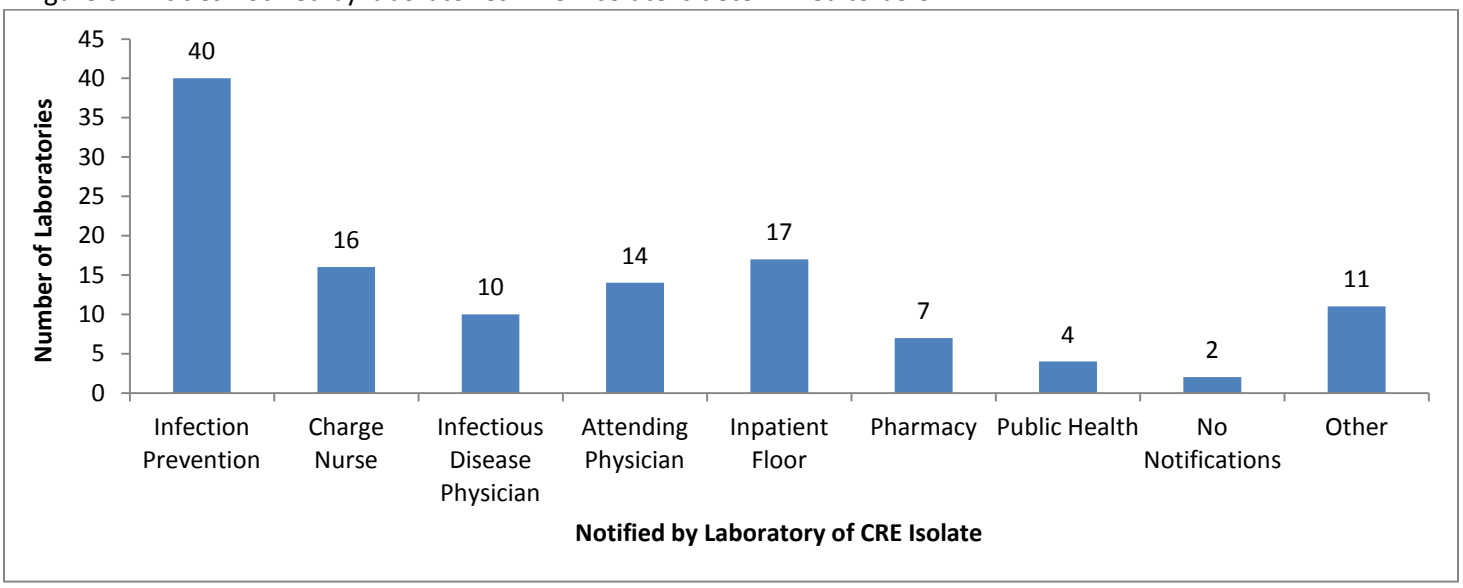
6. Results Notification

Laboratories were asked about the language they used to communicate CRE results on a lab report. They reported a variety of ways in which results were communicated, such as including a comment that explicitly mentions CRE, listing the susceptibility results (MIC, S-I-R, etc.), creating a critical notification to Infection Prevention, or including a comment indicating the result was a multidrug-resistant organism or extended-spectrum beta-lactamase (ESBL) producer without specifically stating CRE. A few laboratories also included isolation precaution language within their CRE comments.

When a CRE isolate is identified, the majority (69%, n=40) of laboratories indicated they notify Infection Prevention (Figure 6). Other most commonly notified entities included the inpatient floor (29%), the charge nurse (28%), and the attending physician (24%). Other entities specified by the laboratories included outpatient physicians, nursing homes, and the facility's antibiotic steward.

[4] Centers for Disease Control and Prevention. (2009). Laboratory Protocol for Detection of Carbapenem-Resistant or Carbapenemase-Producing, *Klebsiella* spp. and *E. coli* from Rectal Swabs. Available at http://www.cdc.gov/hai/pdfs/labsettings/klebsiella_or_ecoli.pdf.

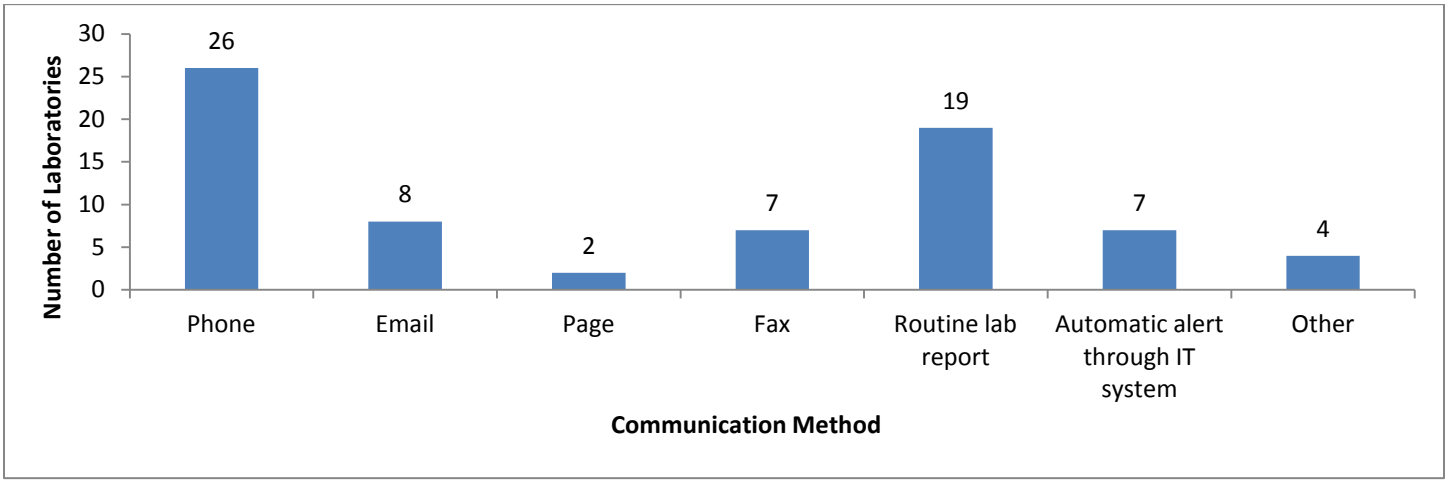
Figure 6: Entities notified by laboratories when isolate is determined to be CRE*



* Respondents could select more than one answer

Among the 40 laboratories that notify Infection Prevention when a CRE isolate is confirmed, the majority (65%, n=26) reported that they communicate the results via telephone (Figure 7). CRE results are also commonly communicated via a routine lab report (33%, n=19). Some other communication methods described were printing the CRE lab results directly to Infection Prevention's printer or combining selected culture results into a single daily report.

Figure 7: Communication methods used to notify Infection Prevention when CRE isolate is confirmed (n=40)*



* Respondents could select more than one answer

If CRE is suspected, such as when a preliminary culture indicates a possible CRE but the isolate has yet to be lab-confirmed, the same 40 laboratories were asked whether they notified Infection Prevention of the isolate's suspected CRE status. Seventeen laboratories (43%) reported they *always* report suspected CRE results to Infection Prevention while 12 laboratories (30%) reported they *sometimes* do. Some of the situations specified by those laboratories that would sometimes notify Infection Prevention were if the patient is newly identified or not already on isolation, for certain hospital locations, or if the specimen came from a sterile body site.

7. Comments

Laboratories were given the opportunity to leave general comments about CRE at the end of the survey. One of the themes that emerged from these comments was concerns over the current testing practices for CRE. Some laboratories

mentioned the difficulty with testing for CRE because they were waiting for the Food and Drug Administration (FDA) to approve the new CLSI breakpoints and alternative molecular confirmation methods. Additionally, several laboratories indicated they were in the process of implementing and validating new testing methods or lab information management systems. Finally, a few laboratories asked for more information about CRE, specifically resource articles that could be used for staff education.

Hospital Infection Preventionist Survey Results

1. Demographic Information

Infection preventionists from 46 facilities responded to the survey (response rate=48%). These respondents had a similar distribution for hospital type and region as the original 95 facilities sent the survey (Tables 4 and 5). The average bed size for respondents was 210 (standard deviation=154.5, range=25-800) and the largest proportion of facilities (46%) had between 100-199 beds. The average number of IP full-time equivalents (FTEs) per facility was 1.53 (range=0.5-8.5) and the average number of hospital beds per IP FTE was 142.6 (range=34-386).

Table 4: Distribution of hospital type for respondents compared to all facilities sent the survey

Hospital Type	Respondents		Surveyed Facilities	
	Number	Percent	Number	Percent
Acute Care	41	89.0	76	80.0
Children's	1	2.2	3	3.1
Critical Access	2	4.4	7	7.4
Long-Term Acute Care	2	4.4	5	5.3
Military	0	0	4	4.2
Total	46	100	95	100

Table 5: Distribution of health planning region for respondents compared to all facilities sent the survey

Health Planning Region	Respondents		Surveyed Facilities	
	Number	Percent	Number	Percent
Northern	4	8.7	9	9.5
Northwest	7	15.2	15	15.8
Eastern	8	17.4	24	25.3
Central	10	21.7	19	20.0
Southwest	17	37.0	28	29.5
Total	46	100	95	100

2. CRE Incidence

In general, approximately 59% of facilities had previously identified CRE infections or colonizations from clinical cultures collected from patients (n=27). In the Northern, Eastern, and Central regions, the majority of facilities had identified CRE in the past, while in the Northwest and Southwest regions, more facilities had never identified CRE (Figure 8). Of particular note, all eight responding facilities from the Eastern region reported previously identifying CRE. Of the facilities that previously identified CRE, the highest proportion (44%) said they identified CRE cultures 2-10 times/year, followed by less frequently than yearly (19%) (Figure 9).

The responding children's hospital and two critical access hospitals both indicated that CRE has never been identified in their facility. Among the two long-term acute care facilities that responded, one indicated that CRE were identified on a monthly basis and the other identified CRE 2-10 times per year.

Figure 8: Facilities that have ever identified CRE infections or colonizations from clinical cultures, by VDH health planning region

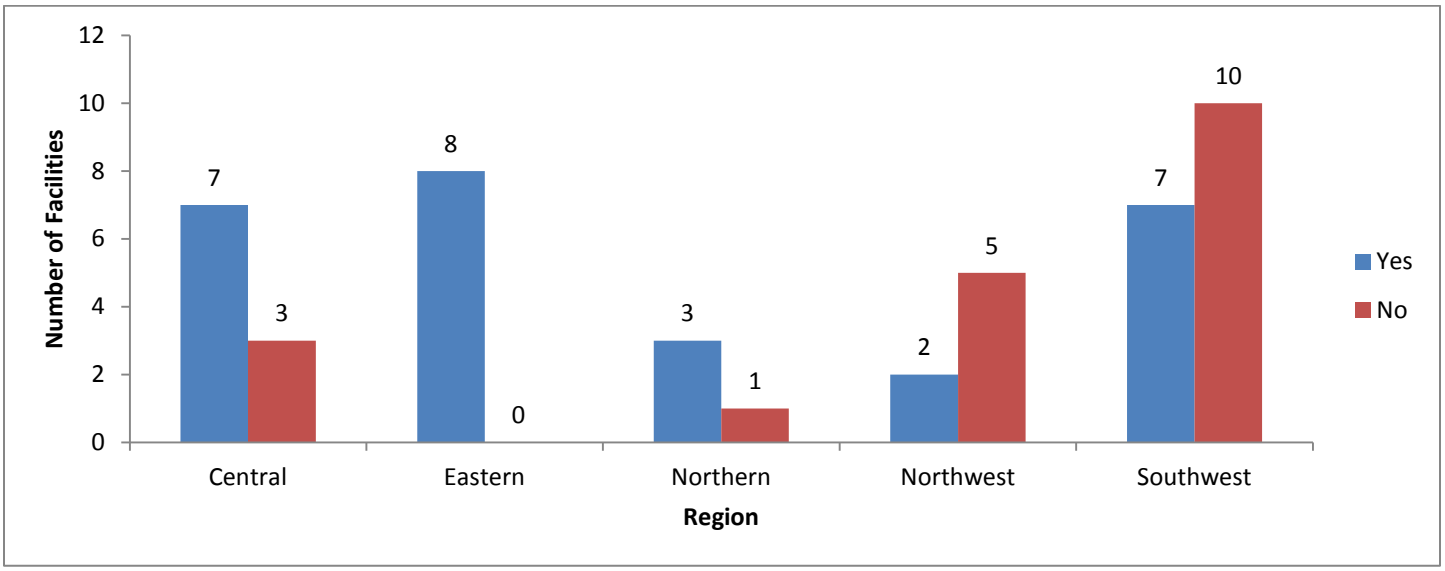
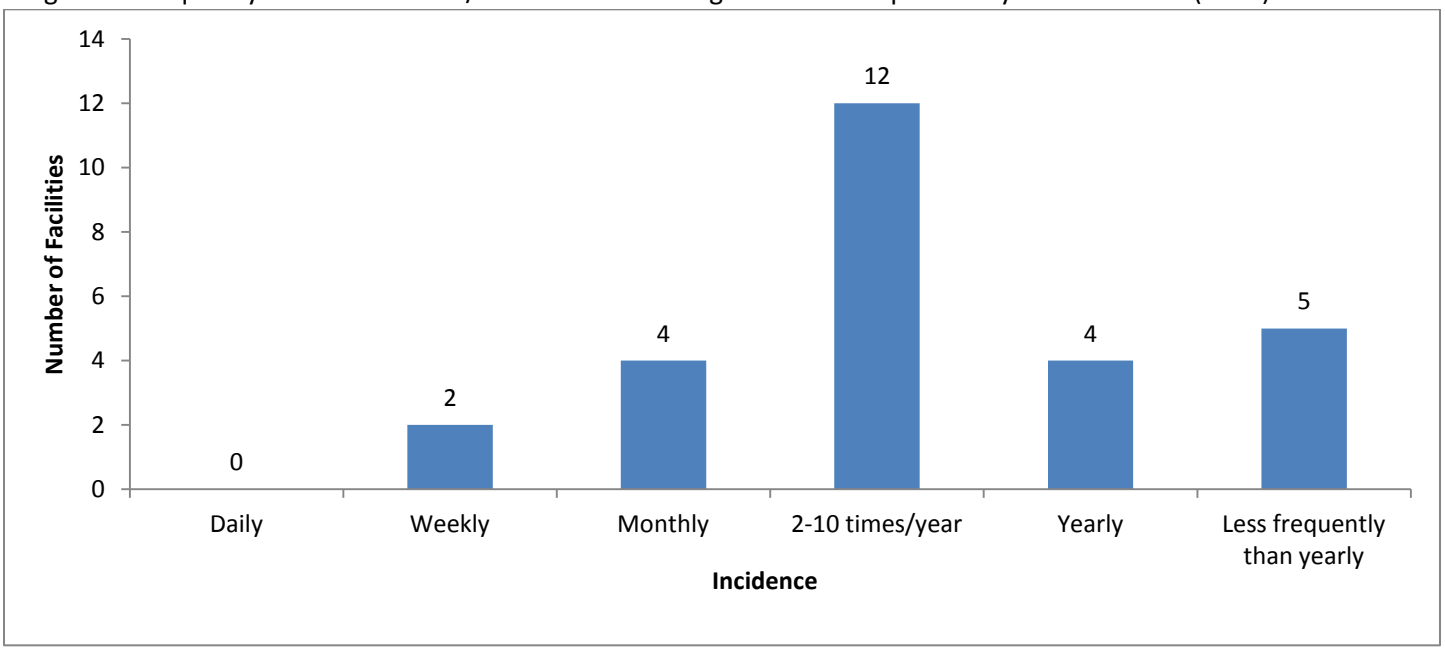
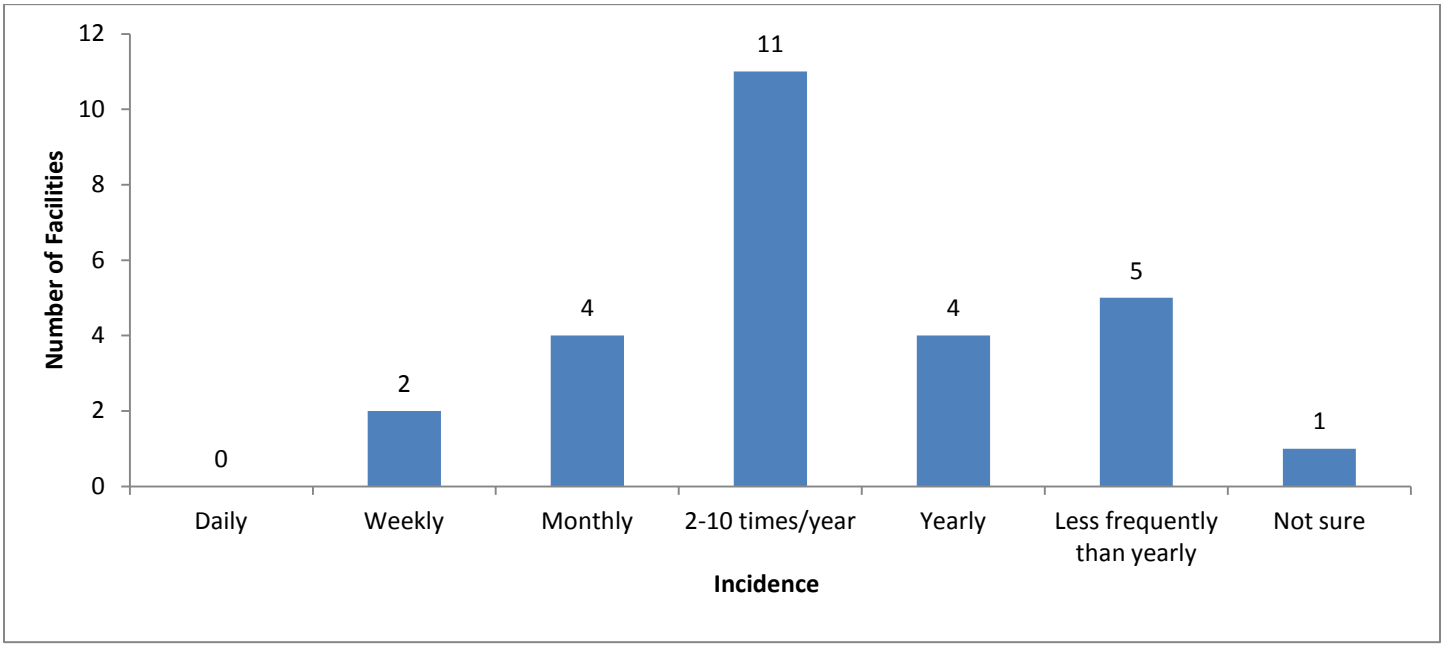


Figure 9: Frequency of CRE infections/colonizations among facilities that previously identified CRE (n=27)



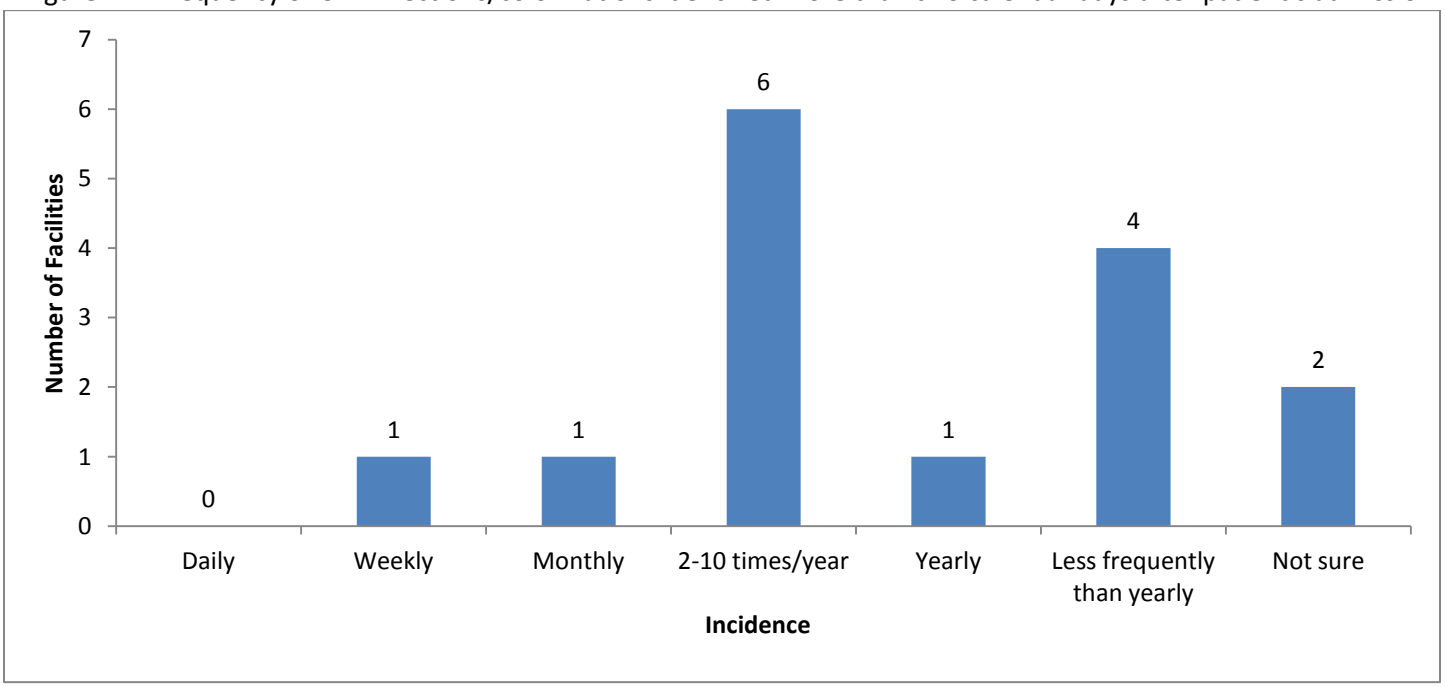
Among the facilities that previously identified CRE, 26 had identified at least one infection/colonization from clinical cultures collected before or within two calendar days of the patient's admission, indicating that the infections/colonizations originated from a previous exposure to a healthcare setting or the community. Facilities most frequently reported identifying these transfer/community cases 2-10 times per year (n=11, 42%), followed by five facilities (19%) that identified them less frequently than yearly (Figure 10).

Figure 10: Frequency of CRE infections/colonizations identified before or within two calendar days of patient's admission



Among the facilities that had previously identified CRE, 12 (44%) had never identified a CRE infection/colonization from clinical cultures collected more than two calendar days after the patient's admission; about half of facilities (48%, n=13) have identified a hospital-associated case. Of these 13 facilities, the highest proportion identified hospital-associated cases 2-10 times per year (46%), followed by less frequently than yearly (31%) (Figure 11).

Figure 11: Frequency of CRE infections/colonizations identified more than two calendar days after patient's admission

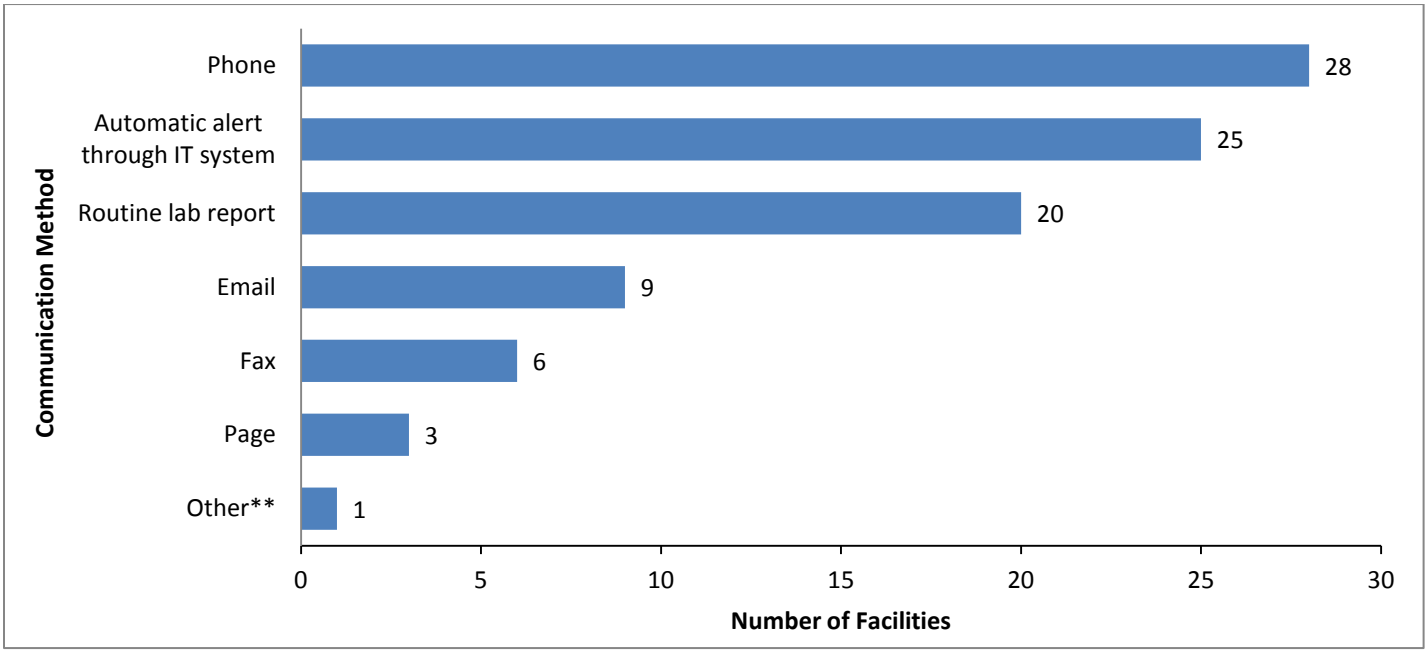


3. Laboratory Testing and Communication

For 20 responding facilities, the microbiology laboratory that performs the CRE testing was physically located on the facility's campus while another 20 facilities used a laboratory that was associated with the hospital/healthcare system but not physically on campus. Of the remaining six facilities, four used an outside private/reference laboratory for CRE testing, one used another laboratory that was not specified, and one answer was missing.

The majority of facilities (87%, n=40) reported having an established system in place for the lab to alert infection prevention staff in a timely manner whenever a CRE isolate is identified, 36 (78%) of which are notified within 24 hours. IPs reported that their preferred methods of communication from the lab regarding a CRE result were by phone (61%), an automatic alert through an information technology (IT) system (54%), or a routine lab report (44%) (Figure 12).

Figure 12: Preferred communication methods for laboratory to report CRE results to infection prevention*



* Respondents could select more than one answer

**Other specified: "Lab prints all positive cultures to my printer"

IPs were asked whether CRE lab results are communicated to Infection Prevention differently on a weekend or holiday when the regular IP staff are out of the office, of which 37% (n=17) responded affirmatively.

IPs were then asked whether CRE lab results are communicated any differently than other multidrug-resistant organisms (MDROs) in terms of communication methods and timeliness, of which 22% (n=10) responded affirmatively. Six of these IPs indicated that, unlike other MDROs, the lab directly calls infection prevention staff upon identifying a positive CRE result. Some other communication differences were:

- "In addition to nursing unit being notified, we [Infection Prevention] are notified at the time of the [results] as a critical value."
- "MRSA [methicillin-resistant *Staphylococcus aureus*], VRE [vancomycin-resistant Enterococcus] & *C. diff* [*Clostridium difficile*] are called. CRE has language added to results report."
- "Some MDRO results are called to the patient care unit."

Additionally, IPs were asked if the way the laboratory communicates CRE results on a laboratory report allows Infection Prevention to know it is CRE in a timely manner so appropriate action can be taken. Approximately 41%, (n=19) said Yes and 43% (n=20) said they did not know because the facility has never had a case of CRE. For those who selected No (13%, n=6), two provided suggestions on how the CRE results on a lab report could be communicated more quickly or effectively:

- "Make CRE a critical [value] that needs to be called to the nurse."
- "Call [directly] to IP."

Note: One facility selected "unknown, facility has never identified a CRE case" even though they previously recorded identifying CRE 2-10 times per year. It is possible this respondent did not know the answer to this question and selected "unknown" even though the facility had previously identified a CRE case.

4. Record Review, Point Prevalence Surveys, and Active Surveillance Testing

Fifteen facilities (33%) reported conducting a **microbiology record review** over a given time period, such as six or 12 months, to detect previously unrecognized or unreported CRE cases. Of those 15, six facilities (40%) did identify previously unrecognized or unreported CRE cases from this record review.

Facilities were also asked if they had ever conducted a **point prevalence survey**, defined as a single round of active surveillance cultures, for CRE in high-risk units such as intensive care, long-term acute care, units where previously unrecognized cases were identified, or units with high antimicrobial use. Five facilities (11%) indicated they had conducted a point prevalence survey, and two of those facilities did not identify any unrecognized CRE from their survey. The remaining three facilities did not answer whether they identified unrecognized cases.

There were six facilities (13%) that had previously conducted **active surveillance testing** for patients admitted to high-risk settings (e.g., ICUs) or patients with known risk factors (e.g., patients admitted from high-risk settings or transferred from an area or facility with high prevalence of CRE). Of those six facilities, two-thirds (n=4) *always* place a patient under preemptive contact precautions pending the results of the active surveillance testing.

If a case of CRE is identified, facilities were asked whether they conduct **testing of patients with epidemiologic links to the CRE case**, such as patients in the same unit or those who were provided care by the same healthcare personnel. Twenty-nine facilities (63%) had never encountered this situation so did not have an answer and 15 facilities (33%) said they did not test patients with epidemiologic links. Only two facilities (4%) said they always test epidemiologic links and no facilities said they sometimes do.

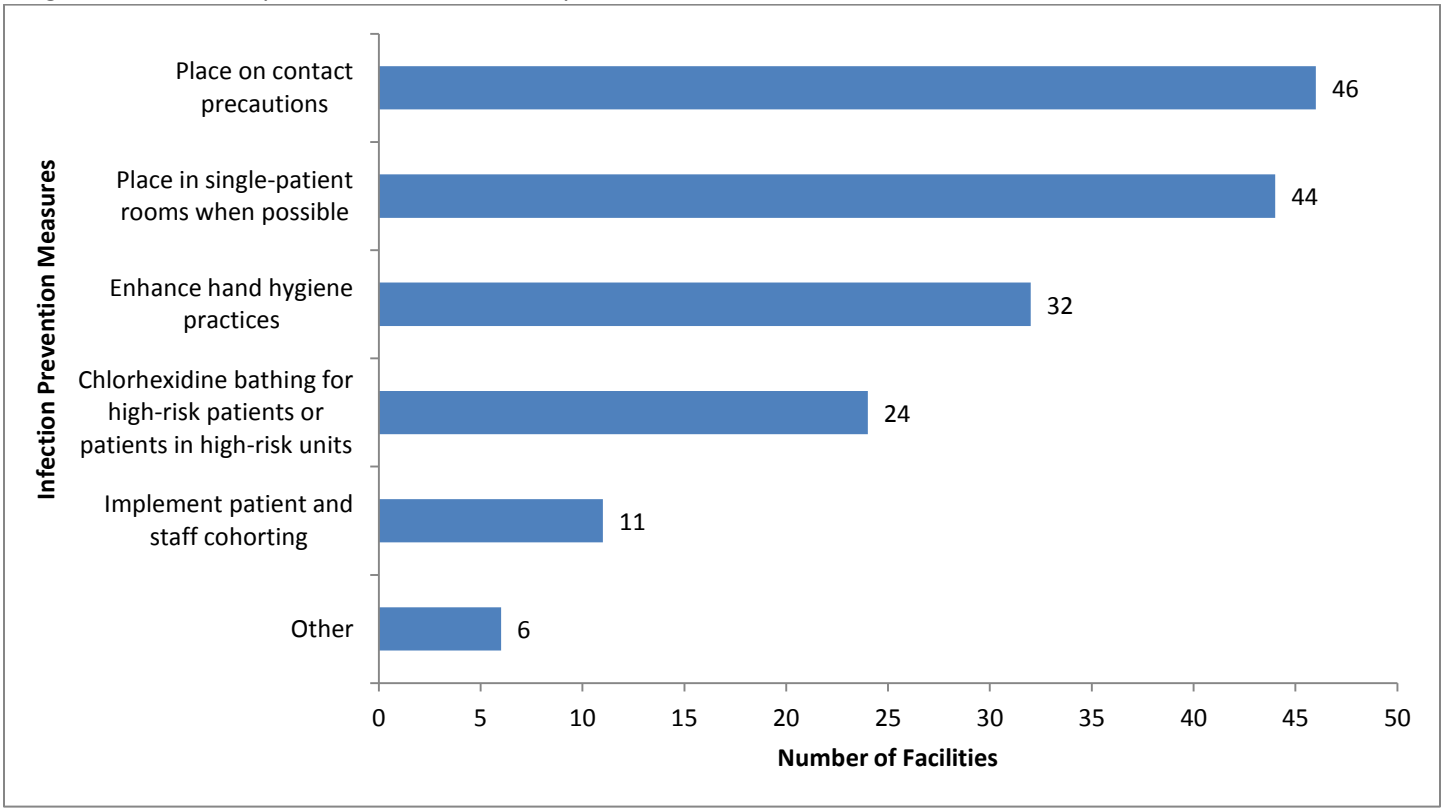
5. CRE Infection Prevention Measures

Facilities were asked which infection prevention measures they would implement if a patient was identified to be **infected** with CRE. All 46 facilities said they would place the patient on contact precautions and 44 facilities (96%) would place the patient in a single-patient room when possible (Figure 13). Approximately one-fourth (24%, n=11) would implement patient and staff cohorting. Some other infection prevention measures specified were clean with bleach and provide staff education at the unit level. One facility indicated that they only do staff cohorting in an outbreak situation.

The majority of facilities (52%, n=23) indicated they would keep a patient with CRE infection on contact precautions *indefinitely* and fourteen facilities (32%) noted they would keep the infected patient on contact precautions only for the duration of his/her current hospital stay (Figure 14). Two facilities specified other lengths of time:

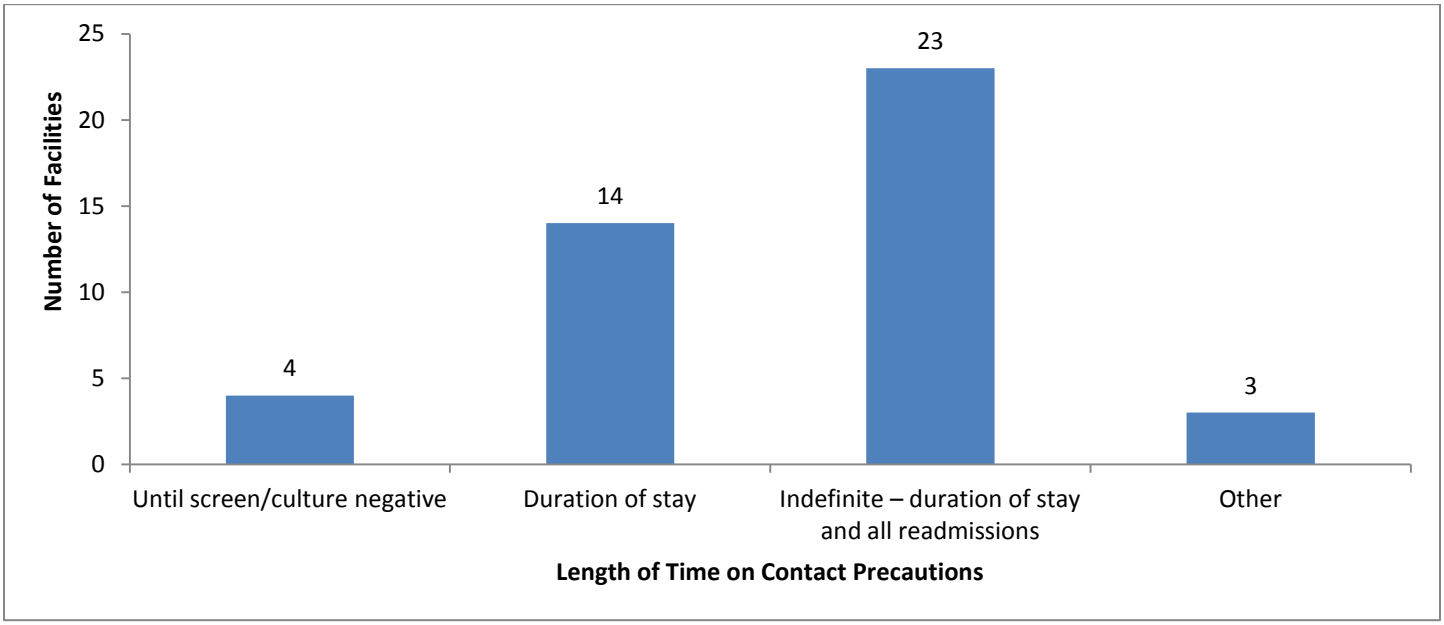
- "Until screen culture negative on two [separate] admissions."
- "Depends on length of stay. If off [antibiotics] >72 hours and no other signs/symptoms [of] infectious process then reculture infected site and perirectal [area] for colonization."

Figure 13: Infection prevention measures for patients identified to be **infected** with CRE*



* Respondents could select more than one answer

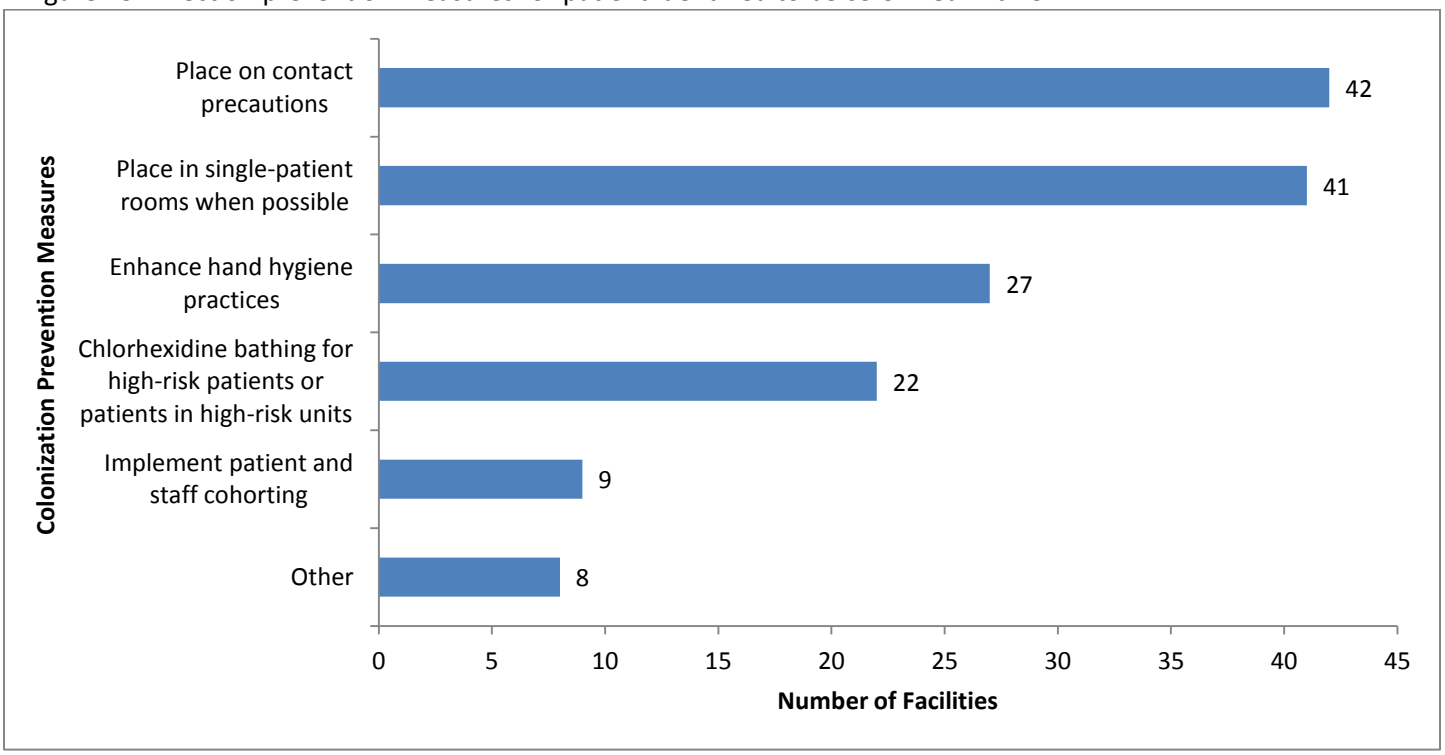
Figure 14: Length of time a patient with CRE **infection** is placed on contact precautions (n=46)*



*Two responses missing

Facilities were then asked which infection prevention measures they would implement if a patient was identified to be **colonized** with CRE. Nearly all (91%, n=42) said they would place the colonized patient on contact precautions and 41 facilities (89%) would place the patient in a single-patient room when possible (Figure 15). One facility clarified that their staff do not culture outpatients with CRE colonization and another facility stated their staff do the same prevention measures for CRE-colonized patients as they would for a CRE-infected patient.

Figure 15: Infection prevention measures for patient identified to be **colonized** with CRE*

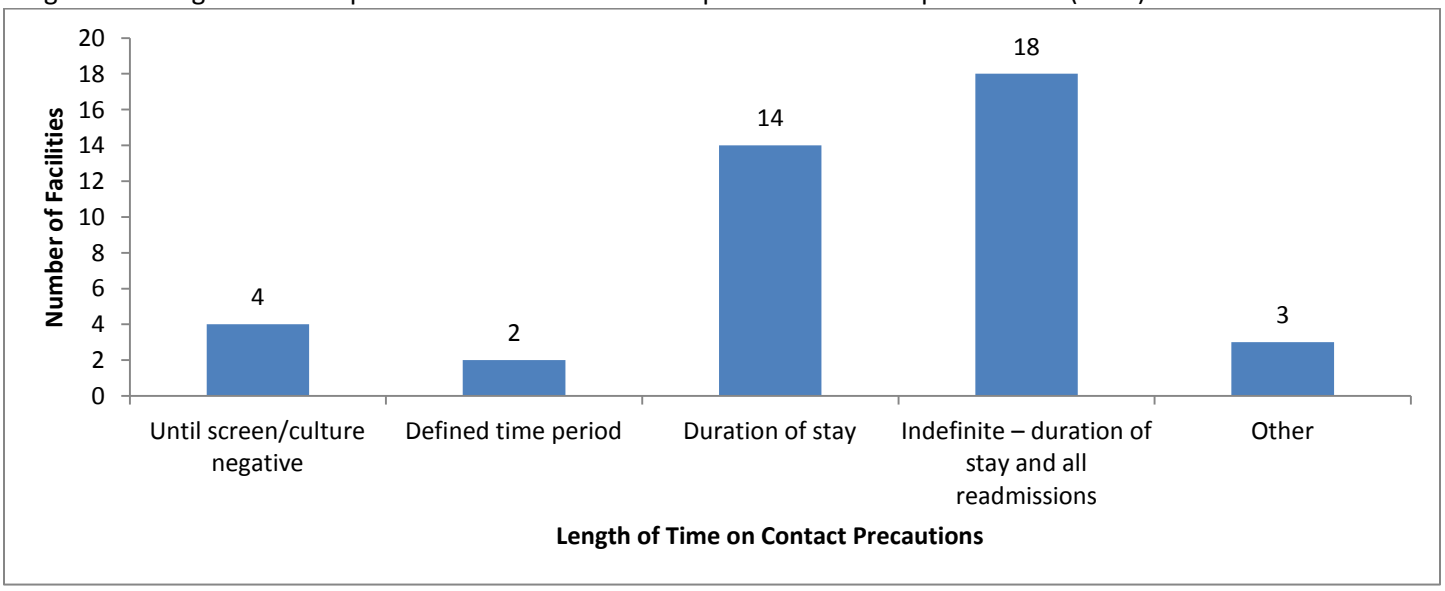


* Respondents could select more than one answer

Among facilities that said they would place a patient colonized with CRE on contact precautions (n=42), the most common duration of contact precautions (44%, n=18) was *indefinitely*, defined as the duration of stay and all readmissions while fourteen facilities (34%) indicated they would keep the colonized patient on contact precautions only for the duration of his/her current hospital stay (Figure 16). Two facilities specified the same "Other" lengths of time they mentioned above when handling a CRE-infected patient:

- "Until screen culture negative on two [separate] admissions."
- "Depends on length of stay. If off [antibiotics] >72 hours and no other signs/symptoms infectious process then reculture infected site and perirectal [area] for colonization."

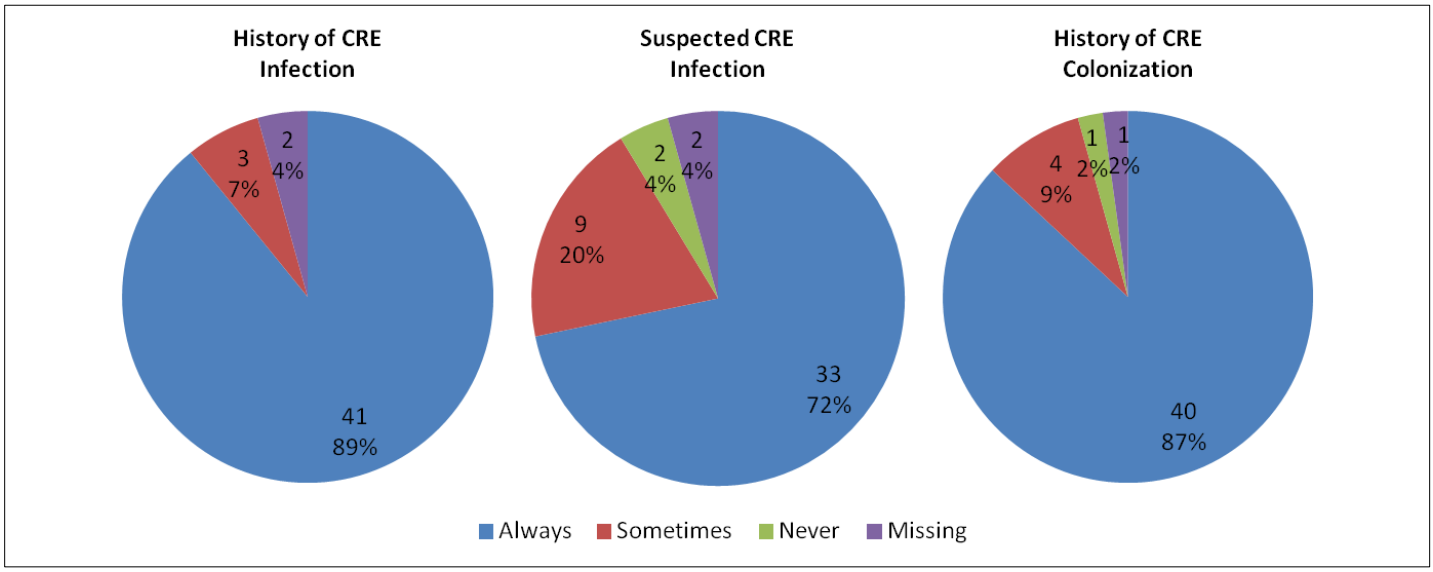
Figure 16: Length of time a patient **colonized** with CRE is placed on contact precautions (n=42)*



* One response missing

Most facilities (89%, n=41) would *always* place a patient with a **history of CRE infection** on contact precautions as well as a patient with a **history of CRE colonization** (87%, n=40) (Figure 17). Less than three-quarters of responding facilities (72%, n=33) would always place a patient with a **suspected CRE infection** on contact precautions.

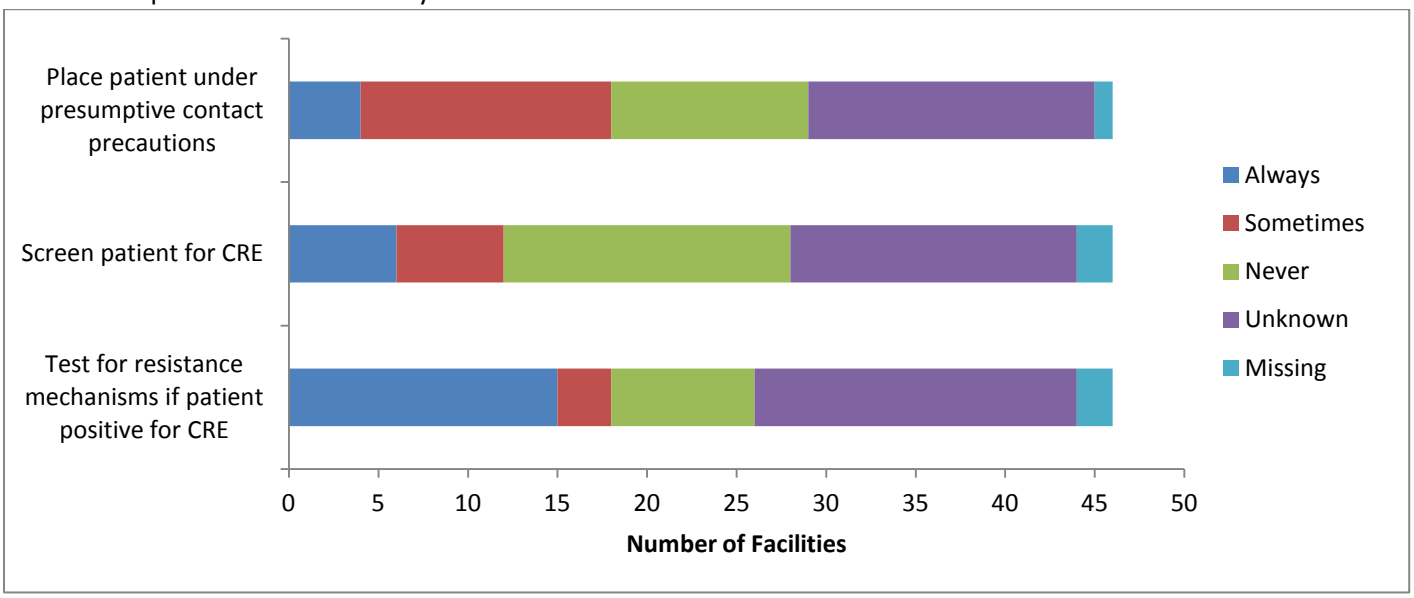
Figure 17: Frequency with which a facility would place patients on contact precautions, given history or suspicion of CRE infection or colonization



More than half of responding facilities (59%, n=27) indicate they *always* collect information about an inpatient's history of recent hospitalization in a county outside of the United States, while 11 facilities (24%) said they *sometimes* collect that information. The facilities that did not or only sometimes collected information about recent hospitalizations in a foreign country (n=17) were asked to identify any barriers or reasons that prevent them from routinely collecting this information. Five facilities (29%) noted that the question was not part of their standardized admission questionnaire, while four facilities (24%) claimed they only asked certain patients based on their demographics and whether it was likely they would travel abroad. The few remaining reasons related to staff not remembering to ask the question and that the information was difficult to obtain, either because it is difficult to find in patient notes when the patient is transferred to the facility or that patients are not the best historians.

Responding facilities were asked how often they implemented certain infection prevention measures if a patient does report a history of recent hospitalization in a country outside the United States (Figure 18). Eighteen facilities (39%) said they *always or sometimes* place the patient on presumptive contact precautions and only 12 facilities (26%) said they *always or sometimes* screen the patient for CRE. Approximately one in three (33%, n=15) said they *always* test for resistance mechanism if a patient meeting this criterion is positive for CRE.

Figure 18: Frequency with which certain infection prevention measures are implemented if patient reports history of recent hospitalization in a country outside the United States



6. Communication of CRE Infection/Colonization Status

IPs were asked how their facility communicates the status of a patient who is known to be colonized or infected with CRE when **transferring** that patient to another facility (Figure 19a). Forty-one facilities (89%) reported that they *always* communicate the patient's CRE status to the receiving facility, while four facilities (9%) said they *sometimes* do. Only one facility reported not communicating the patient's CRE status when transferring the patient to a different facility. Then IPs were asked how a patient's CRE status is communicated when their facility is **receiving** the patient from another facility (Figure 19b). Only five facilities (11%) said the transferring facilities *always* communicate the patient's CRE status, while 31 facilities (67%) indicated the transferring facilities *sometimes* communicate the patient's CRE status. Five facilities (11%) said transferring facilities *never* communicate a patient's CRE status.

Figure 19a: Frequency with which a facility communicates a patient's CRE status when **transferring** to another facility

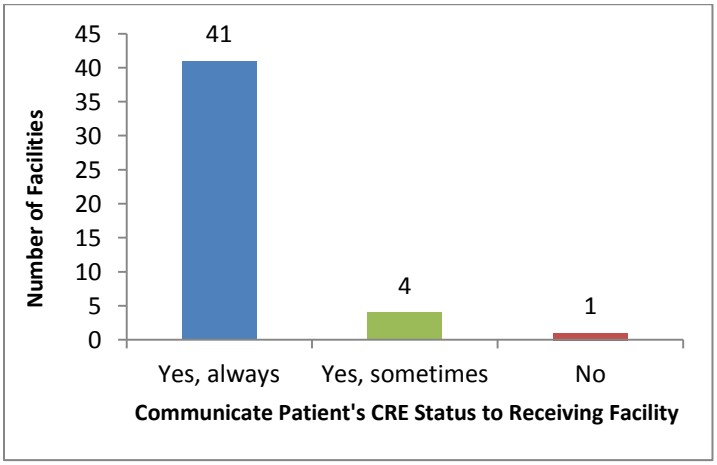
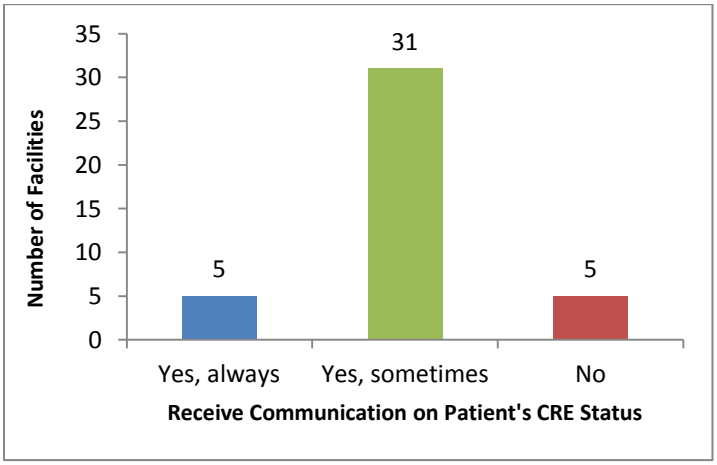
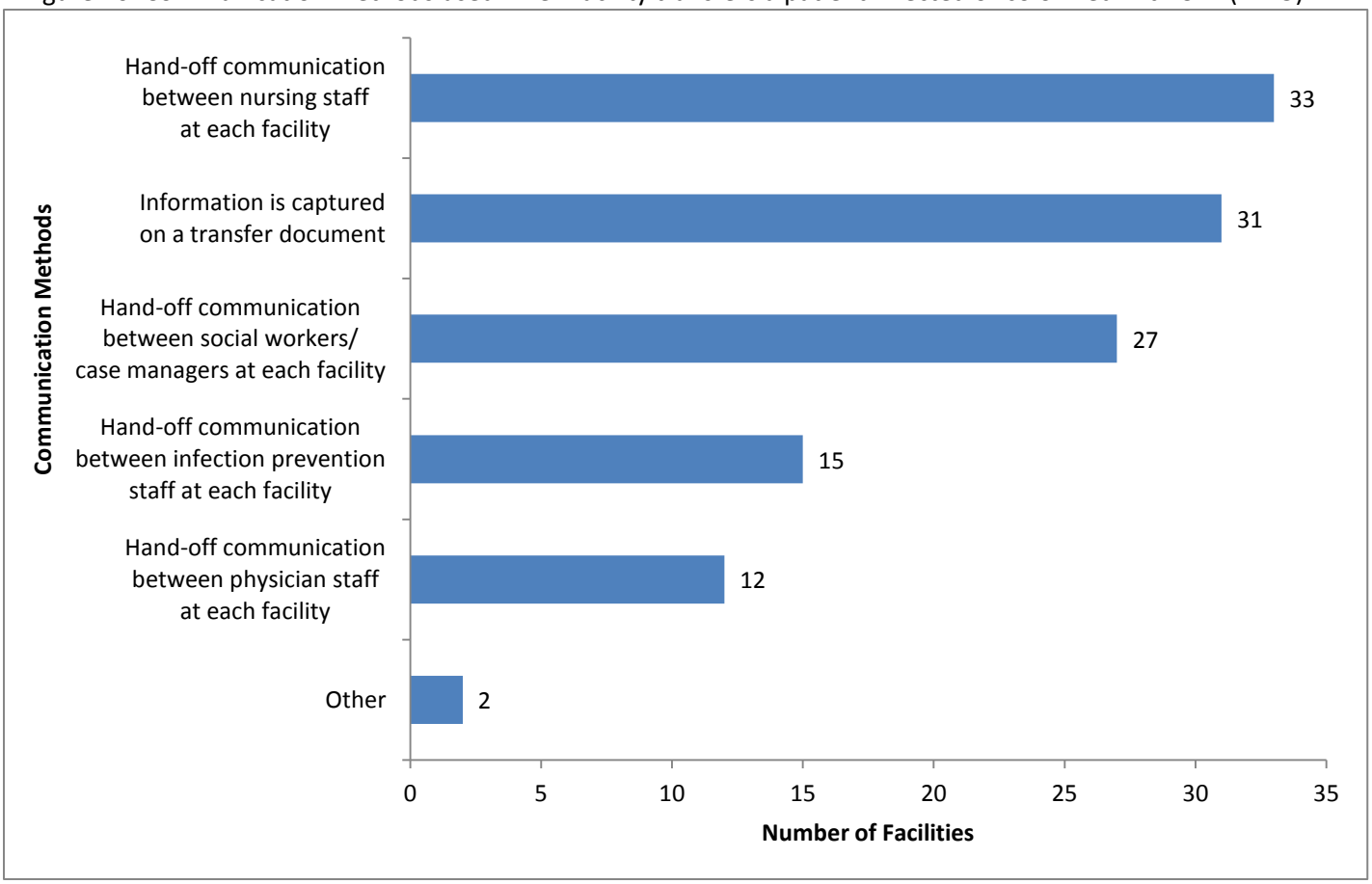


Figure 19b: Frequency with which a facility receives communication on a transfer patient's CRE status when **receiving** from another facility



When **transferring** a patient to another facility, most facilities communicated patient CRE status to the receiving facility via hand-off communication between nursing staff at each facility (73%), on a transfer document (69%), or via hand-off communication between social workers/case managers at each facility (60%) (Figure 20).

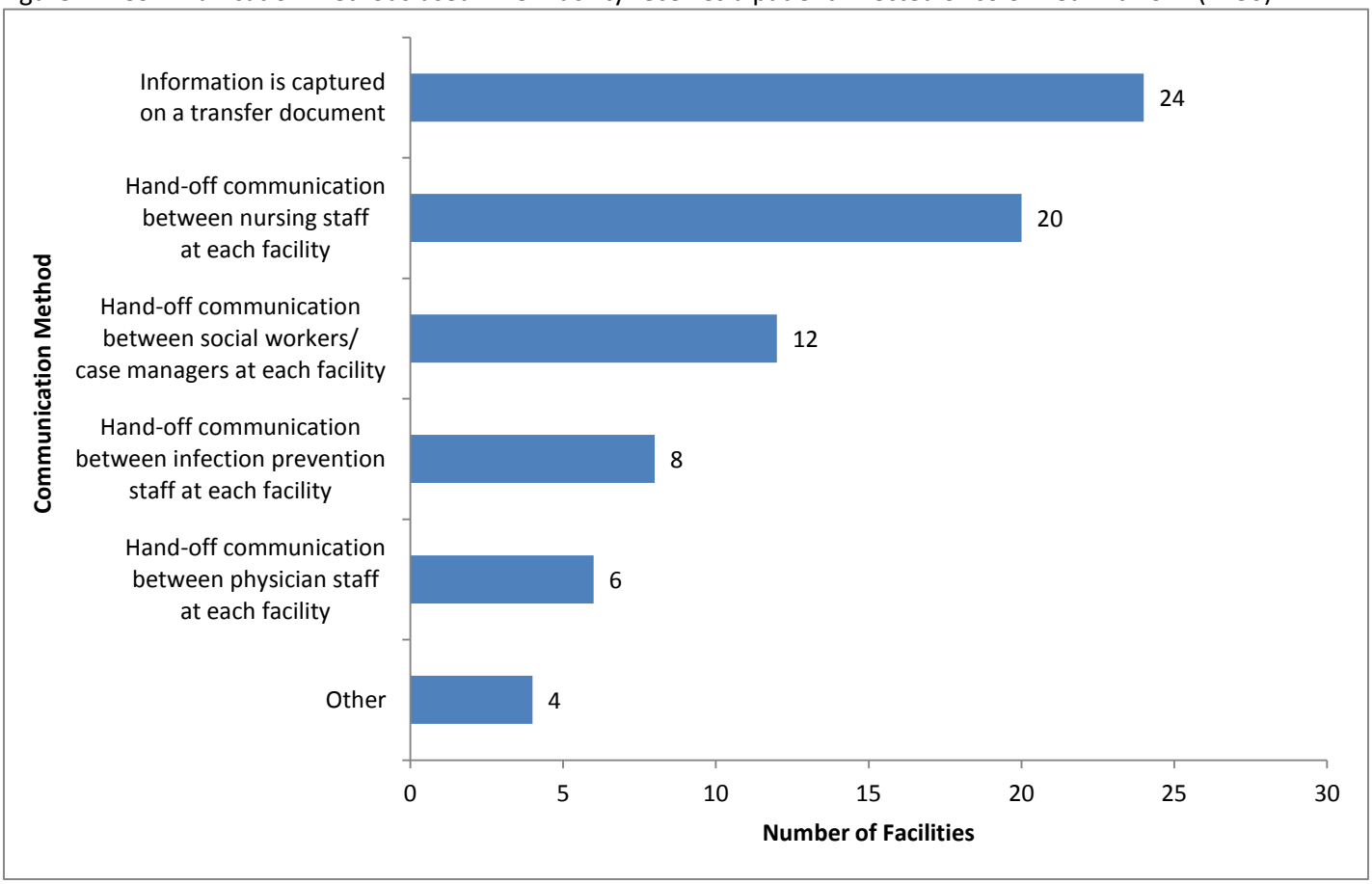
Figure 20: Communication methods used when facility transfers a patient infected or colonized with CRE (n=45)*



* Respondents could select more than one answer

When **receiving** a patient transferred from another facility, the facilities that get communication on the patient's CRE status most often received a transfer document (67%). Other common methods of communication were hand-off communication between nursing staff at each facility (56%) and hand-off communication between social workers/case managers at each facility (33%) (Figure 21).

Figure 21: Communication methods used when facility receives a patient infected or colonized with CRE (n=36)*



* Respondents could select more than one answer

7. Conclusion and Comments

Finally, IPs were asked their opinion on whether their facility considers CRE to be an epidemiologically important multidrug-resistant organism for which specific infection prevention practices are indicated to eliminate transmission. The majority of facilities (85%, n=39) agreed that their facility considers CRE to be important, with 26 facilities (56%) strongly agreeing with this statement. Three facilities (7%) neither agreed nor disagreed that their facility considers CRE to be important. Only one facility disagreed and three facilities did not respond to the question.

IPs were given the opportunity to leave general comments regarding CRE at the end of the survey. One theme that emerged was a concern over CRE cases coming from the community and nursing homes. Several IPs noted that they rarely if ever see their CRE cases coming from people with recent overseas travel. One IP mentioned the difficulty her facility sometimes experiences in sending a patient who was admitted with CRE back to the nursing home he/she came from, while another IP mentioned that all patients her facility admits from nursing homes are placed in isolation upon admission while they are screened for multidrug-resistant organisms.

Limitations

These surveys have several limitations. As with most surveys administered electronically, it is possible that some respondents interpreted questions differently from what was intended, despite pilot testing both surveys prior to implementing them. Additionally, recall bias and laboratorian and IP time constraints could have affected the accuracy and detail of information provided.

In the laboratory survey, the carbapenem susceptibility breakpoints provided for laboratories to choose from did not match up with the current CLSI recommendations. There was no ≤0.5 option offered; therefore to assess whether laboratories were using the current CLSI breakpoint for ertapenem, ≤0.25 was used as a proxy. While this proxy value can help provide a general idea of what laboratories are currently using, the responses might not reflect the true number of laboratories using the current breakpoints. Additionally, laboratories were not asked to identify the hospitals they serve, therefore direct comparisons between responses from the laboratory and IP surveys could not be made.

Less than half of all the eligible hospitals in Virginia responded to the IP survey. While the respondents were very similar demographically to all hospitals that received the survey, the results may have been different if more had responded to the assessment. Furthermore, none of the military hospitals responded to the IP survey. The military hospitals serve a unique population with many high-risk individuals who can have serious wounds, recent hospitalizations in a foreign country, and longer lengths of stay. Further attempts should be made to engage with the military hospitals to assess their CRE incidence and prevention strategies.

These surveys were conducted at a single point in time and the results are being distributed several months after the surveys were administered. Therefore, testing practices, infection prevention methods, and regional incidence of CRE may have changed during the time that has elapsed. New laboratory techniques continue to be developed and CRE incidence continues to increase in the United States, so repeated attempts to gauge CRE testing practices and disease burden in Virginia should be conducted in the future. Given that many hospitals are not actively screening patients for CRE, it is likely that the actual CRE incidence in Virginia is higher than what was measured by these surveys.

Discussion

Laboratory Survey

Using the CLSI M100-S23 as a guide, most of the laboratories (88%) in Virginia are not using the current carbapenem susceptibility breakpoints when determining if an isolate is a CRE. This problem is not unusual amongst laboratories that use automated testing systems. The Food and Drug Administration (FDA) approves the susceptibility breakpoints that can be used in automated testing systems and for the past several years the FDA breakpoints and CLSI breakpoints have differed for carbapenems. While laboratories wait for FDA to set new breakpoints that align with CLSI recommendations, CLSI encourages laboratories that test for CRE using non-current breakpoints to back up their initial testing with a confirmatory test. Seventeen laboratories (29%) did not perform confirmatory testing or send their CRE isolates to a reference laboratory for confirmatory testing. Fourteen of these laboratories are not using the most current CLSI breakpoints, and therefore should be conducting confirmatory tests on their suspected CRE isolates. The reason the laboratories are not doing these tests could be because they lack the resources to implement the confirmatory tests themselves or to send them to a reference laboratory, but efforts should be made to confirm any CRE isolate that is identified with non-current CLSI susceptibility breakpoints.

The gold standard confirmatory test for CRE is molecular testing, such as PCR. Only three laboratories (5%) were able to perform PCR testing, although 21 laboratories (36%) were able to perform the Modified Hodge Test, which is a CLSI-

approved confirmatory test for CRE. Building laboratory capacity for identifying and confirming CRE isolates should be investigated further, as resources permit.

Laboratories identified a multitude of ways in which they communicate CRE laboratory results to Infection Prevention. Many laboratories indicated that when adding language to a CRE laboratory report, they included phrases such as "CRE", "carbapenem-resistant", or "carbapenemase-producing" to help Infection Prevention and others easily identify the isolate as CRE. Alternatively, some reported language was not conducive for Infection Prevention's timely identification for CRE. For instance, one laboratory reported that for CRE laboratory reports, the language they add mentions the isolate is an MDRO, but not further described as CRE. Additionally, another laboratory describes CRE isolates as "extended spectrum beta-lactamase (ESBL)-producing", which is not an accurate description of CRE. It is important for Infection Prevention and clinicians to be able to easily identify the isolate as a CRE so they can quickly implement the proper infection prevention measures and relevant treatment decisions for these cases.

One way to make sure Infection Prevention learns of a positive CRE result in a timely manner is by having the laboratory call Infection Prevention directly when a CRE isolate is identified. A large proportion of laboratories (45%) indicated they already call CRE results to Infection Prevention and most IPs (61%) reported their preferred method of communication from laboratories regarding a CRE result was by phone. If laboratories are unable to place phone calls for CRE results, possibly other rapid notification methods can be explored, such as sending critical notifications through an IT system. Although electronic notification requires IT resources to create the alert, automating communication can help assure that communication occurs as soon as the result is confirmed.

Infection Prevention Survey

Using the CDC 2012 CRE Toolkit as a guide, all regions in Virginia are classified as "regions with few CRE identified," meaning CRE is identified on a monthly basis or less often for the majority of hospitals in the region (Figure 9). Based on this designation, the CDC 2012 CRE Toolkit (from here on referred to as "the Toolkit") advises that aggressive action should be taken to control and prevent widespread emergence of CRE. Two actions CDC recommends are to: 1) ensure facilities are implementing the recommended CRE infection prevention measures, and 2) encourage facilities to routinely complete inter-facility transfer forms with documentation of a patient's CRE status.

The Toolkit provides a list of eight core recommended infection prevention measures for all acute care facilities and two supplemental measures for those facilities where CRE transmission has occurred. Below, a subset of those measures, as well as the recommendation to routinely use inter-facility transfer forms, is compared with the IP survey results to assess how well hospitals in Virginia are managing CRE and to help identify any gaps in CRE prevention and control. For a full analysis of all the eight core and two supplemental Toolkit infection prevention measures compared with the CRE IP survey results, contact the VDH Healthcare-Associated Infections Program and request the in-depth CRE IP survey analysis report.

Infection Prevention Measures:

- **Patient and staff cohorting** (core measure) – The Toolkit recommends that patients infected or colonized with CRE should be isolated into single-patient rooms or cohorted when single rooms are not available, and they should have their own dedicated staff. The majority of facilities surveyed reported they would place a CRE-infected or CRE-colonized patient in a single room (97% and 89%, respectively). Alternatively, only 24% of facilities would implement patient/staff cohorting with a CRE-infected patient and 20% would for a CRE-colonized patient. In this survey, the practices of staff and patient cohorting were asked together in one question, so it is difficult to ascertain whether facilities were speaking for both patient and staff cohorting or just one of the two. Regardless, staff cohorting is recommended for all patients with CRE, even those in single rooms. Therefore, more education and sharing of strategies is needed for implementing staff cohorting effectively, as this task can often be difficult to carry out due to staffing resources and the amount of medical care required by a patient infected or colonized with CRE.

- **Laboratory notification** (core measure) – Rapid notification from the laboratory regarding a positive CRE result is crucial for healthcare professionals to ensure they are implementing proper infection prevention and control practices in a timely manner and making appropriate clinical decisions. The majority of responding IPs reported that their facility had a system in place for the lab to rapidly alert them whenever CRE is identified. The Toolkit does not specifically list a time frame for when labs should notify the IPs of a positive result, but 78% of IPs said they were notified by their labs within 24 hours of identifying a CRE isolate. IPs identified they most often preferred to be notified by the laboratory of a CRE result by a phone call to Infection Prevention, followed by an automatic alert through an IT system. This information will be helpful for laboratories in assessing whether their current communication methods meet the needs of their Infection Prevention counterparts.
- **CRE screening** (core measure) – The Toolkit encourages facilities to screen for unrecognized CRE cases in two ways: 1) conduct periodic **point prevalence surveys** on units with unrecognized CRE cases; and 2) **screen patients with epidemiologic links** to a patient with previously unrecognized CRE infection or colonization. Among the survey respondents, only five facilities (11%) reported ever conducting a point prevalence survey (three acute care hospitals, one critical access hospital, and one long-term acute care hospital). Two of these hospitals have yet to identify CRE in their facility, indicating that they are taking a proactive approach to identifying and controlling CRE. Only two facilities that had found a previously unrecognized CRE patient tested other patients with epidemiologic links to the index case, while 15 facilities did not test epidemiologic links. This represents a missed opportunity for facilities to implement recommended infection prevention measures that could help limit CRE transmission within the facility.
- **Active surveillance** (supplemental measure) – The Toolkit's supplemental measures are intended for those facilities that have identified CRE transmission within their facility. Thirteen facilities that participated in this survey indicated they have previously identified hospital-associated CRE cases. Of these 13 facilities, only four (31%) had ever conducted active surveillance testing for high-risk patients or patients admitted to high-risk units. Active surveillance can serve as an important tool to recognize patients with CRE infection or colonization early; therefore, any facility might find it useful to implement active surveillance, regardless of whether they have demonstrated previous CRE transmission. Specifically, facilities that admit a patient with certain risk factors or from certain high-risk settings, such as recent foreign hospitalization or patients coming from long-term acute care facilities, may wish to implement targeted active surveillance testing to ensure appropriate and timely use of contact precautions and other infection prevention measures. However, active surveillance testing can require significant time and resources; therefore, barriers to implementing active surveillance need to be explored further.

Inter-Facility Transfer Communication:

The United States healthcare system increasingly involves the movement of patients across many healthcare settings; patients can move from acute care to long-term acute care to a nursing home and then cycle back through again. As such, it is imperative that good communication occurs between transferring facilities regarding a patient's health status. This is especially important for CRE, since these organisms have no decolonization techniques, limited treatment options, high mortality, and can easily spread their resistance mechanisms to other members of the Enterobacteriaceae family. The Toolkit recognized the importance of inter-facility transfer communication for all multidrug-resistant organisms and encourages all facilities to routinely use transfer forms.

The majority of the facilities that responded to the IP survey (89%) indicated they *always* communicate a patient's CRE status to the receiving facility when transferring. In contrast, the majority of responding facilities (67%) reported they only *sometimes* receive information on a patient's CRE status when receiving a patient transferred from another facility. Hospitals may indeed be more likely than other settings, such as nursing homes, to send more complete information about a patient's health status when transferring a patient due to various factors that were not explored by this assessment. However, since only hospitals were surveyed, we were unable to validate the claim that they *always* communicate a patient's CRE status when transferring to another facility (such as a nursing home).

Communication of patient information between healthcare settings (including the presence of infection or colonization) clearly has room for improvement.

The use of a transfer form is one such way to improve communication between healthcare settings when transferring patients. More than two-thirds of responding facilities stated they use a transfer form when transferring a patient to another facility and received a transfer form when a patient is transferred to their hospital (69% and 67%, respectively). Ideally, the Toolkit recommends a transfer form be used for *every* transfer. In 2009, a Virginia-based multi-agency workgroup created a pair of model transfer forms[5] to help streamline information sharing between Virginia's nursing homes and emergency rooms/hospitals. Unfortunately, these forms do not contain a specific place to indicate whether the patient has ever been infected or colonized with CRE, as recommended by the Toolkit, but they do offer a section to record placement on different isolation precautions. The use of a standardized transfer form could aid in the assurance of appropriate and complete transfer communication between facilities and help to limit the further spread of CRE, MDROs, and other healthcare-associated infections. Transfer forms, or any communication method used when transferring patients between facilities, should include information such as diagnoses (i.e., infection, colonization, or history of infection/colonization) of MDROs or other epidemiologically important organisms (e.g., *Clostridium difficile*), current symptoms, invasive devices in place, current antibiotic use, and relevant vaccinations. An example of an inter-facility infection control transfer form developed by the CDC is available here: http://www.cdc.gov/HAI/toolkits/InterfacilityTransferCommunicationForm11-2010.pdf.[6]

Several IPs shared comments at the end of the survey about their concern with CRE coming from nursing homes and the community. This underscores the ease with which CRE and other MDROs can spread from different healthcare settings across the continuum of care. Adequate information exchange between facilities could help with these concerns. Further education for nursing homes and the community about CRE and other MDROs may also be beneficial.

Recommendations

Laboratory Recommendations

- Laboratories should follow the most recent CLSI susceptibility breakpoints for carbapenems. If unable to use current breakpoints due to available instrumentation, be sure to conduct or refer for confirmatory testing.
- Confirm there is prompt and clear notification of CRE results to Infection Prevention and applicable clinical staff. Phone notification was preferred by IPs. An automated notification through an IT system can also serve as a useful communication method.
- Assure that there is a process to deliver CRE results on weekends and holidays that ensures appropriate infection prevention precautions and clinical decision making can be implemented.
- Explore opportunities to participate in antimicrobial stewardship initiatives with other healthcare partners.
- Report any CRE that is suspected or confirmed to have an unusual resistance mechanism (e.g., NDM-1, VIM, OXA-48) to the health department as an "unusual occurrence of disease of public health concern."
- The CDC laboratory can conduct resistance mechanism testing for laboratories that are unable to perform the testing and to assist with laboratory testing during outbreak investigations. Those samples truly suspected of having an unusual resistance mechanism can be forwarded to CDC through DCLS. DCLS can also forward samples to CDC for confirmatory testing if needed.

[5] Model Universal Transfer Form for Use in Transfers Between Nursing Facility and Emergency Department/Hospital. (2009). Available at http://www.vdh.virginia.gov/OLC/Forms/Documents/HOSPITAL/pdfs/Final%20TransferFormJune09editable.pdf.

[6] Centers for Disease Control and Prevention. (2010). Inter-Facility Infection Control Transfer Form for States Establishing HAI Prevention Collaboratives. Available at http://www.cdc.gov/HAI/toolkits/InterfacilityTransferCommunicationForm11-2010.pdf.

Infection Prevention Recommendations

- Facilities should conduct more epidemiologic screenings for CRE, such as point prevalence surveys, retrospective microbiology record reviews, or active surveillance testing of high-risk patients. These screenings will allow facilities to better understand their incidence of CRE and to identify any potentially missed CRE cases. VDH can assist by offering educational resources on how to conduct CRE screenings.
- Ensure CRE risk factor information, such as recent foreign hospitalization, is collected at admission and documented in such a way that it is easy for Infection Prevention and clinical staff to locate in the patient's medical record.
- If a previously unrecognized CRE infection or colonization is identified, it is important to assess for and screen any other patients with epidemiologic links to the CRE case in an effort to prevent the organism's spread within the facility.
- The CDC 2012 CRE Toolkit emphasizes that infection prevention measures are the same for patients with CRE infection *or* colonization. Ensure that the recommended infection prevention measures are carried out for both types of patients in your facility.
- Assess current inter-facility transfer communication methods to determine if they are adequate for CRE, MDROs, and epidemiologically important organisms. Consider adopting an inter-facility transfer form if one is currently not in use. Refer to the Virginia Model Universal Transfer Form or the CDC Inter-Facility Infection Control Transfer Form as a guide.
- Assure that there is a process to deliver CRE results on weekends and holidays that ensures appropriate infection prevention precautions can be implemented.
- Explore opportunities to participate in antimicrobial stewardship initiatives with other healthcare partners.
- Report any CRE that is suspected or confirmed to have an unusual resistance mechanism (e.g. NDM-1, VIM, OXA-48) to the health department as an "unusual occurrence of disease of public health concern."

Conclusion

CDC and VDH consider CRE to be an important and emerging public health threat warranting immediate public health action. In Virginia, CRE is present in all health planning regions and most commonly is isolated from clinical cultures 2-10 times/year in acute care hospitals. A recent peer-reviewed journal publication found a five-fold rise in CRE cases in southeastern United States community hospitals between 2008 and 2012 (including some Virginia hospitals), indicating that CRE is on its way to becoming endemic to the region.[7] VDH and DCLS will continue to assist laboratory and healthcare partners in efforts to identify, prevent, and control CRE infection and spread. Efforts to build epidemiology and laboratory capacity for CRE and other MDROs in Virginia's laboratories and healthcare facilities will be pursued as opportunities arise.

The VDH Healthcare-Associated Infections Program team will continue to provide education and training on CRE prevention, especially by engaging non-acute care settings such as nursing homes. A sample in-service for educating staff about CRE as well as a document for acute care and long-term care facilities summarizing the 2012 CDC CRE toolkit and discussing when to call the local health department are available on the VDH HAI Program website: http://www.vdh.virginia.gov/epidemiology/surveillance/hai/MRSAandMDRO.htm.

For further information on Virginia's CRE prevention efforts or assistance with CRE outbreaks, please contact your local health department. For information on CRE laboratory testing methods, please contact the DCLS Microbial Reference Group Manager at (804) 648-4480.

[7] Thaden, JT, et. al. (2014) Rising Rates of Carbapenem-Resistant Enterobacteriaceae in Community Hospitals: A Mixed-Methods Review of Epidemiology and Microbiology Practices in a Network of Community Hospitals in the Southeastern United States. *Infection Control and Hospital Epidemiology*; 35(8): 978-983.

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Thaden, JT, et. al. (2014) Rising Rates of Carbapenem-Resistant Enterobacteriaceae in Community Hospitals: A Mixed-Methods Review of Epidemiology and Microbiology Practices in a Network of Community Hospitals in the Southeastern United States. *Infection Control and Hospital Epidemiology*; 35(8): 978-983.

Appendix A: VDH CRE Laboratory Survey

1) Laboratory name:

2) City/County:

3) Name of survey respondent:

4) Which of the following best describes your laboratory?

Hospital laboratory

Independent private laboratory

Other (please specify): _____

5) Is antimicrobial susceptibility testing (AST) performed in your laboratory for gram-negative bacilli? (specifically Enterobacteriaceae such as *Escherichia coli, Klebsiella*, *Enterobacter*, *Serratia*, *Citrobacter*, etc.)

Yes (*skip to Q8*)

No

6) What factors have inhibited your laboratory from conducting antimicrobial susceptibility testing for Enterobacteriaceae? (*please check all that apply*)

Cost of equipment

Cost of personnel to do testing

Training for personnel to do testing

Inability to maintain competency

Other (please specify)

7) If you do not perform antimicrobial susceptibility testing for Enterobacteriaceae in your laboratory, where do you send your samples for testing?

8) Which of the following carbapenem susceptibility testing methods does your laboratory/reference laboratory use for suspected carbapenemase-producing Enterobacteriaceae? (*please check all that apply*)

Automated system (*if checked, go to Q9; otherwise, skip to Q13*)

Broth microdilution

E-test

Kirby-Bauer disk diffusion

Other (please specify) : _____

None

9) Please indicate which automated system(s) your laboratory/reference laboratory routinely uses for susceptibility testing of gram-negative bacilli. (*please check all that apply*)

Microscan

Phoenix

Sensititre

Vitek

Vitek 2

Other (please specify): _____

10) For Enterobacteriaceae, which susceptibility breakpoint is your laboratory/reference laboratory using to define <u>susceptible</u> for the following antimicrobials? (*choose one MIC for each antimicrobial*)

	≤0.25 mcg/ml	≤1 mcg/ml	≤2 mcg/ml	≤4 mcg/ml	Do not test
Imipenem	_____	_____	_____	_____	_____
Meropenem	_____	_____	_____	_____	_____
Ertapenem	_____	_____	_____	_____	_____
Doripenem	_____	_____	_____	_____	_____

11) Which carbapenem antibiotic(s) are normally employed for susceptibility testing for Enterobacteriaceae? (*please check all that apply*)

Doripenem

Ertapenem

Imipenem

Meropenem

12) Which other antibiotic(s) are normally employed for susceptibility testing for Enterobacteriaceae to determine whether the isolate is a CRE? (*please check all that apply*)

Ceftriaxone

Ceftazidime

Cefotaxime

Other (please specify) : _____

13) Which of the following confirmatory tests for carbapenemase are performed on non-susceptible isolates of Enterobacteriaceae? (*please check all that apply*)

E-test

Kirby-Bauer disk diffusion

Modified Hodge Test (MHT)

Molecular testing, such as polymerase chain reaction (PCR)

Other (please specify) : _____

No confirmatory tests are performed for carbapenemase

14) For each of the following organisms, please indicate which of the following statements apply to how your laboratory information management system is able to pull the records. (*please check all that apply*)

	Carbapenem non-susceptible organisms are flagged	Minimum inhibitory concentrations (MICs) are recorded	Sensitive-intermediate-resistant (S-I-R) interpretations are recorded	System cannot do any of these functions
Enterobacter spp.	_____	_____	_____	_____
E. coli	_____	_____	_____	_____
Klebsiella spp.	_____	_____	_____	_____

15) Is your laboratory information management system able to be queried to provide lists of cultures for any of the following groups?

	Yes	No	Don't know
"Flagged" carbapenem non-susceptible organisms	_____	_____	_____
MIC	_____	_____	_____
S-I-R	_____	_____	_____
Species	_____	_____	_____
Specimen type (e.g., blood, urine, etc.)	_____	_____	_____

16) For the most current <u>full year</u> that data are available, approximately how many individual patients with CRE did your lab identify? (i.e., not counting duplicate isolates from the same patient)

N/A – lab does not have capacity to identify CRE (*skip to Q25*)
N/A – lab does not have capacity to count individual patients (*skip to Q19*)
None (*skip to Q18*)
1-3
4-10
11-25
26-50
50+
Unsure

17) For the most current full year that data are available, approximately what percent (%) of the CRE identified by your lab were *Klebsiella* spp., *Enterobacter* spp., or *Escherichia coli*? (*enter a whole number*)

18) What year was used to answer the previous question(s)?

2012

2011

Other (please specify) : _____

19) Has your laboratory validated methods for detection of carbapenem-resistant or carbapenemase-producing, *Klebsiella* spp. and *E. coli* from rectal swabs? (as defined by CDC at http://www.cdc.gov/HAI/pdfs/labSettings/Klebsiella_or_Ecoli.pdf)

Yes

No

Unknown

20) In an outbreak situation, would your laboratory be able to implement this protocol?

Yes

No

Unknown

21) How are CRE results communicated on a laboratory report?

22) Who do you (laboratory staff) notify when an isolate is determined to be a CRE? (*please check all that apply*)

Infection prevention (*if checked, then answer Q23 and 24; else skip to Q25*)

Charge nurse

Infectious disease physician

Attending physician

Inpatient floor

Pharmacy

Public health

None – no notifications take place

Other (please specify) : _____

23) Once the laboratory <u>confirms</u> a CRE, how is it communicated to Infection Prevention? (*please check all that apply*)

Phone

Email

Page

Fax

Routine lab report

Automatic alert through information technology (IT) system

Other (please specify): _____

24) If a CRE is suspected (preliminary lab culture results indicate a possible CRE but not yet lab-confirmed), is Infection Prevention notified?

Always

Sometimes (please specify when): _____

Never

25) Who is the point of contact at your laboratory for questions about antimicrobial susceptibility testing and reporting protocols?

Name:

Title:

Email Address:

Phone:

Fax:

26) If we have follow-up questions, may we contact the point person identified in the previous question?

Yes

No

27) Do you have any questions, comments, or concerns to share with VDH or DCLS about this topic?

Appendix B: VDH CRE Infection Preventionist Survey

Background Information

1) Facility name:

2) City/County:

3) Total number of infection preventionists (FTEs) in the facility:

4) Total number of licensed beds in the facility:

5) Which of the following best describes your facility?

Acute care hospital
Children's hospital
Critical access hospital
Long-term acute care hospital
Military hospital
Other (please specify): _____

Incidence of CRE

6) In general, how often do you identify CRE infections or colonizations from clinical cultures collected from your patients?

Daily
Weekly
Monthly
2-10 times/year
Yearly
Less frequently than yearly
CRE has never been identified (*Skip to Q9*)
Not sure

7) Specifically, how often are CRE infections or colonizations identified from clinical cultures collected *before or within 2 calendar days* of admission (i.e., transfers or present on admission)?

Daily
Weekly
Monthly
2-10 times/year
Yearly
Less frequently than yearly
Has not been identified
Not sure

8) Specifically, how often are CRE infections or colonizations identified from clinical cultures collected *more than 2 calendar days* after admission (i.e., healthcare-associated)?

Daily
Weekly
Monthly
2-10 times/year
Yearly
Less frequently than yearly
Has not been identified
Not sure

Laboratory Testing

9) Does the microbiology laboratory that performs cultures for your facility have an established system for alerting infection prevention staff within a timely manner whenever a CRE isolate is identified?

Yes; within 24 hours
Yes; within time frame greater than 24 hours
No

10) Where is the microbiology laboratory that performs CRE testing for your facility located?

Physically on the facility's campus
Not physically on the facility's campus but associated with the hospital/healthcare system
Outside private/reference laboratory
Other (please specify): _____

11) What are the preferred communication methods for the laboratory to report CRE results to Infection Prevention? (Check all that apply)

Automatic alert through information technology (IT) system
Email
Fax
Page
Phone
Routine lab report
Other (please specify): _____

12) Are CRE lab results communicated to Infection Prevention differently on a weekend or holiday when regular IP staff are out of the office?

Yes (please specify how they are communicated differently:
_____)
No

13) Are CRE lab results communicated any differently than other multidrug-resistant organisms (in terms of communication method(s) and timeliness)?

Yes (please specify how they are communicated differently:
_____)

No

14) Does the way the laboratory communicates CRE results on a laboratory report allow Infection Prevention to immediately know it is CRE so appropriate action can be taken?

Yes (*Skip to Q16*)
No
Not applicable; Infection Prevention does not receive a laboratory report when CRE is identified (*Skip to Q16*)
Not applicable; facility has never had a case of CRE so cannot determine if results are communicated in a manner that promotes appropriate action (*Skip to Q16*)

15) Please suggest how the CRE results on a laboratory report can be communicated more quickly or effectively.

Record Review, Point Prevalence Surveys, and Active Surveillance Testing

16) Has your facility ever reviewed microbiology records over a given time period (e.g., 6 or 12 months) to detect any previously unrecognized or unreported CRE cases?

Yes
No (*Skip to Q18*)

17) Did your review identify any previously unrecognized or unreported CRE cases?

Yes
No

18) Has your facility ever conducted a point prevalence survey (single round of active surveillance cultures) for CRE in high-risk units (e.g., units where previously unrecognized cases were identified, intensive care, long-term acute care, or units with high antimicrobial use)?

Yes
No (*Skip to Q20*)

19) Did your facility identify any unrecognized CRE from the point prevalence survey?

Yes
No

20) Has your facility ever conducted active surveillance testing for patients admitted to high-risk settings (e.g., ICUs) or patients with known risk factors (e.g., patients admitted from high-risk settings or transferred from an area or facility with high prevalence of CRE)?

Yes
No (*Skip to Q22*)

21) Pending results of the active surveillance testing, does your facility place the patient under preemptive contact precautions?

Yes; always
Yes; sometimes
No

22) If a CRE case is identified, does your facility conduct testing of patients with epidemiologic links to the CRE case (e.g., patients in same unit or who were provided care by same healthcare personnel)?

Yes; always
Yes; sometimes
No
N/A – have not encountered this situation

CRE Infection Prevention Measures

23) If a patient in your facility is identified to be INFECTED with CRE, which of the following measures are (or would be) implemented? (Choose one response per row)

Place on contact precautions	Yes	No
Place in single-patient rooms when possible	Yes	No
Enhance hand hygiene practices	Yes	No
Implement patient and staff cohorting	Yes	No
Chlorhexidine bathing for high-risk patients or patients in high-risk units	Yes	No

Other: _____
_____

24) [If Yes to "Place on contact precautions" in Q23] How long is the patient with CRE INFECTION placed on contact precautions?

Until screen/culture negative
Defined time period (please specify: _____)
Duration of stay
Indefinite – duration of stay and all readmissions
Other (please specify: _____)

25) If a patient in your facility is identified to be <u>COLONIZED</u> with CRE, which of the following measures are (or would be) implemented? (Choose one response per row)

Place on contact precautions	Yes	No
Place in single-patient rooms when possible	Yes	No
Enhance hand hygiene practices	Yes	No
Implement patient and staff cohorting	Yes	No
Chlorhexidine bathing for high-risk patients or patients in high-risk units	Yes	No

Other: _____
_____

26) [If Yes to "Place on contact precautions" in Q25] How long is the patient with CRE <u>COLONIZATION</u> placed on contact precautions?

Until screen/culture negative
Defined time period (please specify: _____)
Duration of stay
Indefinite – duration of stay and all readmissions
Other (please specify: _____)

27) In the following scenarios, how often would your facility place a patient on contact precautions? (Choose one response per row)

Suspected CRE infection	Always	Sometimes	Never
History of CRE infection	Always	Sometimes	Never
History of CRE colonization	Always	Sometimes	Never

28) Does your facility collect information from its inpatients about history of recent hospitalization in a country outside the United States?

Yes, always (*Skip to Q30*)
Yes, sometimes
No

29) What are the barriers to collecting this information or reasons why this information is not routinely collected from all hospital inpatients?

30) For patients with a history of recent hospitalization in a country outside the United States, how often are the following measures implemented? (Choose one response per row)

Place patient under presumptive contact precautions	Always	Sometimes	Never	Unknown
Screen patient for CRE	Always	Sometimes	Never	Unknown
Test for resistance mechanism if patient positive for CRE	Always	Sometimes	Never	Unknown

<u>Communication of CRE Infection/Colonization Status</u>

31) If a patient at your facility who is known to be colonized or infected with CRE is transferred to another facility, does someone from your facility regularly communicate the patient's CRE status to the receiving facility?

Yes; always
Yes; sometimes
No (*Skip to Q33*)

32) How is that information communicated? (Check all that apply)

Information is captured on a transfer document
Hand-off communication between infection prevention staff at each facility
Hand-off communication between nursing staff at each facility
Hand-off communication between physician staff at each facility
Hand-off communication between social workers/case managers at each facility
Other: _____
_____

33) If a patient is being transferred to your facility from another facility, does someone from the transferring facility notify your facility about the patient's CRE status prior to transfer?

Yes; always
Yes; sometimes
No (*Skip to Q35*)

34) How is that information communicated? (Check all that apply)

Information is captured on a transfer document
Hand-off communication between infection prevention staff at each facility
Hand-off communication between nursing staff at each facility
Hand-off communication between physician staff at each facility
Hand-off communication between social workers/case managers at each facility
Other: _____
_____

Conclusion

35) In your opinion, does your facility consider CRE to be an epidemiologically important multidrug-resistant organism for which specific infection prevention practices are indicated to eliminate transmission?

Strongly agree
Agree
Neither agree nor disagree
Disagree
Strongly disagree

36) Please provide the name and contact information for the person completing this survey – we would like to be able to contact you to clarify any information you may have provided.

Name:
Title:
Email Address:
Phone:
Fax:

37) Do you have any questions, comments, or concerns to share with VDH about the topic of CRE?