

**Project Title:** Rural Trial of Clinic Order Entry with Decision Support  
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**Organization:** University of Utah  
**Mechanism:** RFA: HS04-012: Demonstrating the Value of Health Information Technology (THQIT)  
**Grant Number:** R01 HS 015413  
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**AHRQ Funding Amount:** \$1,499,650  
**Summary Status as of:** August 2008, Conclusion of Grant

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**Strategic Goal:** Develop and disseminate health IT evidence and evidence-based tools to support patient-centered care, the coordination of care across transitions in care settings, and the use of electronic exchange of health information to improve quality of care.

**Business Goal:** Implementation and Use

**Summary:** Dr. Samore’s team implemented the computerized clinic order entry (CCOE) tool, a Web-based program for generating and executing ambulatory orders. The tool was evaluated in a cluster randomized trial in rural primary care clinics. Their technology partner was CaduRx. The evaluated tool is proprietary. It currently adheres to 338 of 479 Certification Commission for Health Information Technology (CCHIT) evaluation criteria. This grant is in the reporting and dissemination stage. Final analyses are being performed. The acronym used for this study was INFORM (Intelligent Network for Registries and Order Management).

This study was conducted in rural primary care clinics throughout Utah, Idaho, and Wyoming. Clinics that were staffed by at least two primary care providers and did not already use an electronic health record were considered eligible for participation. A total of 16 clinics completed the 3-year study; 9 were randomly assigned begin use of the CCOE tool between May and August 2005, and 7 were assigned to begin use of the tool between May and August 2006. Most of the study clinics had no previous experience with health information technology (IT), and some had no previous in-clinic Internet service. None had previous existing electronic health records (EHR) or CCOE. One challenge that many study clinics experienced was limited access to reliable high-speed Internet services, which was a precursor to implementing the health IT intervention into their clinics. The study team assisted the clinics in identifying possible options for obtaining the services to address this barrier. Another barrier the study clinics faced was unfamiliarity with the Internet and Web-based communication, such as e-mail. The study team spent time with study providers who needed assistance learning these methods.

This grant addressed the strategic goal of medication management. The primary order entry features of the CCOE tool included a prescription writer and laboratory and x-ray order entry modules. It was designed for use on any type of Web-enabled computer, including handheld computers, tablet, laptop, and desktop computers. Features of the prescription writer included on-the-fly drug-to-drug interaction prompts; automatic allergy and drug intolerance checking; ICD-9 coding for lab and x-ray orders, including sensitivity to Medicare coding rules; capacity to drill-down to the Multum™ database for detailed prescribing recommendations; the ability to print orders, fax them directly to pharmacy, lab, or x-ray department; and direct electronic transmission to participating pharmacies. The prescription writer generated a refill queue to facilitate hand-off from nursing staff to the primary care provider.

*Drug-drug interaction checker:* The drug-drug interaction checker displayed information about potential drug-drug interactions above the electronic prescription pad. Drug names color coded red indicated a

major drug-drug interaction, purple indicated a moderate reaction, and green indicated the drug is not known to have a moderate or severe interaction with any of the patient's active medications; minor reactions were not targeted. When an order was attempted with a medication identified as having a major drug interaction, the alert presents in a separate window, and the prescriber was forced to hit continue before the electronic prescription pad appears. Moderate alerts were passive in that the prescriber was allowed to proceed directly to the electronic order view without the extra step required for major alerts.

*Decision support tool for antimicrobial prescribing:* The respiratory infection algorithm was an individual patient, point-of-care-based clinical decision support tool designed to help clinicians manage patients with acute respiratory infections. The branching logic used in the decision support tool was similar to the algorithm implemented in an earlier study in rural communities. At the start of the algorithm, the provider selected one of four options: "upper respiratory tract infection," "lower respiratory tract infection," "other infection," or "not for an infection." If either of the first two options was selected, additional checkboxes were revealed to solicit sufficient clinical information to generate a management recommendation. Information previously entered about the patient such as age, allergies, and weight was integrated into the algorithm.

The program had several different entry points: 1) automated trigger when an antibiotic is chosen during the electronic prescription writing process, 2) initiation by clinical staff (e.g. documenting patient's chief complaint), and 3) user-directed algorithm button on the patient home page. The algorithm was intended to be easy to use and time-neutral.

*Vaccine reminder:* The vaccine reminder was an automated notification to inform the provider when influenza vaccination was indicated on the basis of time of year and patient criteria. CDC recommendations for influenza vaccination were translated into computer logic, driven by the available electronic data about the patient. Chronic diseases such as diabetes mellitus were inferred from the patient's active medication list or from ICD-9 codes linked to laboratory test orders. When the reminder popped up or was selected, the provider had the option of declining or canceling or ordering the vaccine for the patient. The reason for not vaccinating, such as allergy or already received, was solicited when the vaccine was declined. Choosing to give the vaccine included an option to print an immunization consent form to be placed in the chart. The vaccine administration date was stored in the patient's electronic record.

The CCOE tool was subjected to a formative evaluation, which included: 1) ongoing tracking of system performance, system usage, and reports of problems; 2) provider survey to examine constructs such as self-efficacy, perceived usefulness, usability, and subjective norms; 3) physician productivity with respect to clinical volume; 4) periodic interactions with providers and clinical staff; and 5) end-of-study focus groups to support a qualitative analysis of user experiences.

The team evaluated the effect of the CCOE tool on clinic processes, focusing on medication management workflow. First, clinic observations were used to construct graphical charts to depict tasks, decisions, and personnel involved in the processing of prescription refills within each clinic. These flow charts were used to qualitatively assess the impact of implementation of the CCOE tool. Second, structured observations were made before and after implementation of the CCOE tool to estimate the average time to process a prescription refill request. Third, Web log files were used to estimate the efficiency of electronic prescription writing for new prescriptions and refills. Rows of data in the Web log files corresponded to specific time-stamped page views that were created during each user session with the CCOE tool. The number of steps and amount of time needed to generate a prescription was compared for prescriptions written entirely by the provider versus prescriptions that entailed clinical staff involvement.

The impact of the CCOE on quality of clinical practice was examined using three endpoints: 1) rate of potential drug-drug interactions, 2) proportion of clinic visits for upper respiratory infection resulting in

the prescribing of an antimicrobial agent, and 3) proportion of adults patients with an indication for influenza vaccine who had documented receipt of influenza vaccine.

### Specific Aims

- Recruit rural primary care practices for participation in a cluster-randomized trial of a computerized clinic order entry (CCOE) tool. **(Achieved)**
- Quantify the impact of the CCOE tool on clinical practice, patient safety, provider productivity, and office efficiency. **(Ongoing - final analyses in progress\*)**
- Assess the effect of the CCOE tool on costs. **(Ongoing - final analyses in progress\*)**

*\* Some aims of the grant were not completed prior to conclusion of the AHRQ funding period, yet work continues and these aims are targeted for timely completion.*

**2008 Activities:** Paper chart review was the primary means by which we assessed the effect of the CCOE tool on clinical practice. Chart review was necessary because electronic data about medications and other practices were not available from these clinics prior to implementation of the CCOE tool.

Three clinical practice domains were studied, linked to the tool's decision support features: medication safety (potential drug-drug interactions), preventive care (adult vaccination), and acute respiratory infection management.

The team developed a chart extraction tool in Microsoft Access using structured data input forms. Documented office visits, medication histories, and immunizations during the interval May 2004 to August 2007 were recorded. Reviewers followed an explicit chart review protocol. Medication histories encompassed drug names and dates as listed in the progress notes, with or without an associated office visit. Documented instances of administration of influenza and pneumococcal vaccines within the clinic or outside the clinic were recorded. Office visits were classified as acute upper respiratory tract infection if acute respiratory symptoms were present or if the provider diagnosed an acute upper respiratory infection.

Some locations were harder than others to schedule for the 2 days required to complete the necessary chart review. This means that these activities took place over several months

**Preliminary Impact and Findings:** Implementation of the CCOE tool led to redesign of clinical processes for prescribing medications. Front office staff became more engaged in the prescription process. The efficiency of communication tasks increased because steps to relay information on paper notes were eliminated. Refill requests were often managed in a batch mode. Provider time spent to write refills was saved. Final analyses of the impact of the CCOE tool on potential drug-drug interactions and antimicrobial prescribing practices are in progress.

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### Selected Outputs

The respiratory infection algorithms are publicly available for use.

Statistical procedures for performing Web log file analysis will be published as supplemental materials.

The CCOE tool is commercially available for clinicians to use on a subscription basis. It is fully integrated with an electronic health record, personal health record, and electronic communication system.

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**Grantee's Most Recent Self-Reported Quarterly Status:** This project is complete, having met all its milestones. Further data analyses are ongoing beyond the scope of the grant, and manuscripts are being prepared for publication.

**Milestones:** Progress is mostly on track.

**Budget:** Spending is roughly on target.