Carbapenem-Resistant *Enterobacteriaceae* (CRE) Control and Prevention Toolkit

PREVENT HAIs
Healthcare-Associated Infections

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Cover photo: Carbapenem-resistant *Enterobacteriaceae,* courtesy of Centers for Disease Control and Prevention, Atlanta, GA

Contents

Introduction

Many in health care are familiar with multiple-drug–resistant organisms (MDROs) such as methicillin-resistant *Staphylococcus aureus* (MRSA), but carbapenem-resistant *Enterobacteriaceae* (CRE) are less well known, in spite of their rapid emergence on a global level. CRE are the result of a complex family of plasmid-borne resistance factors that circulate among *Enterobacteriaceae*. In the United States, the overwhelming majority of CRE cases are caused by the plasmid-borne *Klebsiella pneumoniae* carbapenemase (KPC) gene circulating among *Enterobacteriaceae*, mostly commonly among *Klebsiella pneumoniae* isolates. KPC-producing organisms have spread epidemically in the United States and around the world among hospitalized patients. Accordingly, the focus of this toolkit is KPC control, and the term KPC will be used in this document rather than CRE. Although the KPC epidemic continues to evolve, there are still opportunities to develop interventions to control further spread of this MDRO.[1]

The toolkit is organized into six sections, and can be used either in its entirety, or by pulling out specific sections that meet your organization's needs. We expect that leaders in infectious disease and infection control, as well as those concerned with patient safety and performance improvement, may be users of this toolkit. For those familiar with leading change processes and implementing process changes, the first few sections may not be necessary; it is possible to move right to Section 3, Putting Your Intervention Into Practice, if you and your organization are at that point. Section 1, Assessing Your Readiness for Change, may be useful if you are concerned about your organization's ability to adopt new guidelines and/or change processes for any type of healthcare-associated infections (HAI) initiative. Section 2, Starting Your Project, will be useful in any situation where a task force or team is needed in order to carry out the project, and provides crucial guidance about integrating your team's efforts with existing infection control routines and practices. Next, Section 3, Putting Your Intervention Into Practice, may be useful in thinking through how to roll out the changes in policy and/or process. Section 4, Implementing Best Practices, provides many tools and strategies that can be used in educating staff about KPC and the need for greater vigilance. Section 5, Measuring the Impact of your Intervention, and Section 6, Implementing and Sustaining Your Intervention, provide tools and information for understanding how well the new processes are working and how to sustain the gains.

[1] Additional resources for understanding the terms CRE and KPC can be found in the following reference: Currie, B. The emergence of carbapenemase-producing *Enterobacteriaceae.* Inf. Dis Special Edition. 2012;15:9-13.

Section 1. Assessing Your Readiness for Change

The implementation of new clinical practice guidelines and procedures of any type can be challenging and complex, because efforts to reduce the spread of infection frequently require system-level changes and collaboration across multiple unit and even multiple facilities. However, it is even more difficult when it involves multiple simultaneous modifications to work flow, communication, and decisionmaking as is needed in the control of healthcare-associated infections, such as KPC. Failure to assess your organization's readiness to make changes across multiple levels and in multiple departments can lead to unanticipated difficulties in implementation of new practices.

In this section, you will consider the following questions:

1. Do organization members understand why new infection control guidelines are needed?
2. Is there urgency to implement a new KPC prevention strategy?
3. Is there leadership support?
4. Who will take ownership of this effort?
5. What resources will you need?
6. What if you are not ready?

1.1 Do Organization Members Understand Why New Infection Control Guidelines Are Needed?

Readiness requires both the capability to implement new practices and the motivation to make the necessary changes. While the motivations for change might be external, (e.g. new guidelines or reimbursement policies), you will have the greatest success if the new initiative is based on a clear understanding of the concerns behind the planned change at all levels of the organization.

The emergence of KPC in health care settings is a significant challenge to all health care professionals. These general statistics might help you engage others in your organization:

- KPC first emerged in North Carolina in 1999. By 2013, it had been documented in 42 States, and has reached endemic levels in 6 States.
- According to a 2010 study, overall mortality for patients infected with KPC was 23 percent in 7 days, 42 percent in 30 days, and 60 percent by the end of their hospitalization.

Also consider whether local cases might be more tangible or compelling. While those who work in infection control may have a clear understanding of the changes that need to occur, it's important to remember that there may be great variation across the organization in levels of knowledge/motivation around KPC and HAIs in general.

To gather support and identify potential barriers for a KPC prevention and control initiative, consider the following steps:

- Identify the reasons to start a KPC prevention and control program in **your** health care organization. If the reasons are general and not specific to your hospital, you may want to find KPC infection cases or examples that will help bring the issue home to your facility. Examples include cases in facilities similar to yours in size or population served, or cases that received negative publicity.
- Determine your facility leaders' interest in infection control. Assess the effort needed to obtain and sustain their support.

- Talk with people in various roles, levels, and clinical areas who have a stake in seeing new KPC prevention and control guidelines implemented.
- Seek their input and develop consensus on reasons this program needs to go forward.
- Assess the extent to which organization members beyond potential supporters understand why a comprehensive KPC control and prevention initiative is needed.
- Consider finding a unit where KPC has been identified, where patients might be at the greatest risk of infection, or where staff is particularly interested in implementing the initiative , and find out what staff members in that unit think .

Updating knowledge and changing attitudes requires not only sharing new information but also assessing and addressing knowledge and/or attitudes that may slow down implementation. Consider surveying staff members throughout the organization to assess their current attitudes and knowledge around infection control—it will help target educational efforts and provide a benchmark against which to assess improvement.

Use a survey to assess clinical staff attitudes about and knowledge of KPC. **A survey developed at Boston University can be found in Section 7, Tools and Resources (Tool 1A, Clinical Staff Attitudes Toward KPC Control and Prevention).**

Additional Resources:

Below are citations of recent articles about the emergence of KPC. These may provide helpful background for you and others who are supportive of new guidelines at your facility.

- Bratu S, Mooty M, Nichani S, et al. Emergence of KPC-possessing *Klebsiella pneumoniae* in Brooklyn, New York: epidemiology and recommendations for detection. Antimicrob Agents Chemother. 2005 Jul;49(7):3018-20. PMID: 15980389.
- Gupta N, Limbago BM, Patel JB, et al. Carbapenem-resistant *Enterobacteriaceae:* epidemiology and prevention. Clin Infect Dis. 2011 Jul 1;53(1):60-7. PMID: 21653305.
- Won SY, Munoz-Price LS, Lolans K, et al. Emergence and rapid regional spread of *Klebsiella pneumoniae* carbapenemase–producing E*nterobacteriaceae*. Clin Infect Dis. 2011 Sep;53(6):532-40. PMID: 21865189.

If senior leaders do not already support a new KPC initiative, you will need to build the case for implementation. The case for implementation may be different for different people in your organization. To get the support of the chief financial officer, you may need to make a business case—how much will KPC infections cost the hospital in terms lower reimbursement rates? For other stakeholders, such as clinical chiefs, you may need to make the case with clinical outcomes and patient care.

A template for developing a business case for KPC control and prevention can be found in Section 7, Tools and Resources (Tool 1D, Business Case Form).

1.2 Is There Urgency To Implement a New KPC Prevention Strategy?

Beyond understanding the need to change clinical guidelines, do organization members find something compelling about KPC prevention and control? If a sense of urgency does not yet exist among key leaders, your job as a change agent is to create it or increase it.

Consider the current organizational attention to healthcare-associated infections in general:

- Does the organization have infection control champions on each unit? If not, who has the lead responsibility for infection control on the units?
- Are HAIs regularly documented, and are the results/reports provided to the staff? Who receives the reports, and who takes action?

The answers to these questions will influence the way you make your case for a specific KPC prevention initiative. To the extent that an existing infection control program is not present, your task will be more difficult, and mounting an effective improvement effort will likely require strong leadership support.

Here are some ways to increase the sense of urgency:

- Reach out beyond those who are already supportive and begin talking with colleagues about KPC, and about infection control more generally and its importance to your facility.
- Use their responses to gather information about potential barriers.
- Conduct a stakeholder analysis to identify key individuals and departments invested in the success of this project.

A template for stakeholder analysis can be found in Section 7, Tools and Resources (Tool 1B, Stakeholder Analysis)

1.3 Does Leadership Support This Effort?

It is crucial to make sure your organization's leadership team shares the urgency about KPC prevention and is willing and able to provide complete and ongoing support for this effort. Lessons learned from past efforts suggest that support is needed from all levels. Ask these questions about leadership support:

- How does this effort fit with the values and goals of your organization?
- Are there other commitments, initiatives or projects around healthcare-associated infections?

Changes are going to require new or reallocated resources, both human and material. In order to assess leadership support and other questions raised here, consider using a facility-level assessment similar to **Tool 1C, Leadership Support Assessment**. This assessment can help you assess potential support you can enlist for this effort. If you find that many answers are not positive, this information can help you identify areas that need attention.

Other Resources:

Saint S, Kowalski CP, Banaszak-Holl J, et al. The importance of leadership in preventing health care-associated infections: results of a multisite qualitative study. Infect Control Hosp Epidemiol. 2010 Sep;31(9):901-907. PMID: 20658939.

1.4 Establishing Ownership

Improvement projects need strong advocates, members of the organization who are committed to the project's goals, will take responsibility for the outcomes, and can influence others to get involved. To be successful, you'll need more than just one or two champions. You will also need support from various disciplines. Given the high prevalence of multidrug–resistant organisms among the chronically ill and long-term–care populations, you may want to consider including medical staff from frequently referring long-term–care facilities.

- Look carefully at the yes and no answers in **Tool 1C, Leadership Support Assessment**. If senior leadership support is not adequate, take steps to inform leaders of the importance and potential benefits associated with KPC and infection control more generally.
- Answer the following questions: Who are the key leaders? What will get them on board, if they are not already on board? What will keep them on board? Which senior leader can be the sponsor, link, or champion for this effort?
- Develop the case for KPC prevention targeted to the priority concerns of the key leaders using **Tool 1D** as examples.
- Consider:
    - Who cares about this issue?
    - Where would the logical home base be for this effort in your organization?
    - Are there individuals in that part of the organization who might be willing to take ownership of this project?
    - Are there external organizations or facilities that need to be involved?

1.5 What Resources Will You Need?

In addition to identifying an implementation team, your project will require both material and human resources. It is also important to meet with senior administrators to determine if funding is available, and how much. Consider creating a checklist, such as the **Resource Needs Assessment (Tool 1E)**.

1.6 What If You Are Not Ready?

You should not move ahead unless you are confident that your organization is ready, based on the results of the tools discussed thus far. You should assess each area of readiness for the implementation of new clinical practice guidelines. To the extent that readiness is not yet evident, or only partial, it is critical to take steps to address those areas. At a minimum, the facility must have one senior leader who understands the importance of this effort and is committed to supporting the effort, both with resources and in terms of any necessary changes to workflow processes.

Ways to build readiness and support may include—

1. Trying implementation in a single receptive unit to demonstrate success to the rest of your organization.
2. Holding one-on-one meetings with key official and unofficial leaders to present your case for change and persuade them that improvement efforts will pay off.

3. Collecting and sharing data on the magnitude of KPC infection rates, either in your facility or in your geographic area.
4. Identifying and recruiting project allies who can help spread the word.
5. Conducting a general staff awareness campaign.

Section 2. Starting Your Project

The work of redesigning existing clinical practices must start with an assessment of the current state of staff knowledge and practice, so that a plan for change can be developed in response to specific needs in your organization.

In Section 1.5, you identified members of your organization who might be willing to take ownership of this effort. It is recommended that some or all of those people join the implementation team to oversee the prevention effort and help manage the clinical changes.

If you already have experience with using teams to guide practice change efforts, you may be able to skip ahead to Section 3.

In this section, we will consider the following questions:

- How can you set up the implementation team for success?
    - Who should be on the implementation team?
    - How can you help the implementation team get started?
    - How will the implementation team coordinate with other teams working on infection control in your facility?
- What needs to change?
    - How do you start the work of redesign?
    - What is the state of staff knowledge about KPC?
    - How does a KPC-specific intervention differ or fit into existing infection control efforts?
- How should goals and plans for change be developed?
    - What goals should you set?
    - How do you develop plans for change?
- How do you bring staff into the process?
    - How do you get staff engaged and committed to new KPC infection control guidelines?
    - How can you help staff adopt new practices?

2.1 How Can You Set Up the Implementation Team for Success?

An infrastructure to support clinical process redesign will help your organization adopt new clinical guidelines. The center of this infrastructure tends to be an interdisciplinary implementation team with strong links to hospital leadership, members who have necessary clinical expertise, a clearly defined task, and access to the necessary resources.

Successful teams have strong leaders who help define members' roles and responsibilities and keep the team accountable for achieving its objectives. Senior leadership support is important for successful change, but change must happen from the ground up. Frontline health care workers, including physicians and nurses, must be actively engaged.

This interdisciplinary team will be responsible for initiating the KPC prevention project, making key decisions about project design and working with the units to implement new clinical guidelines and monitor progress. It is essential that it include some members with clinical expertise who can bring that experience to bear in project design.

You will face a number of decisions in setting up the implementation team. Decisions will include—

- Who should you put on the team?
- How can you help the team get started on its work?

2.1.1 Who Should You Put on the Implementation Team?

As suggested above, the most effective teams have several characteristics:

- **Interdisciplinary:** Infection control nurses, infectious disease specialists, and bedside staff all will be key to bringing practical and clinical knowledge to the process. Use **Tool 2A (Multidisciplinary Team)** to help identify other possible team members.
- **Strongly linked to leadership:** One way to have adequate senior leadership support is to include a senior leader on the team, but this may not always be feasible or appropriate. As an alternative, consider asking senior leadership to designate a champion for KPC prevention, and the team's leader can stay in contact with that person.
- **Linked to Quality Improvement:** The implementation team will be strengthened by having a member with expertise in process improvement methodology and team facilitation.
- **Linked to the affected clinical areas:** It is not always possible to anticipate all of the areas of your facility that will need to be involved, but it's important to think broadly about the units and departments that might be affected by the initiative.

See Tool 2A for suggestions about different staff members and stakeholders to include on your implementation team.

Resources: Visit these Web sites for ideas on selecting implementation team members:

- www.ihi.org/IHI/Topics/ImprovementMethods/HowToImprove/formingtheteam.htm
- http://www.ahrq.gov/professionals/education/curriculum-tools/cusptoolkit/modules/assemble/index.html

2.1.2 How Can You Help the Implementation Team Get Started?

Changing routine processes and procedures to alter the way in which people conduct their day-to-day work is challenging. Successful implementation teams pay explicit attention to the development of systems that make new clinical practices obvious, easy, reliable, and efficient, but the way they do their work may vary.

The team will need to consider the following questions:

- **How will the team do its work?** This question refers to the day-to-day of team operations, what resources are needed and what methods the team will employ to do its work. How will the team assess current knowledge and practices? How will the team use that information to change clinical practices? How often will it meet? How will members communicate with each other?
- **What's the team's agenda?** The team needs a clear charge and scope for its work. Can leadership provide team members with a clear understanding of the short- and long-term goals and timeframes for implementation of KPC prevention efforts?

Here are some tips on effective teamwork:

- Write a clear statement articulating the scope of the implementation team's charge.
- Ensure that senior leadership agrees with the statement.

- Communicate with team members about why they have been included and make sure their efforts are recognized.
- Provide team members a basic orientation to quality improvement principles and approaches.
- Make sure your team has the information it needs about the scope of the KPC problem at your facility and at nearby health care institutions, and your reasons for doing this work.
- Be clear about the expected outcomes of the project.
- Schedule team meetings at a time and place convenient for team members, and make sure meetings are scheduled frequently enough to make progress.
- Develop a timeline for specific tasks and outcomes.
- Assign team members responsibility for those tasks and outcomes.

2.1.3 How Will the Implementation Team Coordinate With Other Teams Working on Infection Control?

In the remainder of this section we will discuss activities that the implementation team will manage. The implementation Team will need to collaborate with people involved in infection control more generally, as well as those working on quality improvement in individual units.

The KPC control project will look at the strengths and deficits in existing infection control efforts and evaluate how new clinical guidelines can fit into existing workflows. The team will determine what changes need to be made, and what specific practices, tools, and materials it needs to accomplish its goals. The implementation team will need to call on infection control or infectious disease specialists and/or unit-based quality improvement teams. Infection control and unit-based quality improvement teams will be responsible for maintaining gains.

The implementation team will need to ensure that all relevant stakeholders are involved, and that the respective roles of both the team and other relevant parties not on the team are clear in order to avoid overlapping and duplicated effort. Each team should be responsible for specific tasks and project outputs, and the breakdown of those tasks should be clear from the start. The implementation team needs to think about not only individual responsibilities of team members, but also ways those responsibilities interact, types of ongoing communication and reporting needed between members, and the best method to link work across organizational units.

2.2 What Needs To Change?

In this section, we identify the steps the implementation team needs to take to assess the current state of infection control practice. These steps are based on the principles of quality improvement, defined broadly to include system redesign and process improvement.

2.2.1 How Do You Start the Work of Redesign?

Many of the tools the team will need are either provided or referenced in this toolkit. Your organization may already be familiar with this type of quality improvement process. If you are not sure about the strength of your organization's quality improvement infrastructure, you may want to complete the quality Improvement Process Inventory (**Tool 2B**) found in the Tools and Resources section. If some of the quality improvement processes listed in this inventory are not fully operational or present at all in your organization, you may need to build your team's improvement capability. Improvement efforts tend to be the most successful when teams follow a systematic approach to analysis and implementation; however there are many different approaches.

Here are a few examples of improvement processes:

- **PDSA (Plan, Do, Study, Act**)—PDSA assumes that not all information or factors are available at the outset; thus, repeated cycles of change are going to be necessary in order to achieve the goal, each cycle closer than the previous. With the improved knowledge, we may choose to refine or alter the goal (ideal state).
- **Six Sigma**—Developed at Motorola, Six Sigma relies on careful analysis of data on deviations from specified levels of quality, and uses redesign to bring about measureable changes in those rates. Six Sigma incorporates a specific infrastructure of personnel with different levels of training in the methodology (e.g., "Champions," "Black Belts," etc.) to take different roles in the process.
- **LEAN/Toyota Production System (TPS)**—TPS is an integrated set of practices designed to bring problems to the surface in the context of continuous workflow, level out the workload, develop a culture of stopping to fix problems, promote the use of standardized tasks, enable worker empowerment to identify and fix problems, allow problems to be visible, and ensure the use of reliable technology that serves the process. If your organization already has a well-established quality improvement process, connect your KPC project with those processes.

2.2.2 What Is the Current State of KPC Prevention Activities?

It will be useful to link new KPC guidelines to existing work being done on infection control in your facility, your referral network, and your community. The work of implementing new KPC control guidelines will mean assessing current infection control practices. In addition to the tools discussed below, you may want to look ahead to Section 5 for additional tools assessing screening practices.

Consider the following questions:

- What aspects of your current KPC prevention procedures follow best practices?
- What practices diverge in small or major ways?
- Which gaps are organization-wide? Which are specific to one or more units?
- What are other facilities in your community already doing to control the spread of KPC?

Understanding the Organizational Context of Infection Control Activities

As a preliminary step, the implementation team will want to review the organizational context for existing screening and monitoring practices on the units:

- Have your efforts to control healthcare-associated infections in general been effective? If not, what barriers have they encountered? How can you avoid the same problems? If they have been successful, are there lessons they can build on?
- Does your organization have an infectious disease specialist or infection control nurses, or both? If not, what are your options for building or acquiring that expertise?
- Are physicians involved in infection control on the units? In what ways? What are their attitudes?
- How is information about emerging infections documented and shared? What metrics, if any, are used to assess organizational performance on infection control or with respect to regular screening of admitted patients?
- Is information about emerging infections documented and communicated with referring facilities? Or other facilities in your community?

Understanding the Current Process on the Units

In order to integrate KPC prevention activities into existing infection control procedures, it's important to have a full picture of those practices. In many organizations, there are gaps between best practices and actual work practices; the extent and size of these gaps is usually unknown until current practices are systematically examined. Understanding current practices will help you better target your approach and document progress that is made. Best practices for KPC prevention are outlined in Section 3, and approaches to measuring key processes of care are outlined in Section 5.

Process Mapping To Document Current Practices

You can use process mapping to examine the key processes where infection control activities could/should be happening. Process mapping can be applied to a specific process, such as inpatient admissions to the Emergency Department, to better understand which individuals carry out each step of the process. Pay particular attention to both the movement of the patient and the movement of the information.

Define who will conduct the mapping and exactly what process will be mapped. Clearly define a start point and an end point and a methodology of all of the processes that are mapped. Making these decisions ahead of time will greatly improve the quality of the data you collect.

Integrating Change Into Current Work Routines

Beyond mapping current clinical practices, and identifying gaps between best practices and actual practices, it's important for the team to think about how recommended care guidelines can be integrated into current infection control practices, or general patient care workflow. It is essential that the team examine how new activities relate to other existing efforts, such as those related to hand hygiene and infection control, in order to ensure that new processes fit logically with existing efforts and do not create unintended consequences. For example, in one hospital, collecting samples from patients was initially assigned to day-shift nurses; however, a later analysis of the unit workflow revealed that it fit better into the patient care activities carried out near the end of the night shift, and responsibility for this process was thus shifted from days to nights. Steps to consider:

- Conduct an assessment of current practices on a sample of representative units to determine existing infection control practices that can be translated to work on KPC prevention and control.
- Use process mapping to describe current control and prevention practices and identify potential problem areas. Process mapping will enhance your understanding of how and when infection control fits into existing care processes. Compare assessment results across units to determine which prevention challenges are organizationwide and which may be unit specific.
- Determine what practices need changing and consider how the new practices can be built into ongoing routines.

See Tool 2C, Current Process Analysis for tips on how to carry out a process analysis in order to understand the current state of practice.

2.2.3 What Is the Current State of Staff Knowledge About KPC?

KPC is an emerging infection that some staff members may not know about. Additionally, staff may have varying levels of knowledge about healthcare-associated infections more generally due to staff turnover, prior knowledge, and training. In order to address these gaps through education, you need to know what the gaps are and where they are located.

Based on an analysis of current staff knowledge, you can assess potential barriers to change. For example, do staff members believe infections are inevitable? Do they believe it's too challenging to maintain contact precautions with family members entering and leaving patient rooms? Because not all barriers are evident from the beginning, it's important to continue to be attentive to potential barriers as implementation moves forward. Here are some steps to consider:

- Administer an inventory of KPC infection knowledge and infection control knowledge more generally to staff members **(Tool 1A)**.
- Consider collecting demographic information at the same time so that your results can be analyzed by unit and occupation. Since this is an educational needs assessment, we do not recommend asking staff to include their names unless they want direct feedback on their score, since that may decrease participation. Develop methods to correct knowledge gaps and misunderstandings.

2.3 How Should Goals and Plans for Change Be Developed?

In the following sections, the toolkit provides guidance on how to develop goals and implementation plans for the changes you have determined are necessary.

2.3.1 What Goals Should You Set?

Once the team has analyzed the data collected, the team will want to review the evidence on best practices and the clinical guidelines found in Section 3. Before turning to these steps, the team will need to set goals for improvement. These may be related to specific outcomes (e.g., a reduction in the incidence rate of KPC in a specific unit, or an increase in successful isolation of colonized patients) and/or to specific processes (e.g., successful screening of all patients admitted through the emergency room). Goals should be related to both current data and broader benchmarks. It will help you identify your next steps.

For example, your analysis may have revealed specific problems related to processes of care:

- While staff maintain contact precautions when in physical contact with the patient, they do not wear masks or gowns when they enter the room but do not plan to touch the patient.
- Contact precautions are not maintained if/when patients are transferred to general medicine floors.

If you identify gaps in care processes, you may want to set improvement goals aimed at reducing those gaps. If you identify gaps in staff knowledge, you may want to set improvement goals in that area. These are key actions to take:

- Set improvement goals based on outcomes and processes
- Identify internal and external benchmarks to judge goals and progress
- Use goals to guide next steps in redesigning infection control practices

2.3.2 How Do You Develop a Plan for Implementation?

By now, the implementation team will be in place, and you will have developed much more information about the current state of infection control in your organization. The current state of

quality improvement efforts in your organization should also be clearer, and a specific team of staff members should have been identified to advance KPC control and prevention efforts. It is now time to develop a more specific plan for implementing new practices and assessing the plan through consistent data collection and analysis. This plan should be extended and refined by work to be completed in response to additional questions we explore in Section 4.

While this plan will need to be flexible in order to be responsive to particular unit-based variation, it is critical to formulate a comprehensive plan to guide next steps. The clinical guidelines and best practices discussed in the next sections are critical to the implementation plan, but are not independently sufficient. They must be implemented within the context of many other factors.

Also, it is important to begin thinking early about sustaining the improvements you have put in place (as discussed in Section 6). Thus, the implementation plan should address—

- Membership and operation of the interdisciplinary implementation team
- Clinical practice guidelines to be met
- Gaps in staff education/competence to be addressed
- Plans for rolling out new standards and practices where needed
- Accountability for monitoring implementation
- Ways changes in processes and performance will be assessed
- Ways the effort be sustained

The Plan of Action found in Section 7, Tools and Resources, can be a useful template for developing your implementation plan (Tool 2D)

2.4 Checklist for Managing Change

This is a good time to make sure the steps taken so far will contribute to a successful launch of your effort. Use this checklist to make sure you've addressed all of the key areas.

Area	Completed
Implementation Team composition	
• Team leader identified and in place	
• Members with necessary expertise/roles identified and invited	
• Linkage to senior leadership defined and established	
Team startup	
• Team agenda and charge clearly stated	
• Team has necessary training and resources to get started	
Current state of practice and knowledge	
• Current practice and policies systematically examined	
• Challenges to good practice identified at organization and unit levels	
• Staff knowledge assessed	
Starting the work of implementation	
• Approaches to implementation explored and chosen	
• Gap analysis of current practice and guideline-consistent practice completed	
Setting goals and plans for change	
• Specific goals set	
• Plan for making changes to meet those goals initiated	
• Preliminary plan for sustaining those changes established	

Section 3. Putting Your Intervention Into Practice

3.1 Understanding the Epidemiology of KPC and the Apparent Inability of Standard Infection Control Practices To Contain and Control KPC

KPC was first reported in North Carolina in 2001, and to date it is the most common type of carbapenemase encountered in the United States. KPC is an enzyme that inactivates all β-lactam antibiotics, including penicillins, cephalosporins, monobactams, and carbapenems. Genes encoding for KPC enzymes are located on plasmids, and other resistance-factor genes are often linked on the same plasmid. There are 10 variants of KPC (KPC-2 to KPC-11). ***Klebsiella pneumoniae*** **isolates positive for carbapenemases typically exhibit resistance to almost all available antimicrobial agents, and infection with a KPC-positive organism has been associated with high rates of morbidity and mortality, increased length of stay, and high costs.** KPCs have also been found in many other gram-negative species including: *Escherichia coli, Enterobacter species, Salmonella enterica, Proteus mirabilis, and Citrobacter freundii, Serratia species, Pseudomonas species,* and *Acinetobacter baumannii.*

Since first described, KPC has spread rapidly in the United States as well as around the world. Endemic in areas such as the northeastern United States, Israel, Colombia, and Greece, KPC colonization is routinely found in patients in both acute- and long-term–care facilities, but reports of community-onset infections with KPC-producing organisms have been rare. Patient risk factors for KPC colonization include recent treatment with broad-spectrum antibiotics, advanced age, nursing home residence, or recent acute-care hospitalization. The rapid spread of KPC is thought to be related to the inter-institutional transfer of asymptomatic patients with rectal KPC colonization. The spread of KPC-producing organisms in health care settings represents a serious infection control issue.

Accurate detection of isolates harboring KPC remains challenging because automated susceptibility testing systems fail to detect low-level resistance. In addition, traditional infection control strategies that only target monitoring of clinical isolates as a trigger for initiating control interventions have not proved effective for KPC control, and are only addressing the "tip of the iceberg," since there are about 100 colonized patients for every infected patient.

Recently, the CDC has provided CRE prevention guidelines for health care professionals, acute- and long-term–care hospitals, and health departments. The recommendations emphasize the need to develop CRE prevention interventions on both a facility and regional basis. The new recommendations include enhancing compliance with hand hygiene, placing CRE-colonized or CRE-infected patients on contact isolation precautions, minimizing use of invasive medical devices, patient and staff cohorting (i.e. designated nursing staff working with colonized or infected patients), promoting antibiotic stewardship, and screening patients with risks for CRE. The CDC recommends that, in areas where CRE is endemic, health care facilities undertake two additional measures: active surveillance for CRE and use of chlorhexidine bath or wipes. Visit www.cdc.gov/mmwr/preview/mmwrhtml/mm6209a3.htm?s_cid=mm6209a3_w and www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf for more information.

While active-surveillance–driven initiation of isolation precautions for MDRO control is a controversial topic in infection control circles, the literature suggests that active screening programs can effectively control MDRO prevalence when they rapidly identify colonized patients and place them into contact isolation precautions, such that a high percentage of total

MDRO patient colonization days are spent as contact isolation days (see Burton, et al, below). Furthermore, numerous reports indicate that this strategy has reduced the prevalence of KPC colonization on a hospital unit, within an institution, and on a regional and national basis.

Suggested references:

U.S. Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, Division of Healthcare Quality Promotion.Guidance for Control of Carbapenem-Resistant Enterobacteriaceae, 2012 CER Toolkit. Atlanta, GA: CDC. www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf.

Siegel J, Rhinehart E, Jackson M, et al. Management of Multidrug-Resistant Organisms in Health Care Settings, 2006. Atlanta, GA: U.S. Centers for Disease Control and Prevention. www.cdc.gov/mmwr/preview/mmwrthml/mm5810a4.htm.

Peterson L, Diekma D. To screen or not to screen for methicillin-resistant *Staphylococcus aureus*. J Clin Microbiol. 2010 March;48(3):683-689. PMCID: PMC2832433.
Currie B. Impact of molecular diagnostics on infection control. Inf Dis Special Edition. 2011;14:11-15.

Kochar S, Sheard T, Sharma R, et al. Success of an infection control program to reduce the spread of carbapenem-resistant *Klebsiella pneumoniae*. Infect Control Hosp Epidemiol. 2009 May;30(5):447-52. PMID: 19301985.

Burton N, Aguirre D, Leung S, et al. PCR based active surveillance for carbapenem-resistant *Klebsiella pneumoniae* (KPC) colonization with rapid initiation of contact isolation achieved significant reduction in KPC colonization prevalence in the ICUs of a NYC medical center. Presented as oral abstract at ID Week 2012, San Diego, CA.

Borer A, Eskira S, Nativ R, et al. A multifaceted intervention strategy for eradication of a hospital-wide outbreak caused by carbapenem-resistant *Klebsiella pneumoniae* in Southern Israel. Inf Control Hosp Epidemiol. 2011 Dec;32(12):1158-65. Epub 2011 Oct 17. PMID: 22080653.

Ben-David D, Maor Y, Keller N, et al. Potential role of active surveillance in the control of a hospital-wide outbreak of carbapenem-resistant *Klebsiella pneumoniae* infection. Infect Control Hosp Epidemiol. 2010 Jun;31(6):620-6. PMID: 20370465.

Munoz-Price L, Hayden MK, Lolans K, et al. Successful control of an outbreak of acute *Klebsiella pneumoniae* carbapenemase-producing *K. pneumonia* at a long-term acute care hospital. Infect Control Hosp Epidemiol. 2010 Apr;31(4):341-7. PMID: 20175685.

Schwaber M. Lev B, Israel A, et al. Containment of a country-wide outbreak of carbapenem-resistant *Klebsiella pneumoniae* in Israeli hospitals via a nationally implemented intervention. Clin Infect Dis. 2011 Apr 1;52(7):848-55. PMID: 21317398.

3.2 Detection of KPC Colonization

Detection of KPC has already proven itself to be a diagnostic problem for the clinical laboratory. KPC-positive bacterial isolates exhibit high variability regarding which carbapenems they hydrolyze, as well as exhibiting day-to-day variation in their ability to hydrolyze any given carbapenem drug. Particular issues with phenotypic or culture identification arise when measured minimum inhibitory concentrations are low, as phenotypic testing may misidentify some isolates as carbapenem susceptible when they are in fact KPC positive.

A variety of phenotypic (culture-based) approaches for the detection of KPC colonization have been reported in the literature. They rely on the use of selective screening plates to identify carbapenemase production, followed by speciation of the isolate using standard automated clinical microbiological systems routinely used. Selective screening plates have included:

1. MacConkey agar plates supplemented with 1.0 µg/ml of meropenem.
2. Selective and Disclosing Media (select for carbapenem resistant-colonies which are color tinged depending on species). These products are commercially available and are marketed as CHROM agar KPC, Brilliance CRE, Hardy CHROM carbapenemase, and Chrom ID.

Similar to routine diagnostic testing in the clinical lab, these screening plates will have issues with sensitivity and specificity, especially when carbapenem MICs are low. They are also associated with fairly long turnaround times to get results, and they require a trained microbiologist to pick appropriate colonies from the plates. They are labor intensive to perform and do not easily fit into clinical laboratory workflow patterns. On the other hand, they are relatively inexpensive and will work well in surveillance situations where rapid turnaround is not necessary. Typical turnaround times for phenotypic detection of KPC are 3–5 days.

A variety of molecular diagnostic approaches for KPC detection have been described in the literature. These approaches primarily consist of “homegrown” real-time multiplex polymerase chain reaction (PCR) assays. PCR primers have been designed to detect all known variants of the KPC gene (KP2 to KPC 12) and their sequences have been published. A single commercial product, Hy-KPC PCR (Hy Laboratories, Ltd.), is available. None of the assays are FDA approved. These assays have been proven to be highly sensitive and specific, with turnaround times of several hours, and have been optimized for use with direct swab samples. However, PCR testing will require purchase of specialized equipment and trained technicians. Successful KPC control interventions using PCR-driven active surveillance coupled with timely initiation of contact isolation have been previously reported. Rapid turnaround time may be critical to intervention success.

In summary, both traditional culture-based methodologies and PCR detection have been used successfully as part of KPC control efforts. While molecular detection methods appear to offer many advantages as a screening tool (rapid turnaround time and improved sensitivity and specificity), they are not FDA approved and are only commercially available on a limited basis.

Each institution will need to carefully choose among the available screening methodologies to support their active surveillance program, and lack of ability to implement molecular testing should not otherwise prevent pursuit of aggressive CRE control efforts using existing culture techniques.

Suggested references:

Birgy A, Bidet P, Genel N, et al. Phenotypic screening of carbapenemases and associated *β*-lactamases in carbapenem-resistant *Enterobateriaceae.* J Clin Microbiol. 2012 Apr;50(4):1295-1302. Epub 2012 Jan 18. PMID: 22259214.

Wilkinson KM, Winstanley TG, Lanyon C, et al. Comparison of four chromogenic culture media for carbapenemase-producing *Enterobateriaceae*. J Clin Microbiol.2012 Sep;50(9):3102-4. Epub 2012 Jul 3. PMID: 22760041.

Singh K, Managold KA, Wyant K, et al. Rectal screening for *Klebsiella pneumoniae* carbapenemases: comparison of real-time PCR and culture using two selective screening agar plates. J Clin Microbiol. 2012 Aug;50(8):2596-2600. Epub 2012 May 23. PMID: 22622443.

Richter SN, Frasson I, Biasolo MA, et al. Ultrarapid detection of *bla* $_{\text{KPC ½-12}}$ from perirectal and nasal swabs by use of real time PCR. J Clin Microbiol. 2012 May;50 (5):1718-1720. Epub 2012 Feb 29. PMID: 22378915.

Chen L, Mediavilla JR, Endimiani A, et al. Mulitplex real-time PCR assay for detection and classification of *Klebsiella pneumoniae* carbapenemase gene (bla_{KPC}) variants. J Clin Microbiol. 2011 Feb;49(2):579-585. Epub 2010 Dec 1. PMID: 21123529.

Section 4. Implementing Best Practices

The decision to choose a KPC detection methodology should be made in collaboration with your institution's clinical microbiology laboratory director and should include a careful review of existing staffing, equipment, financial resources, and laboratory expertise. Planning strategies should include the resources to handle the anticipated volume of samples and include a plan to notify appropriate staff when patients colonized with KPC are identified. Important questions to address include—

- How and when will samples be collected and transmitted to the lab as part of the clinical workflow?
- How will the lab handle this new and additional workflow?
- What is the anticipated volume of samples?
- How and when will clinicians be notified of screening results? What will happen then?
- Are adequate supplies of personal protective equipment available on the unit(s) where screening occurs? Do all staff know when/how to use them in caring for KPC-positive patients?

4.1 Collecting Patient Specimens

Although patients can be colonized with KPC at any anatomic location (e.g., asymptomatic bacteruria, chronic wounds, etc.), previous studies have documented that a peri-anal swab sample will detect all KPC colonized patients.[2] Cotton-tipped swabs in use at the institution will suffice. Do not assume that the collection of samples is intuitive to hospital staff—consider providing laminated sheets that document and illustrate the sampling process (see **Tool 4A** for an example). While obtaining a peri-anal swab sample is a noninvasive procedure, it is a sensitive issue for many patients. Strong consideration should be given to having nursing staff obtain the samples. They can incorporate sampling seamlessly into their normal patient care activities, enhancing patient acceptance and compliance with sampling and preventing disruption caused by unnecessary patient maneuvering for the sole purpose of sampling. Patient samples should be identified with routine labels currently in hospital use. Place pickup containers on each patient care unit for pickup of specimens at designated times. Specimen pickup provides an opportunity to review with nursing staff whether any issues or problems associated with obtaining samples. Specimens do not require either incubation or refrigeration, as *Enterobacteriaceae* are robust organisms. The importance of complete sampling of all target patients should be stressed as an important determinant of intervention success.

4.2 Surveillance Strategies

No single approach to KPC surveillance will optimally address all scenarios of KPC prevalence, and your approach should be designed and customized to address the situation at your institution. Active surveillance should be considered when KPC clinical cultures begin to appear at your institution, or at another health care facility in your geographic area (many public health departments are facilitating the sharing of this information about MDROs in recognition

[2] Simkins J, Pokharel R Dogra S, et al. Prevalence of carbapenemase-producing *Klebsiella pneumoniae* colonization at an academic medical center in New York City. Abstract 1349 presented at Infectious Diseases Society of America annual meeting, Boston, October 22, 2011.

that the problem requires population-level monitoring). Surveillance approaches might include periodic prevalence surveys involving a representative sample of inpatients, including both geriatric and intensive care unit (ICU) patients, such that every third inpatient is sampled during a 1- to 2-week period.

Given the importance of inter-institutional transfer of KPC-colonized patients to the spread of KPC, the survey should include a sampling of emergency department patients who are nursing home residents or recent discharges from other acute-care hospitals who have been admitted but not yet transferred to an inpatient unit. Also include a sample of patients directly transferred to your hospital's inpatient areas from similar facilities. Here rapid reporting of test results is not important, and you may elect to use a culture-based technique for KPC detection.

If results reveal a significant presence of KPC among your patients or in patients recently discharged or transferred from other institutions, escalate your KPC control program to include more aggressive approaches. If results indicate a low prevalence, repeat your survey at regular intervals. If the KPC prevalence rate is greater than 2 percent or KPC is present at a neighboring institution, immediately escalate your KPC control efforts. Even with KPC colonization rates of 5 to 7 percent (endemic to epidemic rates), enhanced KPC control programs have significantly reduced the prevalence of KPC colonization. If you and your neighboring institutions share a significant KPC colonization prevalence rate, consider collaborating on a joint KPC control program.

Infection control practitioners may find it valuable to contact their peers at other institutions in their region to periodically exchange information about the emergence and/or prevalence of KPC in nearby institutions. Both acute- and long-term–care facilities should be included in these information exchanges. In addition, the CDC recommends that public health authorities develop programs to monitor KPC activity within their jurisdictions. Some state and county health departments now require reporting of all KPC isolates. Local health authorities may provide valuable information about potential KPC activity in your area. See the recent CDC toolkit for more information (CDC CRE 2012 Toolkit, "Guidance for Control of Carbapenem-Resistant Enterobacteriaceae (CRE), 2012 CRE Toolkit" www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf). Escalation of your control program should include active surveillance coupled with rapid initiation of contact isolation precautions for every colonized patient. Here the emphasis is on testing all patients in a target group, rapidly identifying KPC-colonized patients, and initiating contact isolation. The process needs to be designed and executed in timeframes that will allow at least 85 percent of total patient KPC colonization days to be in contact isolation. Complete sampling of the target population is required, as well as daily sampling of patients transferred or admitted to the target population.

A typical active surveillance program would include weekly sampling of the total target population and daily testing of newly admitted/transferred patients. To measure your impact on KPC colonization prevalence rates, collect baseline data before you initiate your intervention strategy. This can be accomplished by weekly sampling of all target patients pre-intervention. Results from a previous cross-sectional sample of your patients can provide important information to identify your target population. KPC colonization prevalence may cluster in certain locations in your facility, such as geriatric service, critical care units, or patients transferred from other institutions directly to inpatient areas or admitted through the emergency department. Alternatively, if you have not conducted exploratory cross-sectional sampling for KPC colonization or believe the prevalence of KPC patient colonization is already increased at your hospital, you may choose to strategize to limit the prevalence of KPC among vulnerable patient populations, such as ICU patients.

References from Section 3.1 provide road maps for successful KPC control interventions for a single clinical unit, all ICU patients in a multihospital network, and an entire acute-care or long-term–care facility.

Section 5. Measuring the Impact of Your Intervention

It is important to measure the impact of your program. While the primary goal of collecting outcome data is to improve patient care, outcome data can serve many other purposes. Tracking appropriate outcome measures allows you to fine tune your intervention program to maximize successful implementation. It is important to demonstrate success to your multidisciplinary team to ensure members' ongoing active participation and compliance. In addition, the information may prove valuable in convincing your leadership to keep supporting your initiative administratively and financially.

5.1 Types of Outcome Measures

Outcome measures can be divided into three major categories:

a. Measuring **the impact** of your intervention

The goal of your intervention program is to reduce the horizontal transmission of KPC to prevent patient colonization. Ideally, you should track the prevalence of KPC colonization (number of KPC positive patients among all those screened) before and after your intervention. If baseline data are not available, track KPC prevalence rates for downward trends. In the prevalence rate, each patient can only count once in the numerator, even those who have been repeatedly positive on weekly sampling. A second helpful measure is to track the number of patients who initially tested negative for KPC and then tested positive. This outcome targets and measures the impact of disrupting horizontal transmission of KPC and preventing colonization. Finally, a crucial outcome measure to track is the percentage of total patient KPC colonization days spent in contact isolation. This is a good indication of how well your intervention is being executed and, in particular, will reflect the timeliness of patient sampling, turnaround testing times, feedback of results to clinical staff, and initiation of contact isolation. Institutions may also want to track actual KPC infections, but it is important to realize that the number of infected patients will be low, even in facilities that are hyperendemic for KPC. Once KPC is established in a facility, there will be approximately 50–100 KPC colonized patients for every detected KPC infection. Monitoring infections as the only outcome can be quite misleading in this setting.

b. Measuring **potential confounders**

Even a well-designed and executed intervention can fail if hospital staff do not comply with the requirements of contact isolation when it is initiated. You may consider tracking staff compliance with hand hygiene; proper use of barrier precautions, including gloves and gowns; and compliance with placement of patients in single rooms. This is best accomplished by periodic unannounced direct observation sessions to ascertain compliance with the elements of contact isolation. Tools for this purpose can be found in **Tool 5A, Infection Control Observation Tool** and at www.jointcommission.org/Measuring_Hand_Hygiene_ Adherence_Overcoming_the_Challenges_.

While seemingly reviewing a patient chart, the observer documents compliance on a checklist tool for a predetermined number of staff-patient encounters. All types of staff need to be observed (physicians nurse, respiratory therapists, etc.). Typically, 30 staff-patient encounters a week is sufficient. This information should be shared with the health care team, and a plan to correct deficiencies should be implemented when necessary, keeping in mind that failures are

often systemic and not solely attributable to individual noncompliance. For example, systemic failures can occur when—

- There is a lack of communication about a patient's colonization status
- There is a lack of accessible personal protective equipment
- There is a lack of understanding about the reasons for the contact isolation

Staff members are frequently not aware of the clinical importance of KPC, even at endemic hospitals, and the fix for poor compliance with contact isolation may need to include staff education about the epidemiology and clinical importance of KPC.

c. Measuring **unintended negative outcomes**

Your KPC control program maybe highly successful but may simultaneously negatively impact other aspects of patient care and hospital operations. Many hospitals already struggle with other multiple MDRO organisms, and the availability of single rooms for contact isolation may already be at a premium. Additional demand for single rooms for the KPC program may result in difficulty in transferring patients within the hospital when the required level of care changes. Tracking delays in transfer related to the inability to find an appropriate single room for continued contact isolation may be important to continued acceptance of your intervention. Concerns about this issue should be explored with staff in targeted areas during the planning stages, and when appropriate, delays should be tracked and measured. Knowledge of KPC colonization status may inappropriately influence the selection of empiric antibiotic therapy. In addition, if PCR detection is used. It is important to remember that these assays are not FDA approved and results should not be used to guide patient therapy. Finally, it is not clinically appropriate to base therapy on colonization status. You may consider tracking polymyxin use before and after you initiate your intervention on the targeted clinical units.

Section 6. Implementing and Sustaining Your Intervention

Before rolling out your intervention, it is helpful to present your program and its objectives to relevant standing committees of the hospital (infection control committee, performance improvement and quality management committee, medical staff committee, and nursing leadership committee) for formal endorsement. Similarly, meet with the nursing director and the chief medical officer to ensure they are aware of the timing of your rollout and to renew their continuing support of your program. Endorsement by the governing structure of the hospital will aid acceptance of your initiative by direct caregivers who will be impacted by the program, and helps assure them that your planning process has been thorough and appropriate and has been carefully reviewed before its initiation.

The actual rollout will take time, at least several weeks, and you should view this initial phase as a "testing the waters." Your program requires multidisciplinary participation and is a complex process with many moving parts. It will take some time to "iron out the wrinkles" until everyone's tasks are integrated into their normal workflow patterns. The project leadership will need to be patient and flexible in rethinking some project design issues, and should spend a great deal of time overseeing this critical period of the rollout process. Rolling out large-scale interventions will almost certainly require a dedicated team approach with daily followup and tracking of each step in the process. Identification of "bottlenecks," poor coordination of activities, and failure to accomplish assigned tasks may require coaching to help participants achieve their tasks and thus enable the overall success of the program. The more you can incorporate each participant's tasks into their normal work routine, the more likely that your program will succeed.

Initiating your rollout should take advantage of already existing meetings and conferences that the involved direct caregivers already attend, such as grand rounds and unit-based nurse manager/nursing staff meetings. This is an effective way to achieve general awareness of your program. Your team should also meet with unit staff for a detailed briefing on their participation and roles. These meetings should be open ended, and participants should be encouraged to ask questions and point out design issues they anticipate. These meetings should "recruit" the participants to all become team members and to take ownership of the program.

These localized rollout meetings are most effective if they: (1) educate staff about the epidemiology and emerging threat of KPC, (2) stress the importance and necessity of this initiative for their clinical practice, (3) introduce the overall design of the intervention, (4) identify specific tasks and responsibilities for each participant, (5) remind them that they must pay close attention to hand hygiene and contact isolation compliance, and (6) reassure them that the intervention team will provide close collaboration and support during the rollout. Consider scheduling meetings in the early morning to simultaneously capture staff from day and night shifts, or videotaping one of the meetings for presentation to staff working off-hour shifts. During initial rollout, the intervention team should visit units daily at sample pickup times to ensure complete sampling of target patients. Team members also will need to track laboratory testing turnaround times, reporting of positive patients to the units, and the speed at which patients are placed on contact isolation.

It is important to give participants periodic feedback about achieving intervention performance metrics. The previous paragraph outlines some metrics you need to track. It is important to share successes with participants to ensure their continued engagement and

enthusiasm. In addition, analyze the intervention clinical outcome data periodically and also share these metrics with participants. Sharing success will help sustain the intervention and provide clinical relevance for participants. Make certain that hospital leadership recognizes and appreciates their success for its importance to the well-being of the hospital's patients and the institution.

Section 7. Tools and Resources

Tool 1A. Clinical Staff Attitudes Toward KPC Control and Prevention

Background: Use this tool to assess clinical staff attitudes before starting your KPC infection control project. It will help identify needs for additional education and advocacy in order to get staff engaged.

I**nstructions**: Let staff know that the information is being collected anonymously, and administer either on paper or via a web survey application.

Use: Use the results to provide feedback to the clinical team on their attitudes.

Clinical Staff Attitudes Toward KPC Control and Prevention

You are being asked to complete this anonymous survey because you are in a staff group that has some responsibility for infection control. Please answer each question based on your own experiences and perceptions. Thank you for taking the time to participate in this important project.

Improving Performance in Infection Control

Definitions: In this survey, we ask about organizational goals, priorities and activities at your facility and in your clinical unit. To clarify a few items as you begin to respond:

By **facility**, we mean the medical center where you are receiving this survey.

By **clinical unit**, we mean the part of the facility in which you work. If you work in more than one unit, please think about the unit on which you spend the most time.

By **team,** we mean the group of people you work with regularly in your clinical unit.

By **senior management,** we mean the top officials in the facility, such as the chief of staff and the nurse executive.

Please indicate the extent to which you agree with the following statements:

1. About your facility:

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
My facility is committed to delivering the highest quality patient care					
My facility has a clear sense of direction					
My facility has a clear action plan that details the steps needed to improve patient care					
At my facility, it is a high priority to provide patient care according to evidence-based guidelines					
The leadership at my facility places high priority on improving infection control in our clinical areas					

2. **About the care provided in your clinical unit:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Day-to-day activities demonstrate that patient care quality is important					
It is difficult to fix quality problems that involve other services at this facility					
Some patients receive too little care					
Patient care processes have been standardized					
Patient care is well coordinated across different parts of the facility					
Handoffs of patients or information across units go smoothly					
I would feel completely comfortable having a family member treated at this facility without my being able to monitor their care					

3. **About your team in your clinical unit:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Our team learns from the efforts of others to improve compliance with infection control guidelines in our facility					
Senior management supports our efforts and helps us obtain the necessary resources and cooperation					
After we have implemented a change, team members think about and learn from the results					
This organization makes sure people have the skills and knowledge to work as a team					
Our service chief or service line manager helps us obtain cooperation and resources from other services or clinical units when needed					
Analyzing clinical processes to identify areas for improvement is a regular part of our work					
When trying to improve performance, we systematically test out new ideas					

4. **About knowledge specific to KPC infections and guidelines**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
The incidence of KPC colonization and infection among our patients is likely to increase in the near term					
KPC is likely to become as big a threat as MRSA and *C. diff*					
Clear and complete information about KPC has been shared with our team					
Our team understands the new infection control guidelines specific to KPC					

5. **About possible barriers to compliance with NEW infection control policies**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
There is a lack of awareness of the new guidelines					
I sometimes forget to follow the new guidelines					
The new guidelines are inconsistent and/or confusing					
The new guidelines are not effective					
Ancillary personnel from outside the unit are not adequately trained on the new guidelines					
The new guidelines are not realistic given our workflow					
There was enough education about the new guidelines					
The necessary supplies/equipment are available to follow the new guidelines					
The supplies/equipment are conveniently located					
Following the new guidelines takes time away from patient care					
Our workload is too heavy to follow the new guidelines					

6. About you

Advanced practitioner (NP, PA, Nurse Manager, Clinical Nurse Specialist)	
Registered Nurse	
LPN or Nursing Assistant	
Physician	
Other Clinical	

Please check the box corresponding to the clinical unit you work in, if you work in more than one please respond with the unit you spend the most time in.

(Put the names of the relevant units at your site here)	
Medical/Surgical ICU	
CT Surgery ICU	
(CCU)	

Tool 1B. Stakeholder Analysis

Background: The purpose of the stakeholder analysis is to help the project team identify departments/individuals who will have an interest in the project, potential barriers, and actions needed to obtain the buy-in and participation of those departments and individuals.

Instructions: The project team can complete this as a group at one of its first few meetings in order to identify relevant stakeholders and their interests and roles.

Use: The team can use this information to develop strategies for getting those stakeholders engaged.

Stakeholder Analysis

Stakeholder	Interest or Requirement in the Project	What the Project Needs	Perceived Attitudes and/or Risks	Next Steps

Tool 1C. Leadership Support Assessment

Background: Many initiatives and projects fail due to lack of senior leadership support and engagement.

Instructions: Use this tool within your team to assess the extent of leadership support for your effort.

Use: If you discover that there are many "no" answers, the team should take some time to develop a strategy for gaining greater leadership support for HAI-related activities. This may include strategies for raising the profile of this issue on the leadership agenda.

Leadership Support Assessment

Leadership Support Assessment	Yes	No
Patient safety is clearly articulated in the organization's strategic plan		
Someone in senior management is in charge of patient safety		
The facility has implemented a shared leadership model		
Funding is allocated for patient safety activities		
The budget includes funding for education and training on patient safety issues		
Prevention of HAIs is a priority within the facility		
The facility has implemented policies to help prevent the spread of HAIs		
Current infection control and prevention goals are being addressed		
There are visible role models/champions for the prevention of HAIs		

Tool 1D. Business Case Form

Background: This tool can be used to make the case for the implementation of a quality improvement initiative by addressing the concerns of key leadership.

Instructions: Please complete the form with all the required information.

Use: Present the completed form to your project sponsor and discuss the potential benefits of the KPC infection control project

Business Case Form

Background of the project (PLEASE KEEP BRIEF)
General aims(s)
Initial Risks
Expected Outcomes
Benefits of Conducting This Project
Initial Cost and Time Estimates **$:** **Time:**
Outcome of the Business Case

Tool 1E. Resource Needs Assessment

Background: Beyond general leadership support, the team is also likely to need specific resources.

Instructions: The team should review this list and consider which entries are needed for its efforts.

Use: Team leaders can use the results of the assessment to shape their resource requests to leadership.

Resource Needs Assessment

Resource Needs Assessment	Resources Needed?	Comments
Staff education programs		
Quality improvement experts		
Infection control consultation		
IT support		
Easily accessible personal protective gear		
Facilities (e.g., meeting rooms)		
Printing/copying		
Protected time for meetings and activities		
Other		

Tool 2A. Multidisciplinary Team

Background: When creating a team, it's important to make sure that participants reflect the range of disciplines and functions that may need to be involved in the team's work. Not all areas listed may be relevant to your particular situation, so it's important to customize this list to your institutional context.

Instructions: Team leaders should use this tool to identify potential team members in each related area.

Use: Team leaders can then use the names generated to help them develop a team that is representative and inclusive on key dimensions.

Multidisciplinary Team

Discipline	Names of Possible Implementation Team Members From Each Area	Area of Expertise
Senior manager		
quality improvement/safety/risk manager		
Infection control specialist		
Staff nurse		
Nursing assistants		
ICU physicians		
Infectious disease specialist		
Medical/Surgical staff		
Other providers		
Patient representative		
Educator		
Materials manager		
Information systems staff		
Lab/Microbiology staff		
Environmental services		
Auxiliary services		
Clerical staff		
Clinicians from frequently referring nursing facilities		

Tool 2B. Quality Improvement Process Inventory

Background: This tool will help you and your team identify the extent to which you have the resources for quality improvement in your organization. Turning Point Initiative developed this form to assess whether an organization has systems in place to improve quality and performance.

Instructions: The implementation team leader should complete this tool in consultation with the quality improvement department. "You" refers to your organization as a whole. Check the box that most accurately describes your organizations current resources.

Use: If you find that your organization has fully operationalized quality improvement processes, connect the pressure ulcer prevention initiative with these existing processes. If some processes are missing, advocate for them to be put into place in the context of the pressure ulcer initiative.

Reference: Turning Point Performance Management National Excellence Collaborative. Performance Management Self-Assessment Tool. Available at: www.turningpointprogram.org/toolkit/pdf/PM_Self_Assess_Tool.pdf.

Quality Improvement Process Inventory

Assessment Questions	No	Somewhat	Yes (Fully operational)
1. **Do you have a process(es) to improve quality or performance?**			
A. Is an entity or person responsible for decision-making based on performance reports (e.g. top management team, governing or advisory board	❒	❒	❒
B. Is there a regular timetable for your quality improvement process?	❒	❒	❒
C. Are the steps in the process communicated?	❒	❒	❒
2. **Are managers and employees evaluated for their performance improvement efforts (i.e., is performance improvement in their job descriptions)?**	❒	❒	❒
3. **Are performance reports used regularly for decision-making?**	❒	❒	❒
4. **Is performance information used to do the following? (check all that apply)**			
A. Determine areas for more analysis or evaluation	❒	❒	❒
B. Set priorities and allocate/redirect resources	❒	❒	❒
C. Inform policy makers of the observed or potential impact of decisions under their consideration	❒	❒	❒
5. **Do you have the capacity to take action to improve performance when needed?**			
A. Do you have processes to manage changes in policies, programs, or infrastructure?	❒	❒	❒
B. Do managers have the authority to make certain changes to improve performance?	❒	❒	❒
C. Does staff have the authority to make certain changes to improve performance?	❒	❒	❒
6. **Does the organization regularly develop performance improvement or quality improvement plans that specify timelines, actions, and responsible parties?**	❒	❒	❒
7. **Is there a process or mechanism to coordinate quality improvement efforts among programs, divisions, or organizations that share the same performance targets?**	❒	❒	❒
8. **Is quality improvement training available to managers and staff?**	❒	❒	❒
9. **Are personnel and financial resources allocated to your quality improvement process?**	❒	❒	❒

Tool 2C. Current Process Analysis

Background: Before beginning a quality improvement initiative, it is important to understand existing practices. This tool is intended for use in describing key processes in your organization where KPC infection prevention activities could/should be happening. Quality Improvement Organizations (QIOs) have developed this tool to provide a guide to identify and evaluate key processes of care.

Instructions: Have the implementation team identify and define every step in the current process for pressure ulcer prevention.

- When defining a process, think about staff roles in the process, the tools or materials staff use, and the flow of activities.
- Everything is a process, whether it is admitting a resident, serving meals, assessing pain, or managing a nursing unit. The ultimate goal of defining a process is identifying problems in the current process.

Use: Determine if there are gaps and problems in your current processes, and use the results of this analysis to systematically change these processes.

Tips:

- Take time to brainstorm and listen to every team member.
- The process must be understood and documented.
- Make each step in process very specific.
- Use one Post-It Note, index card, or piece of scrap paper for each step in the process.
- Lay out each step, move steps, and add and remove steps until the team agrees on final process.
- If the problem is that a process does not exist (for example, there is no current process to screen for pain upon admission and readmission), then identify the related processes (for example, the process for admission and readmission)
- If process is different for different shifts, identify each individual process.

Example: Process for making buttered toast

Step	Define
1	Check to see if there is bread, butter, knife, and toaster.
2	If supplies are missing, go to the store and purchase them.
3	Check to see if the toaster is plugged in.If not, plug in the toaster.
4	Check setting on toaster and adjust to darker or lighter as preferred.
5	Put a slice of bread in toaster.
6	Turn toaster on.
7	Wait for bread to toast.
8	When toast is ready, remove from toaster and put on plate.
9	Use knife to cut pat of butter.
10	Use knife to spread butter on toast.

1. Identify the steps of your defined process

Press for details. At the end of the gap analysis, compile the results in a document that displays each step so that team members have the map of the current process in front of them during the team discussion.

2. Team discussion

Evaluate your current process as you define it:

- What policies and procedures do we have in place for this process?
- What forms do we use?
- How does our physical environment support or hinder this process?
- What staff is involved in this process?
- What part of this process does not work?
- Do we duplicate any work unnecessarily? Where?
- Are there any delays in the process? Why?

Continue asking questions that are important in learning more about this process.

Tool 2D. Plan of Action

Background: The purpose of this tool is to provide a framework for outlining steps needed to design and implement the KPC initiative. The form was adapted from material produced by the Quality Improvement Organization program for the Centers for Medicare & Medicaid Services.

Instructions: The form lists six key tasks. For each, list in the second column the steps that will be taken to address the task, including tools to be used. The form gives examples of steps or activities for each task. In developing the plan, it is not expected that you will provide results but only that you lay out what will need to be done. In the last two columns, determine who will have lead responsibility for completing each task, and estimate an appropriate time frame for completing the activities. Use the plan as a working document that can be revised. As you begin to carry out the plan, you may need to make adjustments and add details to the later tasks.

Use: Use the completed sheet to plan, manage, and carry out the identified tasks. The plan should guide the implementation process, and can be continually amended and updated.

Plan of Action

Improvement Aim: Reduce KPC transmission within the health care setting			
Key Interventions/Tasks	**How will this be done? What specific tools/activities can be used?**	**Which team member(s) will make sure this happens?**	**Target date for completion of task**
Analyze current state of KPC infection control in this organization.			
Identify the bundle of prevention practices to be used in redesigned system.			
Assign roles and responsibilities for implementing the redesigned practices.			
Put the redesigned practices into place.			
Monitor infection rates and practices.			
Sustain the redesigned prevention practices.			

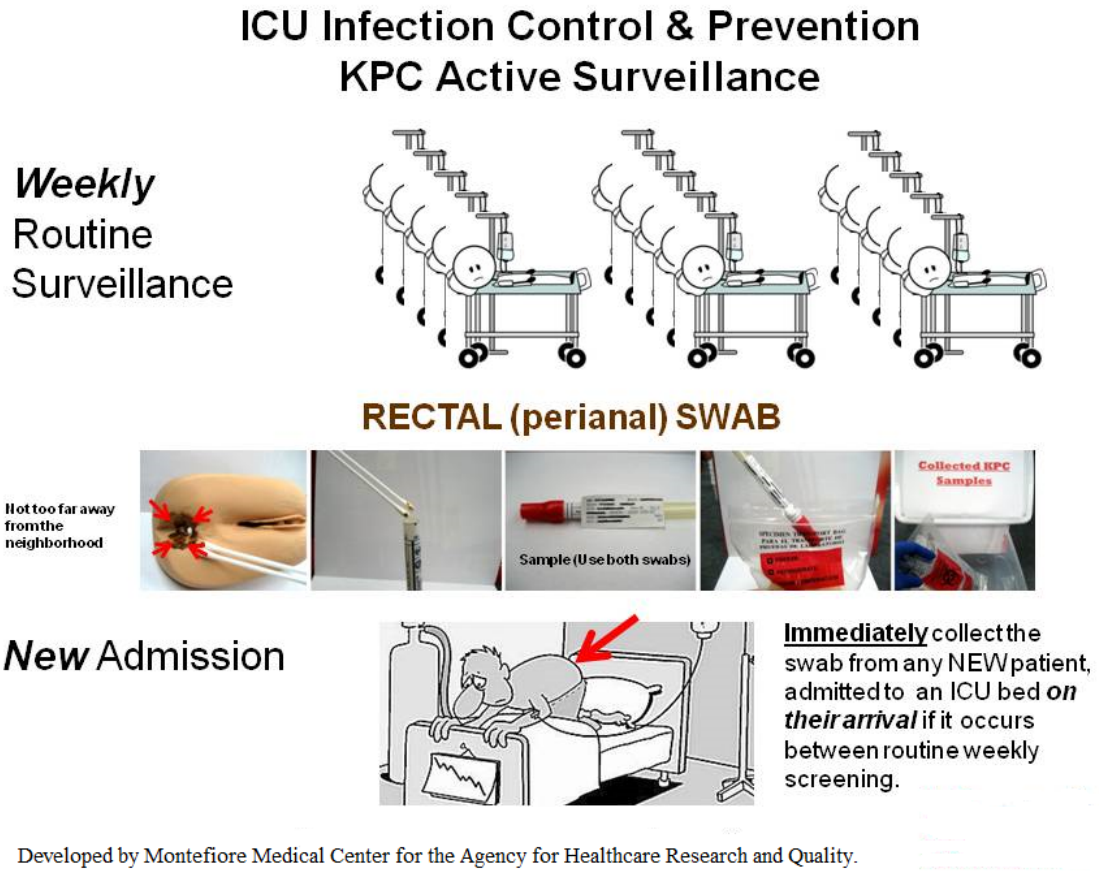
Tool 4A. Sampling Process Graphic

Background: The authors found that the details of the KPC surveillance program were easy for busy nurses to forget, and this graphic was developed as a quick reference card to explain how to do a rectal swab for a sample to test for the presence of KPC.

Instructions: Copies can be laminated and placed in areas where sampling materials are to be located, and where completed samples will be retrieved.

Use: This can also be used to train staff involved in implementing the surveillance program.

Sampling Process Graphic



Tool 5A. Infection Control Observation Tool

Background: Efforts to prevent HAI often benefit from the collection, comparison, and sharing of data on fundamental infection control practices such as hand hygiene.

Instructions: This observation tool can be used to systematically collect data about hand hygiene compliance during multiple hand hygiene opportunities. The tool itself contains instructions about how to best carry out such observations.

Use: Data can be used to identify baseline hand hygiene practices, and then later to see how education and awareness activities may have changed behaviors.

Hand Hygiene Compliance Report

Instructions for Using the Hand Hygiene Observation Tool

1. This tool will be used for quality improvement purposes only. Not to be used for punitive purposes.
2. The purpose of this tool is to collect baseline data about current compliance with the CDC Hand Hygiene Guideline. Hand hygiene means using an alcohol-based antiseptic or soap before and after contact of any kind with a patient or his/her immediate environment. Under certain circumstances, the guideline calls for the use of nonsterile gloves. There is also a circumstance in which an alcohol-based antiseptic is not sufficient and actual hand washing must take place.
3. Data collection needs to be done discreetly, ideally by someone who would normally be in the unit, so that the person's presence is not thought to be unusual. Keep observation tools in a discreet location to minimize influence on current behaviors. It is important to have reliable baseline data.
4. Some suggestions for completing this tool:
   a. Identify your unit and date.
   b. Under staff category, identify the job category of the person you are observing.
   c. A key is listed at the bottom of the tool. For example, a staff physician code is MD, a nurse code is RN, chaplain is CHAP, and so on.
   d. Each category has a column for yes and no. Yes means the individual observed proper hand hygiene as specified on the left side of the tool, or no the individual did not. Make a hash mark for each yes or no. You may have multiple hash marks for each person you are observing in both columns and even within one category of patient contact. Each hash mark represents a discreet observation.
   e. Try to observe the behavior of every job category, not just nurses and doctors. This includes any employee who may have contact with the patient, including x-ray technicians, social workers, respiratory therapists, etc.
   f. Try to get a representative sample that reflects the true number of opportunities for hand hygiene in your unit. This means you could expect more hash marks for nurses than doctors and more for doctors than chaplains. One way to do this is to try to observe a single room for 5 minutes at a time.
   g. This tool can be completed at different times.

Send completed forms to the **Infection Control Unit.**

Hand Hygiene Compliance Report – Please Fax To (Fax number) (Infection Prevention Office) When Completed

INSTRUCTIONS: Observe practice. Include a variety of disciplines. NOTE: Hand Hygiene refers to use of alcohol foam hand rub or washing hands with soap and water for a least 15 seconds. Make a CHECK **(√)** for each hand hygiene opportunity. Please submit a minimum of **30** observations per month per unit.

Name of person completing observation sheet:
_____Date(s):_____

SPECIFY which campus i.e., for example: □ **Main Hospital** □ **Amb Site** **[specify site & address or unit]**:
_____

Staff Title																		
HAND HYGIENE	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Before clean and aseptic procedures, including medication prep and prior to prep, gown, and glove for sterile procedures.																		
Before entering patient's room.																		
After contact with blood, body fluids, secretions or excretions, mucous membranes, non-intact skin.																		
After handling objects and devices such as soiled linen, trash, equipment.																		

After removing gloves or other personal protective equipment used for contact with body substances.																		
Before patient contact or equipment contact.																		
After and/or between patient contact and equipment contact.																		
After leaving patient's room.																		
GLOVE USE																		
Whenever potential for hand contact with blood/body substance.																		
Gloves removed immediately after use to avoid contaminating the environment.																		

GOWN AND GLOVES																		
Worn on entering a patient room on contact precautions																		

6. **Staff Titles**: **MD**=Attending/Resident/Fellow; **MS**=Medical Student; **RN =** Registered Nurse**; NA =** Nursing Assistant**; RT**=Respiratory Therapy; **XR**=X ray; **IVT**=IV Team; **DT**=Dietitian; **CHAP**=Chaplain; **SW**=Social Worker: Other=identify.

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