

exposure to hospital-acquired conditions. Severity-of-illness scores, such as the CURB-65 criteria, can be used to identify patients with CAP who may be candidates for outpatient treatment.¹¹

CDS, when used to manage CAP, can assist clinicians during the critical time period when an assessment of severity must be made to determine a course of treatment. When CDS is used in conjunction with an EHR system, it can influence clinician behavior, diagnostic test ordering, and costs of care, as well as impact clinical outcomes.^{12,13}

The general clinical data elements that make up the CURB-65—demographics (i.e., patient age); vital signs (i.e., blood pressure and respiratory rate), and lab tests—are all required to be included in EHRs as part of the Centers for Medicare & Medicaid EHR incentive program.¹⁴ It is expected that four of five data elements required for the CURB-65 can be extracted from the EHR. These data can be used to trigger a clinical decision support tool (CDS) to calculate severity of CAP. The fifth variable—patient confusion—will most likely need to be assessed by a clinician at the time of the visit and entered into the EHR to fully run the CURB-65. Given that the CRB-65 tool in primary care practices will not require the BUN lab test, clinicians will only need to consider four elements.

Assigning a value of one point for each clinical feature present at the time of diagnosis, the CURB-65 severity score ranges between 0 and 5, with higher scores representing increased mortality risk and need for hospital admission.¹⁵ Once the score is calculated, the outputs of the tool include an estimate of 30-day mortality and a recommended site of care (home or hospital).

The benefits of the CAP alert are:

- It supports accurate appraisal of pneumonia severity
- It provides site of care recommendations to assist in clinical decision-making
- It offers easy access to evidence-based guidelines on management via hyperlinks

How to Use this Toolkit

This toolkit should be used primarily to implement the CAP alert in an ambulatory care setting, such as a primary or specialty care outpatient practice or an emergency room. This toolkit may also help inform your decision about whether to implement the CDS in your practice by clearly describing the steps necessary for its implementation. The toolkit helps explain the impetus for and relevance of the CAP alert, as well as its benefits; it may assist in gaining clinician buy-in for using the tool; and it may serve as a training guide for how to integrate the tool into practice. The tools in this toolkit should be used as guides to assist with the implementation and use of the CAP alert. The specific implementation of the CAP alert in your electronic health record should be considered carefully within the context of your practice and the capabilities of your electronic health record system, and customized to your staff's preferences and workflows. Where appropriate, we provide recommendations and guidance on specific aspects of the design and workflow integration of the tool in your own practice.

Potential Users of the Toolkit

Potential users of the tool and toolkit include clinicians (e.g., physicians, advanced practice clinicians, nurses), administrators (e.g., medical directors, medical information officers, information technology staff, and practice managers), and those developing and implementing the CDS (e.g., informaticists, IT staff). Of these groups, this handbook will be of great value for clinician champions and IT staff charged with leading the administrative, clinical, and technical implementation of the CDS as well as the training of end-users. The settings in which implementation of this tool is appropriate includes ambulatory care settings such as a primary care practice and an emergency department in a hospital.

What are the CAP Alert Tools?

Table 1 below describes each of the four tools you will find in this toolkit and their purpose. Subsequent sections of this handbook will go into more detail on how to integrate these tools into your practice’s implementation of the CAP alert tool. Tool “a” in each set refers to materials pertinent to emergency department (ED) settings, and Tool “b” in each set refers to materials for the primary care setting.

Table 1. Tools Available in the Implementation Toolkit

Tool	Use this tool to...	Description and formatting
For CDS developers and implementers		
Tool 1: Low-fidelity prototype <ul style="list-style-type: none"> ■ Tool 1a: ED ■ Tool 1b: Primary Care 	Implement the CAP alert in your EHR	<p>The low-fidelity prototype of the CAP alert will be an EHR vendor-agnostic visual representation of the design of the tool. This resource could be used by CDS developers/implementers to develop a CURB/CRB-65 tool within their specific EHR.</p> <p>Format: PDF document. There is one version for the ED setting, and one for the primary care setting.</p>
For end-users of CDS		
Tool 2: Workflow diagrams <ul style="list-style-type: none"> ■ Tool 2a: ED ■ Tool 2b: Primary Care 	Help end-users understand the workflow impacts of the tool	<p>The workflow diagrams detail:</p> <ul style="list-style-type: none"> ■ Current state workflows: the baseline workflow for managing CAP ■ Data Flow: a diagram that highlights the points in the clinical process where the data relevant for the CURB-65 tool are introduced ■ Future state workflow: a diagram that demonstrates how the CAP alert can be integrated into the clinical workflow. <p>Format: PDF document. There is one version for the ED setting, and one for the primary care setting.</p>
Tool 3: Pamphlet <ul style="list-style-type: none"> ■ Tool 3a: ED ■ Tool 3b: Primary Care 	Inform CDS end-users	<p>Targeting clinicians, the pamphlet provides a brief overview of the clinical relevance of CAP and the CURB/CRB-65 tool, and the benefit of using this tool. This pamphlet will be available in digital format, but may be printed out for distribution in practices. It can also become a part of the EHR’s knowledge library.</p> <p>Format: Two-page PDF document. There is one version for the ED setting, and one for the primary care setting.</p>
Tool 4: Training slide deck <ul style="list-style-type: none"> ■ Tool 4a: ED ■ Tool 4b: Primary Care 	Train CDS end-users	<p>The training slide deck includes textual and graphic instructions for how and when to use the CAP alert in the practice’s EHR, with an explanation of how the tool fits into the user’s workflow. It also contains background information related to the guidelines supporting the CURB/CRB-65 tool for assessing 30-day mortality.</p> <p>Format: PowerPoint slide deck. There is one version for the ED setting, and one for the primary care setting.</p>

What are the Resources Needed?

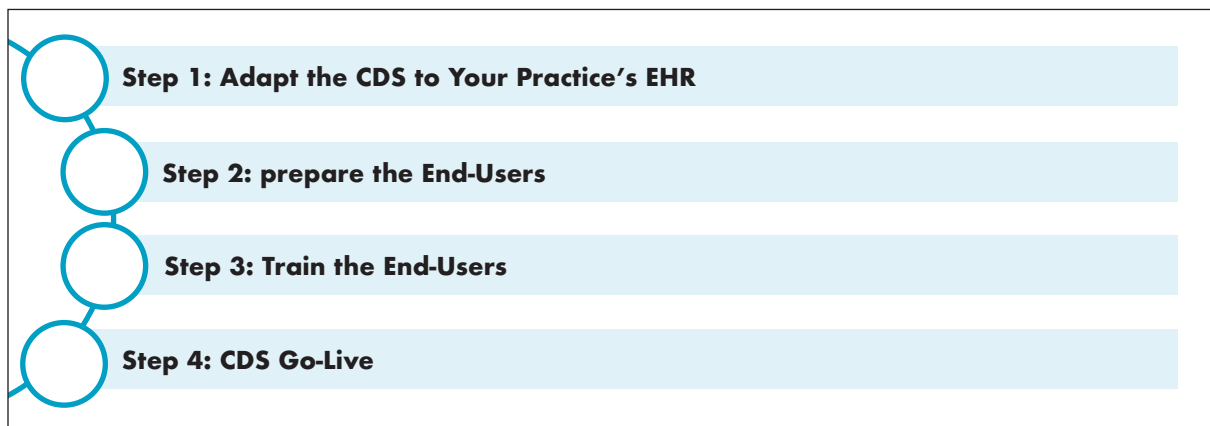
Ideally, a staff liaison or clinician champion will serve as the main resource to drive implementation and adoption of the CDS. He or she helps to bring other potential users of the tool on board and to disseminate the tools in the toolkit at the appropriate points in time, and may be responsible for introducing the tool to other clinicians and being available for technical support. However, because this tool is relatively intuitive to learn and use regardless of ambulatory care setting, and the materials provided in this toolkit should provide all the necessary support, the role of the staff liaison or clinician champion is not expected to be time-consuming.

Additionally, information technology personnel, informaticists, and support may be necessary to adapt and implement the CDS tool in the practice's EHR.

Implementing CAP Alert in Your Practice

The following is an overview of the steps to implement the CAP alert into your practice. The four steps outlined in this implementation handbook can help your practice adapt and implement the CAP alert. See Exhibit 1 Below.

Exhibit 1: CAP Alert Implementation Overview



Step 1: Adapt the CDS to Your Practice's EHR

Once your practice has decided to implement the CAP alert, the clinician champions will need to conduct a workflow assessment to make some decisions about how to implement the alert.

Baseline Workflow Assessment

Tool 2, the Workflow Diagrams, contains two sets of diagrams—one that is applicable to most outpatient clinic settings that do not have rapid availability of lab tests (Tool 2b), and the other that is applicable to settings such as emergency departments where stat lab results can be obtained (Tool 2a). In each set, we provide the following diagrams:

- A view of the workflow prior to the CDS installation
- A view where the required data elements are likely to become available
- A view demonstrating where the CDS is likely to fit in the workflow

Exhibit 2 below provides a set of questions your practice can use to assess your workflow for managing CAP.

Exhibit 2: Baseline Workflow Assessment Questions

1. How is disease severity of CAP currently assessed?
2. What are the tasks of the clinical workflow?
 - a. What is the most common sequence in which these tasks are performed?
 - b. How is the patient engaged for each task?
3. Is the CURB-65 tool used by your practice/department?
 - a. If yes, how is it used?
 - b. Who completes the tool?
 - c. Are the elements captured electronically?
4. If the CURB-65 tool is not used, is another tool such as the Pneumonia Severity Index (PSI) tool used?
5. Are other assessment tools integrated into the EHR?
 - a. If so, how effective have they been?
 - b. Are there preferences in presentation and layout of those?
6. To what extent do clinicians rely on CDS systems in your practice?
 - a. What do clinicians like about them and what would they like to see changed?
7. Would clinicians launch the CAP alert or want it to be triggered automatically?

Workflow Trigger Point Recommendations

Using the tools described in the section above, we recommend conducting both a pre- and post-implementation workflow assessment in both settings to analyze the current practice for managing pneumonia cases as well as each staff person's role in interacting with both the patient and the electronic health record system. Conducting a formal or informal evaluation of the impact of the **CAP alert** on workflow *after* it has been implemented is important to ensure the tool is available at the appropriate point in time for the majority of clinicians.

In Table 2 below, we present the set of triggers used in the pilot of this tool to ascertain the appropriate trigger point for decision-making. In your practice's implementation of this tool, consider whether these triggers are appropriate given the current workflow for seeing patients. We recommend avoiding non-specific chief complaints, as the broader the triggers are, the more it will decrease the specificity of the alert and contribute to firing inappropriately and too often.

Table 2. Advisory Triggers in the ED and Primary Care Settings

Attribute	Characteristics	
Alert	CURB-65	CRB-65
Patient Location	Emergency department	Primary care office
Age	Age >= 18 years	Age >= 18 years
Chief Complaints	<ul style="list-style-type: none"> ■ Cough ■ Respiratory difficulties ■ Respiratory distress ■ Breathing problem ■ Shortness of breath 	<ul style="list-style-type: none"> ■ Cough ■ Shortness of breath ■ Malaise ■ Bronchitis ■ Confusion ■ Pneumonia ■ Recurrent pneumonia ■ Respiratory difficulties ■ Breathing problem ■ Respiratory distress
Other	<ul style="list-style-type: none"> ■ No admission order ■ Chest X-ray marked as "Exam Completed" by radiology technician 	No admission order

Types of Alerts

In the ED setting, we recommend that the CAP alert manifests as an interruptive alert since typical ED workflow has multiple handoffs, and the user seeing the alert will need to act upon the decision support without deferring to another user. If possible, providing the ED user with a “snooze” option is helpful so that the alert does not interfere with urgent patient care needs. In the primary care setting we recommend that the CAPSS-CDS tool be informational and non-interruptive, i.e., presented in a visual display but not necessarily interruptive workflow. In a brief outpatient visit, often as brief as 15 minutes, it is unclear at what point in time it would be appropriate to fire an interruptive alert, thus the CAP alert should be more passive in nature.

Considerations for the Trigger Point of the Interruptive Alert in the ED

Given the exact point of clinician decision-making for site of care is highly variable, careful consideration needs to be given to when to trigger the alert so it is optimally helpful for the clinician. Thus, in order to ensure the workflow trigger point for the interruptive alert in the ED allows for flexibility, we recommend designing the alert with a “snooze” option, much like that of an alarm clock. In this design the alert can fire and the clinician is given some degree of control over responding to the information provided in the alert or selecting the ‘snooze option’ so they can be reminded at a later, more appropriate time.

CDS Adaptation and Design

Information gathered from the workflow assessment can inform the adaptation and design of your practice’s implementation of the CAP alert. **Tool 1**, the Low-Fidelity Prototype (see Exhibit 3 below), can help initiate these conversations. The clinician champion should meet with the IT department and/or EHR vendor. The purpose of this meeting will be for your clinician champion to discuss which features of the CDS will be appropriate for your

practice, potential design considerations, and how the tool will integrate into the clinical workflow based on the workflow assessment. It is suggested that ED settings utilize the CURB-65 version of the tool, while primary care practices utilize the CRB-65 version, given the typical lack of stat labs in the primary care setting.

It is recommended that in an ED setting the tool is initiated after any lab work has been completed and the chest X-ray is marked as “completed” by the radiologist, as described in the previous section. Due to the ED workflow and multiple handoffs, the person making the disposition decision is likely to be the one evaluating the patient after these test results are available. In the primary care setting, the advisory does not depend upon the presence or absence of labs, or imaging results as most of these are available after the conclusion of the patient visit, and thus the CRB-65 does not utilize the BUN element. Most decisions are made without ancillary testing. Moreover, the decision support is not dependent on the results of such testing.

If your practice utilizes the Epic electronic health record, you may download the CAP alert from the Epic UserWeb library. You may feel free to adapt the alert in any way for your own practice.

For sites that plan to adapt the CAP alert for their own EHR systems the following steps should be followed:

- Use patient data that has already been recorded in the EHR.
- Display the information that went into the calculation of either score (CURB/CRB-65).
- Present guidance on CAP severity and what the consequent action ought to be.
- Provide access to CAP treatment guideline.
- Request verbal feedback from representative users on clarity and relevance of information presented.
- Record the parameters of the score in the EHR.

Exhibit 3: Low-Fidelity Prototype (ED Setting)

Pneumonia acuity score and recommendations below

CURB65 score 1		
<small>Details here</small>		
<table style="width: 100%;"> <tr> <td style="width: 5%; text-align: center; vertical-align: top;">1</td> <td> <p>Criteria included: SBP<90, or DBP <=60</p> <p>Criteria not included: Age >=65 Patient confused Last BUN > 20 mg/dL Resp rate >=30</p> </td> </tr> </table>	1	<p>Criteria included: SBP<90, or DBP <=60</p> <p>Criteria not included: Age >=65 Patient confused Last BUN > 20 mg/dL Resp rate >=30</p>
1	<p>Criteria included: SBP<90, or DBP <=60</p> <p>Criteria not included: Age >=65 Patient confused Last BUN > 20 mg/dL Resp rate >=30</p>	
Recommendation: Home (30d mortality 2.7%)		
Acknowledge Reason		
<input type="button" value="Agree with recommendation"/> <input type="button" value="Disagree with recommendation"/>		

Two other possible considerations for design, if it is within the capacity and resources allocated for your own implementation, is to design the alert where the CURB/CRB-65 score and recommendation appear together first for a simplified view, and then if the clinician wants more information, they can click to view the criteria and other information present in Exhibit 3 above. The second consideration is to allow the alert to be “snoozed” by the user to re-appear in a predetermined amount of time.

Step 2: Prepare the End-Users

Once the CAP alert has been adapted to your practice's EHR, it will be time to prepare the potential end-users of the tool.

Inform Staff of Changes

The clinician champion should inform all staff about the upcoming implementation and why it is important. Let them know the benefits of using the tool, the expected impacts to workflow, and resources available for training (Step 3). Here are some possible avenues for announcing the implementation:

- Email
- Staff meetings
- Informal announcements while supervising
- Posting information in the clinic

It is recommended that more than one of these formats be used to ensure the message about the implementation reaches all your staff. The workflow diagrams (**Tool 1**) will be helpful during this process. Another helpful tool to share at this point is the pamphlet (**Tool 3**). This tool gives an overview of the background of CAP and relevance of the tool, as well as how it will impact clinicians' work, and the benefits of integrating the tool into practice.

Gain User Buy-In

Once the potential end-users have been introduced to the new tool, it will be important to earn user buy-in, to ensure that everyone is on board with the implementation and coming changes. This can be done through frequent and open communication, as well as visual reminders. The pamphlet (**Tool 3**) is a document that can be printed and posted in your clinic, or the digital version can be emailed or posted to a shared location on your organization's Intranet.

Step 3: Train the End-Users

Once the end-users have received an introduction to CURB/CRB-65 and the CAP alert the end users are now prepared to train on the tool's use and application. The tool's user-friendly design will require minimal training in order to use it effectively; the guidance will allow for rapid startup and seamless integration into the workflow.

Training Approach and Content

Training should follow the organization's established processes. Tools 2-4 are useful training aids. Screenshots of the actual CDS from your EHR, outlining the site workflow, will be essential in user training. Although the CAP alert was designed to be intuitive to use, some training is recommended. At the very least, training should cover the goal of the CAP alert, how it works, and how it will fit into clinical workflows. If you were to only use one training tool, **Tool 4** is the most comprehensive.



Step 4: CDS Go-Live

Upon completion of end-user training, it will be time to go-live with the CAP alert. At this point, it is important to keep the training materials available during, throughout, and after implementation so that users can refer to the materials at all times. The clinician champion should also be available for questions and assistance.

Local EHR change control processes should be adhered to during this time. Coordinating go-live timelines with standard change control avoids any conflicts with EHR access, disruption to end-user workflow, or inadvertent corruption of existing EHR tools. Go-live may be as simple as “turning on” the CDS alert in the appropriate settings.

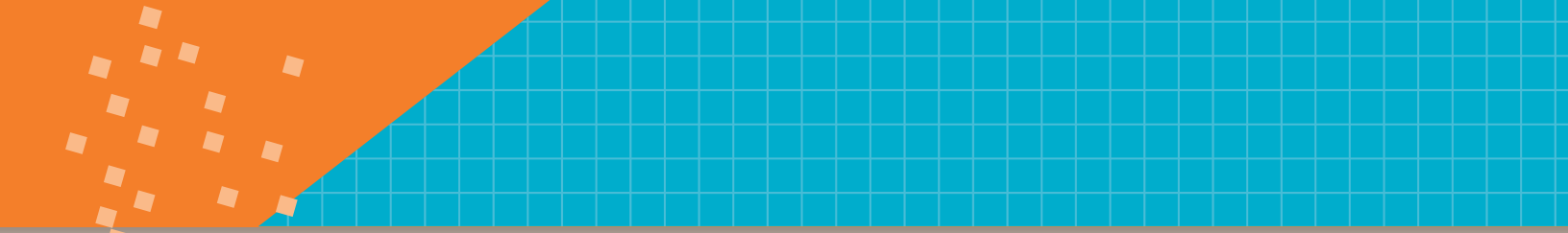
Implementation Activities

Implementation activities will include:

- Review of the resources in the toolkit
- CAP alert go-live
- Post go-live Q&A/assistance

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