Partner Packet
April 2018 *Vital Signs* Report

Containing Unusual Antibiotic Resistance

Early, aggressive action can prevent spread

All materials in this packet are embargoed until Tuesday, April 3, 2018 at 1 p.m. ET.

Colleagues:

On Tuesday, April 3, CDC will release a *Vital Signs* report that focuses on the Containment Strategy, an approach designed to slow the spread of unusual resistance. Germs with unusual resistance include those that are:

- Resistant to all or most antibiotics tested, making them hard to treat, and
- Uncommon in a geographic area or the US, or
- Have special genes that allow them to spread their resistance to other germs.

Antibiotic resistance has been found in every state in the U.S. and while resistance varies across the country, we know that new types of resistance are constantly developing and spreading. In 2017 alone, CDC identified 221 instances of unusual resistant genes in nightmare bacteria. However, at the first indication of unusual resistance, health departments, health care facilities and CDC can significantly slow and even stop the spread of resistance with fast and aggressive action.

This is the *Vital Signs* Partner Packet, which provides embargoed materials that we would be grateful if you shared broadly within your networks and among partners. Because of the wide range of involvement needed to implement the Containment Strategy, we welcome and appreciate support from your organization in raising awareness.

Here are a few ways to participate:

- On April 3 at 12 p.m. ET, listen to a press conference with CDC's principal deputy director, Anne Schuchat, MD to announce the release of the *Vital Signs* Report. Join our listen only line: 800-369-1605 Passcode: CDC Media
- Visit the *Vital Signs* website after the embargo has lifted on April 3 at 1 p.m. to find more information and materials available for download: https://www.cdc.gov/vitalsigns/
- Join us for a virtual Town Hall on April 10 at 2 p.m. ET where you will hear real-world examples of states that have implemented the Containment Strategy: https://www.cdc.gov/stltpublichealth/townhall/index.html
- Learn about what CDC is doing in your state: https://www.cdc.gov/arinvestments/

Thank you for your support in spreading the word about ways that we can save lives by combating antibiotic resistance.

Sincerely,

Nicole Coffin, MA

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Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

Upcoming Events

- Listen to CDC telebriefing Tuesday, April 3 at 12 p.m. ET.
    - Dial in: 800-369-1605
    - Passcode: CDC Media

- After 1 p.m. ET on April 3, share the *Vital Signs* materials by newsletter, e-mail and social media

- Post on social media (examples provided in social media section of this packet) or simply repost CDC Containment Strategy social media – look for it on:
    - @CDCgov
    - @CDC_NCEZID
    - Facebook

- Learn how states are implementing the Containment Strategy by joining the *Vital Signs* Town Hall Teleconference April 10 2-3 p.m. ET.
    - More information: https://www.cdc.gov/stltpublichealth/townhall/2018/4-apr.html

CDC Vitalsigns™

#vitalsigns
APR. 2018

Containing Unusual Resistance

Early, aggressive action can prevent spread

221

New nationwide testing in 2017 uncovered 221 instances of unusual resistance genes in "nightmare bacteria."

1 in 10

11% of screening tests, in people with no symptoms, found a hard-to-treat germ that spreads easily.

1st

The Containment Strategy keeps new threats from spreading. Launch at the first sign of unusual resistance.

More than 23,000 Americans die each year from infections caused by germs resistant to antibiotics. While antibiotic resistance (AR) threats vary nationwide, AR has been found in every state. And unusual resistance germs, which are resistant to all or most antibiotics tested and are uncommon or carry special resistance genes, are constantly developing and spreading. Lab tests uncovered unusual resistance more than 200 times in 2017 in "nightmare bacteria" alone. With new resources nationwide, early and aggressive action—when even a single case is found—can keep germs with unusual resistance from spreading in health care facilities and causing hard-to-treat or even untreatable infections. For example, CDC estimates show that this aggressive approach could prevent 1,600 cases of CRE* in one state over three years. Health departments can lead the Containment Strategy and act swiftly with health care facilities and CDC at the first sign of unusual resistance.

State and local health departments can:

- Make sure all health care facilities know what state and local lab support is available and what isolates (pure samples of a germ) to send for testing. Develop a plan to respond rapidly to unusual genes and germs when they first occur.
- Assess the quality and consistency of infection control in health care facilities across the state. Help improve practices.
- Coordinate with affected health care facilities, the new AR Lab Network regional labs, and CDC for every case of unusual resistance. Investigations should include onsite infection control assessments and colonization screenings for people who might have been exposed. They could spread it to others. Continue until spread is controlled.
- Provide timely lab results and recommendations to affected health care facilities and providers. If the patient came from or was transferred to another facility, alert that facility.

Want to learn more?
Visit: www.cdc.gov/vitalsigns/containing-unusual-resistance

*CRE is carbapenem-resistant Enterobacteriaceae.

Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

PROBLEM:

Antibiotic-resistant germs can spread like wildfire.

Germs constantly develop resistance against new and older antibiotics. Antibiotic-resistant germs can cause difficult-to-treat or untreatable infections. Some types of antibiotic resistance are already widespread.

Once antibiotic resistance spreads, it is harder to control–like a wildfire.

Finding and responding to unusual resistance early, before it becomes common, can help stop its spread and protect people.

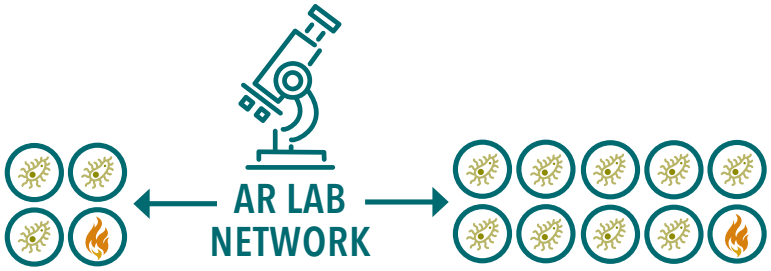
New or rare types of antibiotic resistance can be easier to contain when found rapidly–like a spark or campfire.

UNUSUAL ANTIBIOTIC-RESISTANT GERMS

- **Resistant to all or most antibiotics tested, making them hard to treat, and**
- **Uncommon in a geographic area or the US, or**
- **Have special genes that allow them to spread their resistance to other germs**

Examples of unusual resistance: Vancomycin-resistant *Staphylococcus aureus* (VRSA), *Candida auris*, and certain types of "nightmare bacteria" such as carbapenem-resistant Enterobacteriaceae (CRE).

CDC'S AR LAB NETWORK UNCOVERS ANTIBIOTIC RESISTANCE & SILENT SPREAD



1 IN 4 GERMS TESTED WAS POSITIVE.
25% of the germs had special genes that allow them to spread their resistance to other germs. In response, many investigations were conducted and screening tests were performed.

1 IN 10 SCREENING TESTS WAS POSITIVE.
If left undetected, patients without symptoms could continue spreading rare, hard-to-treat germs in the health care facility.

ANTIBIOTIC RESISTANCE CAN SPREAD

- From people with and without symptoms of infection
- Between facilities
- Between germs

PREVENTING AN UNUSUAL ANTIBIOTIC RESISTANCE WILDFIRE

Rapid Response in **Tennessee**

- Health department identified an unusual resistance germ in a patient who recently received health care outside the US.
- Health department and the facility in Tennessee did infection control assessments and colonization screenings within 48 hours. No spread found.
- Moving forward, CDC's AR Lab Network regional labs expanded services to test patients in the US with recent health care outside the country.

Ongoing Vigilance in **Iowa**

- Health department identified an unusual resistance germ in a nursing home patient.
- Health department and the facility did infection control assessments and screened 30 patients for colonization. Investigation revealed the germ may have spread to 5 additional people.
- Facility used infection control and contact precautions, such as gloves and gowns, to help stop spread.
- No further spread found during follow-up assessments.

SOURCE: CDC Vital Signs, April 2018.

Containment Strategy: Be on guard to contain the first spark.

THE NATION CAN IDENTIFY AND RESPOND TO UNUSUAL ANTIBIOTIC RESISTANCE

In addition to leading the Containment Strategy, CDC is working with other Federal agencies to combat antibiotic resistance nationwide by preventing infections and improving antibiotic use. CDC's activities are supported by ongoing resources from Congress.

7 AR Lab Network Regional Labs

56 AR Lab Network State and Local Labs

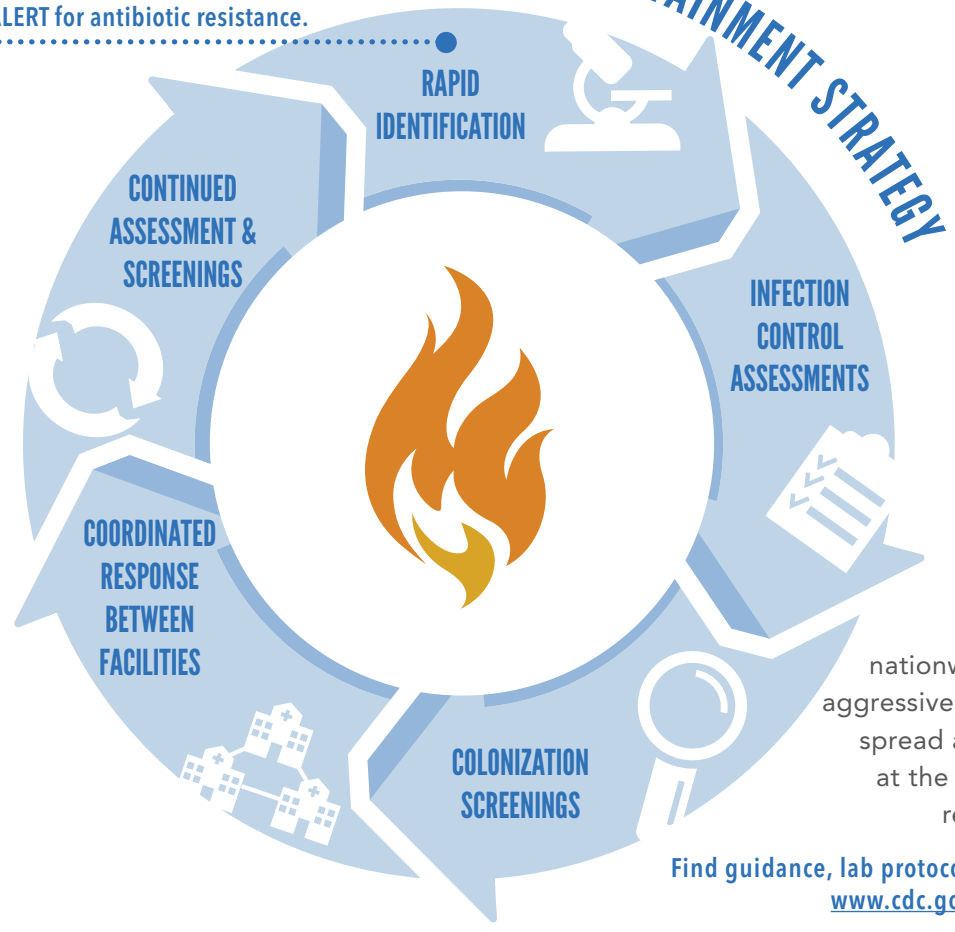
500+ Local Staff to Combat AR

35 Advanced Programs to Prevent Spread & Improve Antibiotic Use

49 Projects Exploring Innovative Detection & Prevention

Health care facilities, health departments, and CDC are ON ALERT for antibiotic resistance.

THE CONTAINMENT STRATEGY



Public health teams nationwide can launch early, aggressive responses to contain spread and protect people—at the first sign of antibiotic resistance, every time.

Find guidance, lab protocols, and more resources:
www.cdc.gov/HAI/Outbreaks/MDRO

SOURCE: AR Investment Map: www.cdc.gov/ARinvestments.

WHAT CAN BE DONE

THE FEDERAL GOVERNMENT IS:

- Monitoring resistance and sounding the alarm when threats emerge. CDC develops and provides new lab tests so health departments can quickly identify new threats.
- Improving identification through CDC's new AR Lab Network in all 50 states, 5 large cities, and Puerto Rico, including 7 regional labs and a national tuberculosis lab for specialty testing.
- Supporting prevention experts and programs in every state, and providing data and recommendations for local prevention and response.
- Testing innovative infection control and prevention strategies with health care and academic partners.

STATE AND LOCAL HEALTH DEPARTMENTS AND LABS CAN:

- Make sure all health care facilities know what state and local lab support is available and what isolates (pure samples of a germ) to send for testing. Develop a plan to respond rapidly to unusual genes and germs when they first appear.
- Assess the quality and consistency of infection control in health care facilities across the state, especially in facilities with high-risk patients and long stays. Help improve practices.
- Coordinate with affected health care facilities, the new AR Lab Network regional lab, and CDC for every case of unusual resistance. Investigations should include onsite infection control assessments to find spread. Consider colonization screenings. Continue until spread is controlled.
- Provide timely lab results and recommendations to affected health care facilities and providers. If the patient came from or was transferred to another facility, alert that facility.
- Find resources: www.cdc.gov/hai/outbreaks/mdro

HEALTH CARE FACILITIES CAN:

- Plan for unusual resistance arriving in your facility. Find resources: www.cdc.gov/hai/outbreaks/mdro
- **Leadership:** Work with the health department to stop spread of unusual resistance. Review and support infection control in the facility.
- **Clinical labs:** Know what isolates to send for testing. Establish protocols that immediately notify the health department, healthcare provider, and infection control staff of unusual resistance. Validate new tests to identify the latest threats. If needed, use isolates from www.cdc.gov/ARIsolateBank.
- **Healthcare providers, epidemiologists, and infection control staff:** Place patients with unusual resistance on contact precautions, assess and enhance infection control, and work with the health department to screen others. Communicate about status when patients are transferred. Continue infection control assessments and colonization screenings until spread is controlled. Ask about any recent travel or health care to identify at-risk patients.

EVERYONE CAN:

- Inform your healthcare provider if you recently received health care in another country or facility.
- Talk to your healthcare provider about preventing infections, taking good care of chronic conditions and getting recommended vaccines.
- Practice good hygiene, such as keeping hands clean with handwashing or alcohol-based hand rubs, and keep cuts clean until healed.

www.cdc.gov/vitalsigns/containing-unusual-resistance
www.cdc.gov/mmwr

For more information, please contact
Telephone: 1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 | Web: www.cdc.gov

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Vital Signs: Containment of Novel Multidrug-Resistant Organisms and Resistance Mechanisms — United States, 2006–2017

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Abstract

Background: Approaches to controlling emerging antibiotic resistance in health care settings have evolved over time. When resistance to broad-spectrum antimicrobials mediated by extended-spectrum β-lactamases (ESBLs) arose in the 1980s, targeted interventions to slow spread were not widely promoted. However, when Enterobacteriaceae with carbapenemases that confer resistance to carbapenem antibiotics emerged, directed control efforts were recommended. These distinct approaches could have resulted in differences in spread of these two pathogens. CDC evaluated these possible changes along with initial findings of an enhanced antibiotic resistance detection and control strategy that builds on interventions developed to control carbapenem resistance.

Methods: Infection data from the National Healthcare Safety Network from 2006–2015 were analyzed to calculate changes in the annual proportion of selected pathogens that were nonsusceptible to extended-spectrum cephalosporins (ESBL phenotype) or resistant to carbapenems (carbapenem-resistant Enterobacteriaceae [CRE]). Testing results for CRE and carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) are also reported.

Results: The percentage of ESBL phenotype Enterobacteriaceae decreased by 2% per year (risk ratio [RR] = 0.98, p<0.001); by comparison, the CRE percentage decreased by 15% per year (RR = 0.85, p<0.01). From January to September 2017, carbapenemase testing was performed for 4,442 CRE and 1,334 CRPA isolates; 32% and 1.9%, respectively, were carbapenemase producers. In response, 1,489 screening tests were performed to identify asymptomatic carriers; 171 (11%) were positive.

Conclusions: The proportion of Enterobacteriaceae infections that were CRE remained lower and decreased more over time than the proportion that were ESBL phenotype. This difference might be explained by the more directed control efforts implemented to slow transmission of CRE than those applied for ESBL-producing strains. Increased detection and aggressive early response to emerging antibiotic resistance threats have the potential to slow further spread.

Introduction

The emergence and spread of antibiotic resistance threatens to outpace the development of new antimicrobials, and slowing the spread of these organisms has become a priority. Among Enterobacteriaceae, the family of pathogens most frequently associated with health care–associated infections (*1*), resistance to the broad-spectrum antimicrobials extended-spectrum cephalosporins and carbapenems has been driven largely by the spread of plasmid-mediated resistance genes encoding extended-spectrum β-lactamases (ESBLs) and

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

carbapenemases, respectively. In the United States, ESBL-producing Enterobacteriaceae were first reported in 1988 (*2*). The emergence of these ESBL-producing isolates limited the options available for treatment, but these organisms remained susceptible to some first-line therapies, including carbapenems. In general, facilities independently selected approaches to control spread, which often included core infection control practices, such as hand hygiene, and placing patients with ESBL-producing strains in single rooms under Contact Precautions.

Enterobacteriaceae resistance to even broader spectrum antimicrobials, including carbapenems, was reported with increasing frequency beginning in 2001 (*3*). Rapid spread of these carbapenem-resistant Enterobacteriaceae (CRE) in parts of the United States and other countries (*4*,*5*) highlighted a need to more aggressively control CRE transmission. In 2009, CDC created CRE-specific guidance, which was endorsed by the Healthcare Infection Control Practices Advisory Committee (*6*). This guidance included recommendations for additional interventions when CRE was identified at a health care facility, including laboratory surveillance of clinical cultures and targeted patient screening to identify health care contacts with asymptomatic colonization. This CRE-specific guidance was updated in 2013 and 2015 (https://www.cdc.gov/hai/organisms/cre/cre-toolkit/index.html) and was highlighted by CDC in a 2013 report (*7*).

In 2017, CDC outlined a new effort to react rapidly to novel multidrug-resistant organisms (*8*); this approach includes encouraging health care facilities and public health authorities to respond to single isolates of an emerging antibiotic-resistant pathogen. The strategy rests on these five pillars: 1) rapid detection of targeted pathogens and their resistance mechanisms, 2) on-site infection control assessments by trained experts to identify gaps in infection prevention, 3) screening of exposed contacts to identify asymptomatic colonization, 4) coordination of the response among facilities, and 5) continuing these interventions until transmission is controlled. Detection and control efforts can extend from the index facility to other facilities that share patients.

To support this approach, CDC established the Antibiotic Resistance Laboratory Network (ARLN) (https://www.cdc.gov/drugresistance/solutions-initiative/ar-lab-networks.html) to improve national capacity to rapidly detect and respond to antibiotic resistance. ARLN provides carbapenemase testing for two emerging antibiotic resistant pathogens, CRE and carbapenem-resistant *Pseudomonas aeruginosa* (CRPA), at 56 state and local public health laboratories and screening for asymptomatic CRE and CRPA carriage at seven regional laboratories (*9*). Carbapenemase-producing strains were targeted for detection and response in part because of their previously demonstrated propensity for spread. CDC also expanded funding to state and local health departments to increase capacity and build expertise in responding to these and other emerging antibiotic resistance threats.

For this report, data from a national health care–associated infections surveillance system were reviewed to determine if the more directed approach applied for CRE was associated with differences in the percentage of Enterobacteriacae health care–associated infections that were CRE compared with those that had the ESBL phenotype. In addition, findings from the first 9 months of the enhanced response to emerging resistant organisms are described.

Methods

Percentage of Enterobacteriaceae with CRE or ESBL phenotypes in the National Healthcare Safety Network, 2006–2015. Included in the analysis were central line–associated bloodstream infections (CLABSIs) and catheter-associated urinary tract infections (CAUTIs) associated with *Escherichia coli* or *Klebsiella pneumoniae* and reported to CDC's National Healthcare Safety Network (NHSN) during 2006–2015 from adult medical, surgical, or medical/surgical intensive care units at short-stay acute care hospitals. The Centers for Medicare & Medicaid Services' (CMS) Hospital Inpatient Quality Reporting Program mandated reporting of CLABSI and CAUTI data to NHSN starting in 2011 and 2012, respectively; data from previous years represent voluntary reporting or reporting to comply with state or local mandates. National pooled mean percentages for Enterobacteriaceae with CRE phenotype (isolates resistant to imipenem, meropenem, doripenem, or ertapenem), and ESBL phenotype (isolates that tested intermediate or susceptible to carbapenems and intermediate or resistant to ceftazidime, cefepime, ceftriaxone, or cefotaxime) were calculated. Log binomial regression models were used to estimate the average annual change in the proportion of *E. coli* and *K. pneumoniae* that had a CRE or ESBL phenotype. P-values <0.05 were considered statistically significant. Sensitivity analyses were performed to account for the change in hospitals reporting to NHSN each year. The results of the log binomial regression model were confirmed by a robust variance Poisson model.

Enhanced detection and response. CRE and CRPA (*P. aeruginosa* resistant to imipenem, meropenem, or doripenem) isolates were submitted to ARLN laboratories for testing for carbapenemases. Among Enterobacteriaceae, *E. coli, K. oxytoca, K. pneumoniae*, and *Enterobacter* spp. were targeted for submission. Testing at ARLN laboratories included carbapenemase production testing and molecular detection of genes encoding for the five carbapenemases of primary public health concern: *Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo-beta-lactamase (NDM), Verona integron

encoded metallo-beta-lactamase (VIM), imipenemase (IMP), and oxacillinase-48-like carbapenemase (OXA-48). ARLN laboratories were asked to report positive findings to local public health authorities and CDC within 1 day and to submit testing summaries to CDC monthly.

For each carbapenemase-producing isolate detected, CDC guidance recommends that state health department staff members contact the health care facility to review infection control measures and consider performing on-site infection control assessments. If indicated, contacts of the index patient are screened to detect transmission; testing capacity for this screening is provided through ARLN. Response activities continue until transmission is controlled. Screening results were stratified by whether the screening took place in a short-stay acute care hospital or a post–acute care facility (i.e., long-term acute care hospital or nursing home).

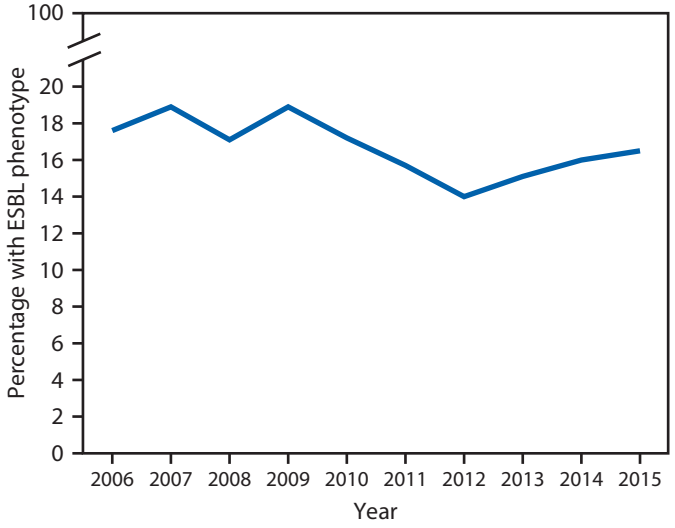
Results

Percentage of Enterobacteriaceae with CRE or ESBL phenotypes in the National Healthcare Safety Network, 2006–2015. Among short-stay acute care hospitals, the percentage of *Klebsiella* and *E. coli* isolates with the ESBL phenotype remained relatively stable, ranging from 17.6% (116 of 659 isolates) in 2006 to 16.5% (694 of 4,211) in 2015, with a peak of 18.9% in 2009 (Figure 1). The percentage of CRE declined from 8.8% (35 of 397 isolates) in 2006 and 10.6% (64 of 604) in 2007 to 3.1% (115 of 3,718) in 2015 (Figure 2). During 2006–2015, the annual percentage of isolates with the ESBL phenotype declined an average of 2% (RR = 0.98, p = 0.009); during the same period, the proportion that were CRE decreased 15% per year (RR = 0.85, p<0.001). Results were unchanged when the analysis was limited to facilities that reported in all years.

Enhanced detection of and response to carbapenemase-producing organisms. During the first 9 months of 2017, among 4,442 CRE and 1,334 CRPA isolates that were tested for carbapenemases from 32 states, 1,401 (32%) CRE and 25 (1.9%) CRPA were carbapenemase producers (Table 1). Among the carbapenemase-producing isolates, 221 (15.5%) expressed carbapenemases other than KPC. Of isolates tested, 1,422 (25%) were collected in the first quarter of 2017, 2,141 (37%) in the second quarter, and 2,213 (38%) in the third quarter. During this period, the median time from specimen collection to CDC notification decreased from 37 to 13 days. The percentage of carbapenemase-producing isolates varied by organism and was highest among *Klebsiella* species (65%). Among carbapenemase-producing CRE, the most commonly identified carbapenemase was KPC (1,232 of 1,401 isolates, 88%); VIM was the most common carbapenemase identified in CRPA (18 of 25, 72%) (Table 1).

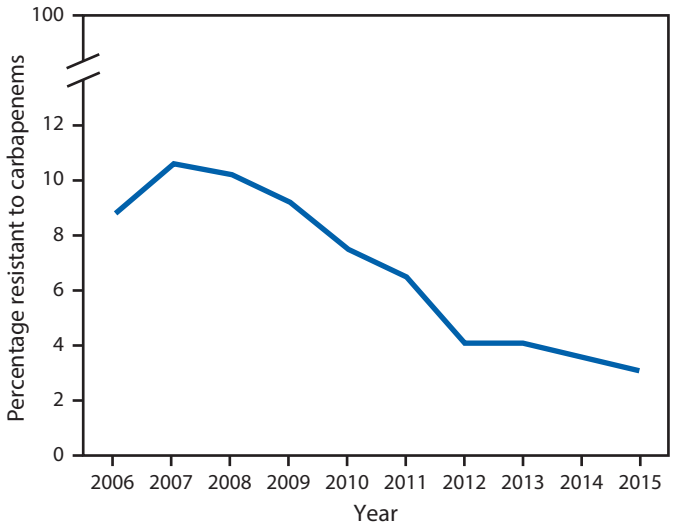
To identify asymptomatically colonized health care contacts of index patients, 1,489 screening tests for carbapenemases were performed during 70 surveys (defined as all screening tests performed at a single facility within a 14-day period)

FIGURE 1. Percentage of *Escherichia coli* and *Klebsiella pneumoniae* isolates from selected health care–associated infections* with the extended-spectrum-β-lactamase (ESBL) phenotype reported as nonsusceptible to extended-spectrum cephalosporins† — National Healthcare Safety Network, United States, 2006–2015



* Central line–associated bloodstream infections and catheter-associated urinary tract infections.
† Nonsusceptible to at least one extended-spectrum cephalosporin.

FIGURE 2. Percentage of *Escherichia coli* and *Klebsiella pneumoniae* isolates from selected health care–associated infections* reported as resistant to a carbapenem — National Healthcare Safety Network, United States, 2006–2015



* Central line–associated bloodstream infections and catheter-associated urinary tract infections.

in 50 facilities. A median of 10.5 contacts (interquartile range = 2–25) were screened per survey. Overall, 11% of screening tests were positive for at least one of the five carbapenemases of primary public health concern (Table 2). A higher percentage of post–acute care facility contacts screened positive for carbapenemases (14% [147 of 1,074 contacts]) than did contacts from short-stay acute care hospitals (5.8% [21 of 365]) (p<0.01). Screening tests performed increased from 363 in the first quarter of 2017, to 732 in the third.

Illustrative examples. Public health responses using this new approach have identified single cases without transmission, transmission within facilities, and spread to multiple facilities. Examples from two states are presented to illustrate these efforts.

In October 2017, the Tennessee Department of Health contacted CDC regarding identification of an NDM and OXA-48–producing *Klebsiella pneumoniae* isolate through ARLN. Infection control assessment and screening of hospital contacts was completed and results returned within 48 hours of identification of carbapenemase presence. No transmission was identified. Because the index patient had a recent health care exposure in another country, ARLN regional laboratories expanded their services to perform CDC-recommended admission screening for patients with a history of overnight health care stays outside the United States during the preceding 6 months (*10*).

In April 2017, the Iowa Department of Public Health contacted CDC regarding IMP identified in a *Proteus* species isolated from a nursing home resident. The state health department assessed infection control practices and performed a point prevalence survey that identified five additional colonized residents among 30 surveyed at the nursing home. The health department conducted additional infection control assessments to ensure adherence to recommended practices and two follow-up surveys of the nursing home wing, which did not identify any additional cases.

Conclusions and Comments

Although the proportion of *Klebsiella* spp. and *E. coli* that had either an ESBL or CRE phenotype both declined during 2006–2015, larger decreases and a lower overall percent resistant were observed for the CRE phenotype. This difference might be attributable, at least in part, to the more directed response employed to slow the spread of CRE once it was identified. Although CDC's containment approach had not yet been fully initiated when the decline in CRE began, these data suggest that an early aggressive response, as outlined in CRE-specific infection prevention recommendations released beginning in 2009 (*6*), can slow emergence and even decrease the occurrence of infections from resistant pathogens. As laboratory capacity improved, ARLN testing volume and public health responses increased over the first three quarters of 2017, demonstrating that recent investments in detection and response capacity are facilitating prompt identification of and response to emerging resistant organisms. Notably, 221 isolates with non-KPC carbapenemases were identified; these rare forms of resistance have the potential to add to the U.S. CRE burden and represent an important opportunity to prevent the spread of novel resistance at its earliest stage. Findings from these enhanced prevention efforts are being used to further refine detection and prevention strategies.

Contact screening identified previously undetected transmission and appeared to have the highest yield in post–acute care facilities with higher acuity patients. Challenges in these

TABLE 1. Carbapenemase testing, by organism — Antibiotic Resistance Laboratory Network laboratories and CDC laboratory, specimens collected January 1–September 30, 2017

	Total		KPC		NDM		OXA-48		VIM		IMP	
Organism	Tested* no.	Positive† no. (%)	Tested no.	Positive no. (%)	Tested no.	Positive no. (%)	Tested no.	Positive no. (%)	Tested no.	Positive no. (%)	Tested no.	Positive no. (%)
Total	**5,776**	**1,426 (25)**	5,755	1,234 (21)	5,570	134 (2.4)	5,323	65 (1.2)	4,724	30 (0.6)	4,068	16 (0.4)
Enterobacteriaceae	**4,442**	**1,401§ (32)**	4,430	1,232 (28)	4,247	134 (3.2)	4,050	65 (1.6)	3,448	12 (0.3)	2,827	11 (0.4)
Klebsiella spp.	**1,439**	**942 (65)**	1,437	862 (60)	1,359	74 (5.4)	1,295	42 (3.2)	1114	4 (0.4)	744	1 (0.1)
E. coli	**789**	**144 (18)**	783	83 (11)	755	43 (5.7)	719	20 (2.8)	665	0 (0)	585	0 (0)
Enterobacter spp.	**1,538**	**201 (13)**	1,537	194 (13)	1,468	14 (1.0)	1,387	0 (0)	1,201	0 (0)	1,063	3 (0.3)
Other	**346**	**72 (21)**	345	53 (15)	336	3 (0.9)	322	2 (0.6)	256	7 (2.7)	238	7 (2.9)
Unspecified	**330**	**42 (13)**	328	40 (12)	329	0 (0)	327	1 (0.3)	212	1 (0.5)	197	0 (0)
Pseudomonas aeruginosa	**1,334**	**25§ (1.9)**	1,325	2 (0.2)	1,323	0 (0)	1,273	0 (0.0)	1,276	18 (1.4)	1,241	5 (0.4)

Abbreviations: IMP = imipenemase; KPC = *Klebsiella pneumoniae* carbapenemase; NDM = New Delhi metallo-beta-lactamase; OXA-48 = oxacillinase-48-like carbapenemase; VIM = Verona integron encoded metallo-beta-lactamase.
* Number of isolates tested.
† Positive for at least one of the five carbapenemases tested (IMP, KPC, NDM, OXA-48, or VIM).
§ 53 isolates were positive for more than one mechanism tested (28 KPC and NDM; 24 NDM and OXA-48; one KPC and VIM).

settings that might facilitate transmission of resistant organisms include long duration of facility stay, less aggressive use of transmission-based precautions because of concerns about resident quality of life, high staff turnover rates, and less expertise and training in infection control. Previous work has also identified these settings as potential amplifiers of CRE transmission (*11*), underscoring the importance of providing ongoing support to these facilities when targeted resistant organisms are identified. This support includes infection control assessments to improve adherence to recommended interventions and screening of contacts to identify asymptomatic carriers.

Although this analysis focused on carbapenemase-producing organisms, the containment strategy can prevent the spread of other emerging antimicrobial resistant pathogens, including *Candida auris* and pan-resistant bacteria. Using existing surveillance systems, including ARLN, further work is under way to better identify and understand new threats, including those that are emerging outside the United States. CDC continues to work to develop tests for new resistance mechanisms that can be made available via ARLN. Resistance is constantly evolving, and the containment strategy and ARLN are designed to be flexible and nimble to rapidly detect and respond to new threats.

Despite improvements in capacity to detect carbapenemases in clinical isolates and asymptomatic carriers through ARLN, challenges remain. Transmission in one facility in a region has the potential to affect all of the facilities and patients in a region through patient sharing; therefore, recognition by health care facilities of the importance of an aggressive, early, and coordinated response is needed to ensure responses are timely and comprehensive. Mathematic modeling of the containment strategy based on a single U.S. state's patient transfer network suggests that an intervention resulting in a 20% reduction in transmission would result in approximately 1,600 fewer clinical cases, a relative reduction of about 76%, 3 years after introduction (CDC, unpublished data, 2018). In addition, commitment from health care personnel and health care facilities to improve adherence to infection control interventions that can prevent transmission, especially in post–acute care settings, is necessary to prevent amplification of emerging resistance. For situations in which a targeted form of antimicrobial resistance has emerged more widely in a region, containment strategies might be less effective; additional work is required for these situations to identify the optimal strategies to reduce the prevalence of endemic resistant organisms. Finally, current interventions are challenging to implement and sustain; new interventions to reduce transmission are needed to supplement currently available prevention measures.

Public health departments, because of their expertise and ability to work across health care facilities, are uniquely positioned to facilitate these responses to emerging antimicrobial resistance. Since 2009, CDC has provided resources to develop state and local health care–associated infection programs; currently, CDC supports approximately 500 persons in state and local health departments to work on health care-associated infections and antimicrobial resistance. Details on funding provided to each state to combat antimicrobial resistance are provided in CDC's antimicrobial resistance map (https://wwwn.cdc.gov/arinvestments).

The findings in this report are subject to at least four limitations. First, resistance data in NHSN are collected using the final interpretations of resistant, intermediate, or sensitive, and this analysis does not account for differences among laboratories in the breakpoints used for interpretation or for changes in breakpoints over time. Enterobacteriaceae breakpoints for carbapenems and some cephalosporins were lowered during the analysis period. This might have resulted in an increase in isolates reported as resistant in later years of this analysis and could have resulted in an underestimation of any reductions in CRE or ESBLs described. Second, NHSN data analyzed for this report represent only isolates from two infection types

TABLE 2. Screening tests for carbapenem-resistant Enterobacteriaceae colonization, by facility type — Antibiotic Resistance Laboratory Network laboratories and CDC laboratory, specimens collected January 1–September 30, 2017

	Total*		Post–acute care facility†		Short-stay acute care hospital	
Carbapenemase	Screened§ no.	Positive no. (%)	Screened no.	Positive no. (%)	Screened no.	Positive no. (%)
Total	**1,489**	**171¶ (11)**	1,074	147 (14)	365	21 (5.8)
KPC	**1,480**	**122 (8.2)**	1,065	103 (10)	365	16 (4.4)
NDM	**1,480**	**6 (0.4)**	1,065	6 (0.6)	365	0 (0)
OXA-48	**1,311**	**0 (0)**	896	0 (0)	365	0 (0)
VIM	**1,488**	**34 (2.3)**	1,073	30 (2.8)	365	4 (1.1)
IMP	**1,311**	**9 (0.7)**	896	8 (0.9)	365	1 (0.3)

Abbreviations: IMP = imipenemase; KPC = *Klebsiella pneumoniae* carbapenemase; NDM = New Delhi metallo-beta-lactamase; OXA-48 = oxacillinase-48-like carbapenemase; VIM = Verona integron encoded metallo-beta-lactamase.
* Includes 50 screening tests without a reported facility type, three of which were positive for KPC.
† Includes long-term acute care facilities, skilled nursing facilities, and inpatient rehabilitation facilities.
§ Number screened refers to individual screening tests. Not all screening swabs were tested for all five mechanisms.
¶ Seven tests were positive for more than one mechanism tested (four KPC and NDM, and three KPC and VIM).

Key Points

- The emergence and spread of antibiotic resistance threatens to outpace the development of new antibiotics. Slowing the spread of emerging resistance is a CDC priority to protect persons and help slow the development of antibiotic resistance overall.
- Infection data from the National Healthcare Safety Network from 2006-2015 were analyzed to calculate changes in the annual proportion of selected pathogens that were nonsusceptible to extended-spectrum cephalosporins (ESBL phenotype) or resistant to carbapenems (carbapenem-resistant Enterobacteriaceae [CRE]).
- The percentage of ESBL phenotype Enterobacteriaceae decreased by 2% per year; by comparison, the CRE percentage decreased by 15% per year.
- The proportion of Enterobacteriaceae infections that were CRE remained lower and decreased more over time than the proportion that were ESBL phenotype. This difference might be explained by the more directed control efforts implemented to slow transmission of CRE than those applied for ESBL-producing strains.
- These data suggest that an early aggressive response, as outlined in CRE-specific infection prevention recommendations released beginning in 2009, can slow emergence and even decrease the occurrence of infections from resistant pathogens.
- In 2017, CDC outlined a new effort to react rapidly to novel multidrug-resistant organisms; this approach includes encouraging health care facilities and public health authorities to respond to even single isolates of an emerging antibiotic-resistant pathogen.
- From January to September 2017, carbapenemase testing was performed by the Antibiotic Resistance Lab Network for 4,442 CRE and 1,334 carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) isolates; 32% and 1.9%, respectively were carbapenemase-producers. Among the carbapenemase-producing isolates, 221 (15.5%) expressed carbapenemases other than *Klebsiella pneumoniae* carbapenemase. Carbapenemases can make germs resistant to some of our most powerful drugs, carbapenems.
- Additional information is available at https://www.cdc.gov/vitalsigns/.

(CAUTI and CLABSI); changes in colonization or other infection types would not be identified. Third, although greater reductions were seen in the percentage of organisms that were CRE compared to those with the ESBL phenotype, this analysis is unable to identify the exact cause for this difference. Finally, some states and health care facilities with colonization testing capacity chose to perform screening in-house rather than through the ARLN regional laboratory; these tests are not reported to ARLN and therefore are not included in this report, resulting in an underestimation of the true volume of screening conducted.

Limiting the spread of emerging forms of antibiotic resistance is a public health priority, and a timely and coordinated effort among health care facilities, local and state health departments, and CDC is needed to accomplish this goal. Research is already under way to expand control strategies through innovative approaches such as patient decolonization and microbiome manipulation, along with a focus on identifying strategies to decrease the time from specimen collection to public health response. Fortunately, with the parallel development of an enhanced prevention strategy for emerging antimicrobial resistance and implementation of advanced laboratory testing in ARLN, the critical tools for controlling the spread of antimicrobial resistance are now available nationwide. In the first year of ARLN implementation, CDC and state and local public health departments and public health laboratory partners have effectively increased the capacity to identify and respond to high concern organisms to prevent transmission of resistant pathogens. Although some challenges remain, this national public health strategy represents a critical step in the effort to decrease the impact of resistant pathogens.

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Conflict of Interest

No conflicts of interest were reported.

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Press Release

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Contact: CDC Media Relations
404-639-3286

Germs with Unusual Antibiotic Resistance Widespread in U.S.

Ramped-up CDC strategy helps providers stop spread of new germs, prevents large outbreaks

Health departments working with CDC's Antibiotic Resistance (AR) Lab Network found more than 220 instances of germs with "unusual" antibiotic resistance genes in the United States last year, according to a CDC *Vital Signs* report released today.

Germs with unusual resistance include those that cannot be killed by all or most antibiotics, are uncommon in a geographic area or the U.S., or have specific genes that allow them to spread their resistance to other germs.
Rapid identification of the new or rare threats is the critical first step in CDC's containment strategy to stop the spread of antibiotic resistance (AR). When a germ with unusual resistance is detected, facilities can quickly isolate patients and begin aggressive infection control and screening actions to discover, reduce, and stop transmission to others.

"CDC's study found several dangerous pathogens, hiding in plain sight, that can cause infections that are difficult or impossible to treat," said CDC Principal Deputy Director Anne Schuchat, M.D. "It's reassuring to see that state and local experts, using our containment strategy, identified and stopped these resistant bacteria before they had the opportunity to spread."

New strategy stops resistant bugs before they spread widely

The CDC containment strategy calls for rapid identification of resistance, infection control assessments, testing patients without symptoms who may carry and spread the germ, and continued infection control assessments until spread is stopped. The strategy requires a coordinated response among health care facilities, labs, health departments and CDC through the AR Lab Network. Health departments using the approach have conducted infection control assessments and colonization screenings within 48 hours of finding unusual resistance and have reported no further transmission during follow-up over several weeks.

The strategy complements foundational CDC efforts, including improving antibiotic use and preventing new infections, and builds on existing detection and response infrastructure. New data suggest that the containment strategy can prevent thousands of difficult-to-treat or potentially untreatable infections, including high-priority threats such as *Candida auris* and carbapenem-resistant Enterobacteriaceae (CRE).

Germs will continuously find ways to resist new and existing antibiotics; stopping new resistance from developing is not currently possible. Recent, nationwide infrastructure investments in laboratories, infection control, and response are enabling tailored, rapid, and aggressive investigations to keep resistance from spreading in health care settings.

Other study findings showed:

- One in four germ samples sent to the AR Lab Network for testing had a special genes that allow them to spread their resistance to other germs.
- Further investigation in facilities with unusual resistance revealed that about one in 10 screening tests, from patients without symptoms, identified a hard-to-treat germ that spreads easily. This means the germ could have spread undetected in that health care facility.
- For CRE alone, estimates show that the containment strategy would prevent as many as 1,600 new infections in three years in a single state—a 76 percent reduction.

To read more about the containment strategy and the entire *Vital Signs* report, visit www.cdc.gov/vitalsigns/containing-unusual-resistance.

About *Vital Signs*

Vital Signs is a report that appears as part of the CDC's Morbidity and Mortality Weekly Report. Vital Signs provides the latest data and information on key health indicators.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Containing Unusual Resistance - Key Messages

Antibiotic Resistance Threat and Disease Burden:

- 2 million Americans get infections from antibiotic resistance and 23,000 die from these infections every year.
- Antibiotic resistance harms people—our friends, our neighbors, and our family members. You likely know someone who has had a tough-to-treat infection, perhaps MRSA.
- Germs will continuously find ways to resist new and existing antibiotics making it impossible to stop new resistance from developing—but the good news is that we can slow the spread.
- New nationwide testing uncovered nearly 221 instances of germs with unusual resistance genes in "nightmare bacteria" in the U.S. in 2017 (Jan-Sept). Identifying unusual resistance early like these genes can help health departments and healthcare facilities respond aggressively to stop spread.
- With new resources nationwide, early and aggressive action—when even a single case is found—can keep germs with unusual resistance from spreading in healthcare facilities and causing hard-to-treat or even untreatable infections.

The Containment Strategy:

- The Containment Strategy is an aggressive approach to slow the spread of new or rare forms of antibiotic resistance. The Containment Strategy includes:
    - Rapid detection,
    - Infection control assessments,
    - Colonization screenings, when needed,
    - Coordination between healthcare facilities in an area,
    - And continued infection control assessments and colonization screenings until spread is controlled.
- The Containment Strategy is not a new concept. Containment complements other effective CDC strategies to combat antibiotic resistance, like improving antibiotic use and preventing healthcare-associated infections.
- Containment is made possible by recent nationwide enhancements to lab, infection control, and response and builds on existing detection and response infrastructure. All of this makes it possible for the nation to get ahead of unusual resistance genes and germs before they gain a foothold.
    - Previously, an outbreak response may wait until a cluster of cases was identified. Now, with enhanced lab and response infrastructure, we can respond to a single case.
    - Health departments are also empowered now to target and respond when resistance changes at a genetic level.

Unusual Resistance:

- Once resistance spreads and becomes common, it is harder to control—like a wildfire.
- Finding and responding to unusual resistance early can help stop its spread and protect people.
- These are germs that can cause potentially untreatable infections. Unusual resistance germs are:
    - Resistant to all or most antibiotics tested, making them hard to treat, and
    - Uncommon in a geographic area or the US, or
    - Have special genes that allow them to spread their resistance to other germs.
- Examples of unusual resistance: Vancomycin-resistant *Staphylococcus aureus* (VRSA), *Candida auris,* and certain types of "nightmare bacteria" such as carbapenem-resistant Enterobacteriaceae (CRE).

- New or rare types of resistance can be easier to contain when found rapidly—like stopping a spark from igniting a wildfire.

AR Lab Network Testing Results from *MMWR:*

- The AR Lab Network provides enhanced lab capacity in all 50 states and six local health departments, including specialty testing from seven regional labs and the National Tuberculosis Molecular Surveillance Center.
- In 9 months, in all states and Puerto Rico, health departments in the AR Lab Network tested 5,776 samples of highly resistant germs (ranked as urgent and serious threats in CDC's *AR Threat Report*).
- These samples were immediately tested for unusual resistance (highly resistant or rare with special resistance genes) that could be shared.
- Of the 5776, about 1 in 4 of the nightmare bacteria had a gene that helps it spread its resistance.
- There were 221 instances of an especially rare resistance gene.
- These results prompted an aggressive response, including many infection control assessments and colonization screenings.
- These screenings showed that about 1 in 10 tests were also positive, meaning the unusual resistance may have spread to other patients and could have continued spreading if left undetected.
- When screening tests were positive, vigilant infection control and screenings continued until spread was stopped.

Potential Impact:

- CDC estimates show that even if only 20% effective, the Containment Strategy can reduce the number of "nightmare bacteria" cases by 76% over three years (in one area).

Building on Other Strategies:

- The report describes how two types of resistance decreased from 2006-2015 using variations of the containment strategy.
- With independent approaches to control spread, a dangerous type of unusual resistance found in Enterobacteriaceae decreased by about 2 percent per year.
- With a more aggressive approach, using guidance like CDC's CRE Toolkit released in 2009, another type of unusual resistance in the same germ decreased by nearly 15 percent per year.
- The difference seen may be due, in part, to the more directed response to slow the spread of the second germ—nightmare bacteria CRE—once it was identified.
- The containment strategy further builds on these efforts, encouraging health care facilities and public health authorities to respond to even single cases of an emerging antibiotic-resistant pathogen.

State and Local Health Departments Can:

- Make sure all healthcare facilities know what state and local lab support is available and what isolates (pure samples of a germ) to send for testing. Develop a plan to respond rapidly to unusual genes and germs when they first occur.
- Assess the quality and consistency of infection control in healthcare facilities across the state. Help improve practices.
- Coordinate with affected healthcare facilities, the new AR Lab Network regional labs, and CDC for every case of unusual resistance. Investigations should include onsite infection control assessments and colonization screenings for people who might have been exposed to the unusual resistance. They could spread it to others. Continue until spread is controlled.
- Provide timely lab results and recommendations to affected healthcare facilities and providers. If the patient came from or was transferred to another facility, alert that facility.

The Federal Government Is:

- Monitoring resistance and sounding the alarm when threats emerge. CDC develops and provides new lab tests so health departments can quickly identify new threats.
- Improving identification through CDC's new AR Lab Network in all 50 states, 5 large cities, and Puerto Rico, including seven regional labs and a national tuberculosis lab for specialty testing.
- Supporting prevention experts and programs in every state, and providing data and recommendations for local prevention and response.
- Testing innovative infection control and prevention strategies with health care and academic partners.

Useful Websites:

https://www.cdc.gov/hai/outbreaks/mdro/index.html

https://www.cdc.gov/drugresistance/index.html

https://www.cdc.gov/drugresistance/solutions-initiative/overview.html

https://wwwn.cdc.gov/arinvestments/

https://www.cdc.gov/drugresistance/threat-report-2013/index.html

CDC Press Office:

media@cdc.gov

404 639-3286 (9 a.m.-6 p.m.)

770 488-7100 (After Hours)

Vitalsigns

Social Media Ideas

- CDC's Containment Strategy is an aggressive approach to slow the spread of new or rare forms of #AntibioticResistance. With new resources nationwide, early & aggressive action can keep germs w/ unusual resistance from spreading. #VitalSigns https://bit.ly/2GjWDBW

- The Containment Strategy keeps new threats from spreading. Launch at the first sign of unusual resistance. Read more about TN & IA efforts showing this approach works. #VitalSigns https://bit.ly/2GjWDBW

- Rapid identification & infection control assessments are critical to stop spread of unusual resistance. Can you name the other 3 parts of the Containment Strategy for Unusual Resistance? #VitalSigns https://bit.ly/2GjWDBW

- Combat #AntibioticResistance: Talk to your health care provider about recent health care, preventing infections, taking good care of chronic conditions, and getting recommended vaccines. #VitalSigns https://bit.ly/2GjWDBW

- Antibiotic-resistant germs can spread like wildfire. New or rare types of resistance can be easier to contain when found rapidly. CDC's Containment Strategy shows early, aggressive action can prevent spread. #VitalSigns https://bit.ly/2GjWDBW

- CDC's AR Lab Network uncovers #AntibioticResistance and helps stop silent spread. Know what isolates to send your HD for testing. www.cdc.gov/hai/outbreaks/mdro

- Plan for unusual #AntibioticResistance arriving in your facility. Find resources: www.cdc.gov/hai/outbreaks/mdro

- In addition to the Containment Strategy, CDC is combating #AntibioticResistance nationwide by preventing infections and improving antibiotic use. Learn about what CDC activities are funded in your state: www.cdc.gov/ARinvestments