Implementation of Computerized Provider Order Entry in the Emergency Department: Impact on Ordering Patterns in Patients with Chest Pain

Terrence Adam, MD, PhD[1], Dominik Aronsky, MD, PhD[2,3], Ian Jones, MD[2], Lemuel R Waitman, PhD[3]. Dept. of Internal Medicine [1], Mayo Clinic, Scottsdale, AZ, USA; Dept. of Emergency Medicine[2], Dept. of Biomedical Informatics[3], Vanderbilt University, Nashville, TN, USA

The impact of implementing a Computerized Provider Order Entry System on ordering patterns is unknown. This study evaluated ordering patterns for CBC, ECG, chest x-ray, BMP, and cardiac enzymes in randomly selected chest pain patients in an adult Emergency Department pre- and post-implementation. The average number of orders documented was significantly higher after implementation for ECG and chest x-ray, but not for the other exams. Order completion times did not change.

Background: The use of computerized provider order entry (CPOE) systems provides a common starting point for initiating requests for clinical tests and treatments. Studies evaluating the impact of CPOE implementation in an Emergency Department (ED) setting remain scarce and it remains unknown whether CPOE implementation changes clinicians' ordering patterns, which was the goal of this pilot study.

Methods: The Vanderbilt trauma level 1 adult ED implemented CPOE in March 2004. We identified all patients with an ICD-9 coded chief complaint of chest pain during a 3-month pre-implementation period (9/1/03-12/31/03) and 3-month post-implementation period (9/1/04-12/31/04). We randomly selected and retrieved charts and paper-based orders for 150 of 931 patients before, and charts and computerized orders for 150 of 965 patients after CPOE implementation. We evaluated the number of orders and completion times (order writing to results availability) for complete blood counts (CBC), electrocardio-grams (EKG), chest xray, basic metabolic panel (BMP), and cardiac enzymes. Statistical analysis was performed with t-tests and chi-squares.

Results: Patients' age averaged 49.8 years during the pre-implementation period (54% female) and 47.5 years during the post-implementation period (55.3% female). Other population statistics were not statistically different. The number of orders for the selected exams are shown in Table 1. In the pre-implementation phase, 9.2 orders per patient were identified. In the post-implementation phase, 16.0 orders were identified per patient ($p < 0.01$). Overall ordering volume has increased for EKGs and Chest x-rays after CPOE implementation, but remained unchanged for the other exams. Order completion times (Table 2) were slightly higher after CPOE implementation, but were no statistically significant differences were observed.

Table 1: Order Volume for selected tests

Study Group	CBC	EKG	Chest Xray	BMP	Card. Enz.
Pre-CPOE	112	105	18	120	144
PostCPOE	116	209	135	113	147
P value	0.31	<.01	<.01	0.19	0.42

Table 2: Study Completion Time (minutes)

Study Group	CBC	EKG	Chest Xray	BMP	Card. Enz.
Pre-CPOE	62	37	80	62	63
PostCPOE	69	38	80	66	67
P value	0.12	0.41	0.49	0.22	0.30

Discussion: The use of CPOE provided a higher level of order documentation in the ED setting. Higher volumes of EKG and chest xray orders were observed after CPOE implementation. Many of these exams were documented on requisitions only and incompletely documented on the patient's paper order sheets. In the post-implementation phase there was a reduced use of the complete metabolic panel and this was replaced by the use of BMP with additional individual tests. The CPOE system contributed to an almost complete electronic capture of all ED orders. This improved documentation captured orders for patients as inpatients who were awaiting hospital placement increasing the order totals. CPOE implementation did not change the turn-around time for the selected exams. It is possible that CPOE implementation may increase the time required for order writing; however, if this is the case, it seems that it does not impact exam turn-around times.