Impact of a Computerized Patient Tracking System in a Pediatric Clinic

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A computerized patient tracking system with an intuitive graphical interface was deployed in a large multidisciplinary pediatric outpatient clinic and has been enthusiastically embraced by both physicians and non-physician staff. Usage of the computerized patient tracking system has been associated with a significant decrease in the total time patients spend in the clinic. The total duration of an average patient visit has declined from 99.25 ± 57.44 minutes to 66.94 ± 30.47 minutes (p=0.03). Most of this decrease has been due to a decrease in total waiting time from 54.17 ± 37.61 minutes to 27.29 ± 14.05 minutes (p=0.006). Usage of the patient tracking system has also been associated with a significant increase in examination room utilization during peak business hours from 58.47 ± 21.18% to 64.49 ± 13.38% (p=0.0329).

INTRODUCTION AND BACKGROUND

Prior to implementing the first phases of a computerized patient record in the outpatient clinics of the Children's Medical Center of the University of Virginia, we performed a comprehensive assessment of current practices. Graduate students from the McIntire School of Commerce at the University of Virginia systematically reviewed work and information flow in the pediatric outpatient clinics located within the Primary Care Center. As a result of this review, a number of processes were eliminated and others were substantially re-engineered [1]. As an outgrowth of this review process, it was concluded that a computerized patient tracking system would aid in communication between various care providers and improve patient throughput as well as overall room utilization.

Approximately one year ago, we first deployed such a computerized patient tracking system. Prior to deployment of the system, we performed an assessment of baseline practices. The purpose of this paper is to document the impact this computerized patient tracking system has had on the daily operations of our outpatient clinics.

METHODS

Location of the Study

The entire study was performed in the Primary Care Center of the Children's Medical Center. This is a multi-disciplinary pediatric clinic staffed by faculty physicians and pediatric resident physicians. Approximately thirty-five pediatric resident physicians and fifty faculty pediatricians rotate through the clinic. Third and fourth year medical students also regularly rotate through the clinic. Approximately 100 children are seen on an average day resulting in approximately 24,000 visits annually. The clinic consists of 22 examination rooms distributed on three hallways as well as a number of treatment and special purpose rooms (i.e., echocardiography, pulmonary function tests), a large shared waiting area, and a number of small conference and teaching rooms.

Routine Patient Flow

Based on previous analysis [1], we have found that routine patient visits in our clinics comprise seven basic steps:

1. The family registers at the front desk.
2. The family is directed to the waiting area.
3. An aide or nursing assistant then takes the patient and family to an examination room where they wait for a nurse.
4. The nurse collects vital signs and measures growth parameters either within the exam room or in a triage area.
5. Once the nurse has completed his or her duties, patients are seen first by either a third or fourth year medical student, or a pediatric resident physician.
6. Following a visit with a student or resident physician, every patient is seen by a faculty pediatrician.
7. Appropriate interventions or treatments are administered.
8. The patient is discharged from the clinic.

Data Collection

For two weeks during the two months prior to and twelve months after deployment of the computerized patient tracking system, a random assessment of patient throughput and room utilization was performed. All assessments were performed by direct observation. Unbiased observers were stationed at several different locations throughout the clinic and they recorded traffic in and out of waiting areas and examination rooms. The following data elements were collected: time spent waiting for registration, registration time, time spent in the waiting area, time spent waiting for a nurse, nursing examination time, time spent waiting for first medical examination, first examination time, time spent waiting for the second examination, and second examination time. The following composite times were calculated: time of

the entire visit, total time spent waiting, and total time with a caregiver in the examination room. On three separate days, observers kept track of the number of examination rooms that were occupied during peak business hours (9:00 a.m. through 5:00 p.m.).

Description of the Computerized Patient Tracking System (TRACKS)

TRACKS is a client-server application written in standard C language for the OS/2 operating system. The client-server configuration includes LAN Manager/Requester communicating via Named Pipes over a token ring network. The system is built around a relational database that refreshes the user interface while saving relevant data from all transactions for later analysis.

The user interface uses a grease board as a metaphor. The physical layout of the entire clinic including all of the examination rooms, treatment rooms, waiting rooms and conference rooms, is graphically depicted (figure 1).
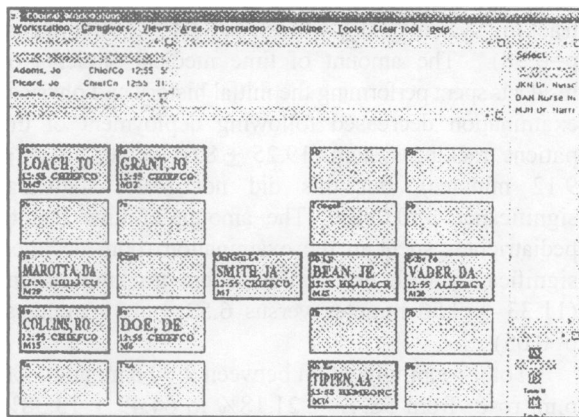

Figure 1: tracking system interface

The system is fully integrated with the University-wide patient registration system so that as a patient registers at the front desk of the clinic, that patient immediately appears in the tracking system's waiting room. The status of examination rooms is color-coded allowing staff to quickly ascertain whether a room is vacant or occupied, and whether a given child has been seen by a nurse and/or a physician. Icons representing patients and caregivers can be dragged and dropped into and out of rooms. By double clicking on a particular patient's icon (figure 2), components of that patient's medical record will be displayed.

Statistical Analyses

All time measurements are expressed as minutes ± standard deviation of the mean. Room utilization rates
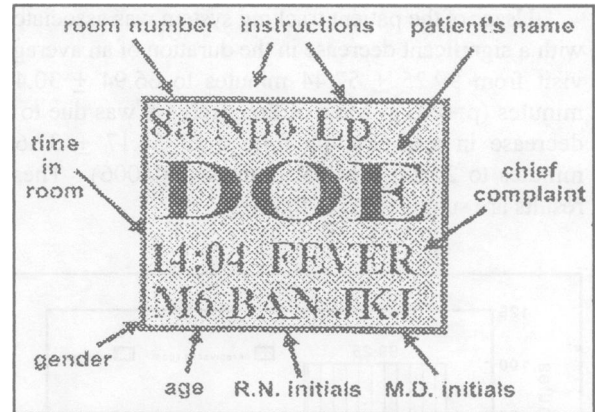

Figure 2: close-up of exam room icon

are expressed as percent time occupied ± standard deviation of the mean. Data before and after implementation of the patient tracking system were compared using the unpaired student's t test with a level of statistical significance being considered $p < 0.05$.

RESULTS

The total number of patient visits to the clinic did not change during the six months prior to and the six months following deployment of the patient tracking system (12,001 versus 12,672). The component times of patient visits during the two weeks before deployment and twelve months after deployment of the patient tracking system are summarized in table 1.

TABLE 1: Component Times of Patient Visits (minutes) (*p<0.05)		
	pre-Tracking System (n=12)	post-Tracking System (n=17)
wait to register	0.75 ± 1.50	0.47 ± 1.19
registration	3.08 ± 1.41	3.41 ± 2.03
in waiting room	21.33 ± 1.40*	3.59 ± 3.90*
wait for nurse	4.25 ± 3.91*	0.60 ± 0.24*
nursing exam	7.0 ± 4.0	6.94 ± 2.98
wait for 1st exam	13.10 ± 62*	8.18 ± 6.94*
first exam	19.25 ± 8.61	13.18 ± 9.12
wait for 2nd exam	5.83 ± 2.11	6.41 ± 5.09
second exam	11.33 ± 9.56*	6.53 ± 4.39*
total visit	99.25 ± 57.44*	66.94 ± 30.47*

Usage of the patient tracking system was associated with a significant decrease in the duration of an average visit from 99.25 ± 57.44 minutes to 66.94 ± 30.47 minutes (p=0.03). Most of this decrease was due to a decrease in total waiting time from 54.17 ± 37.61 minutes to 27.29 ± 14.05 minutes (p=0.006). These results are summarized in figure 3.
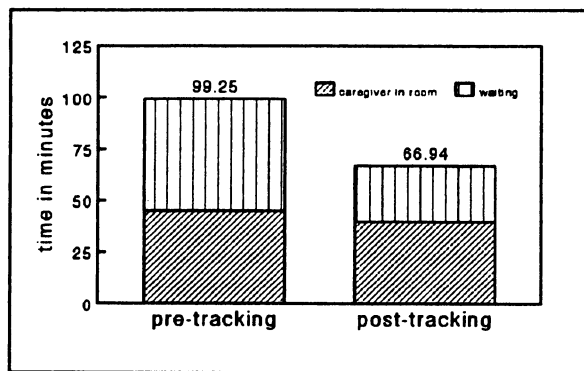

Figure 3: total visit time

The various components of waiting time before and after deployment of the patient tracking system are summarized in figure 4.
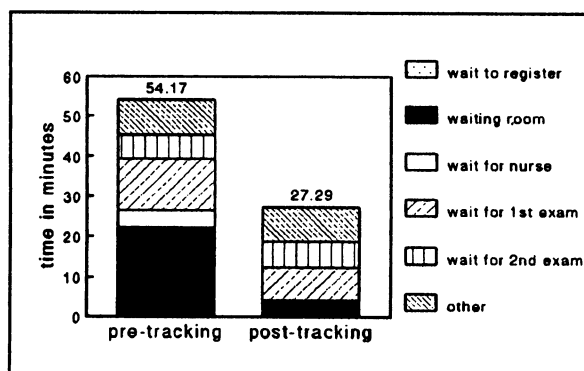

Figure 4: components of waiting time

Use of the patient tracking system was associated with a dramatic decline in the amount of time patients and families spent in the waiting room, going from 21.33 ± 20.9 minutes to 3.59 ± 3.90 minutes (p=0.001). Use of the patient tracking system was also associated with significant decreases in the amount of time families waited for nursing staff (4.25 ± 3.9 minutes to 0.60 ± 0.24 minutes, p<0.0001) as well as the time families waited for medical students or residents to begin their examinations (13.1 ± 11.6 minutes to 8.18 + 6.94 minutes, p=0.031).

The total amount of time caregivers spent in the examination room with patients and families declined from 37.58 ± 19.64 minutes prior to deployment of the

patient tracking system to 26.65 ± 12.79 minutes after deployment however this change was not statistically significant (p=0.058). The amount of time different caregivers spent in the examination room before and after deployment of the patient tracking system is summarized in figure 5.
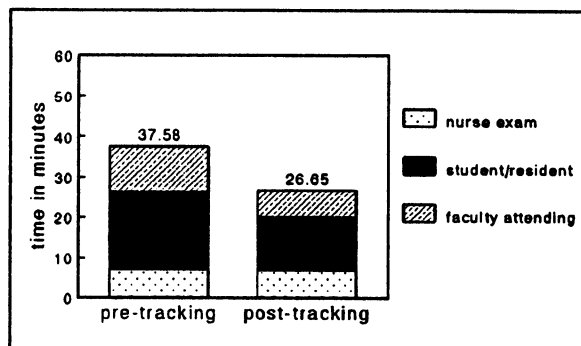

Figure 5: time caregivers in exam rooms

The amount of time nurses spent in the examination room did not change following deployment of the patient tracking system (7.0 ± 4.0 versus 6.94 ± 2.98 minutes, p=0.98). The amount of time medical students or residents spent performing the initial history and physical examination decreased following deployment of the patient tracking system (19.25 ± 8.61 versus 13.18 ± 9.12 minutes), but this did not reach statistical significance p=0.082). The amount of time faculty pediatricians spent in the examination room declined significantly with use of the patient tracking system (11.33 ± 9.56 minutes versus 6.53 ± 4.39 minutes, p=0.05)

Total room utilization between 9:00 a.m. and 5:00 p.m. rose from 58.47 ± 21.18% to 64.49 ± 13.38% following deployment of the patient tracking system (p=0.0329).

DISCUSSION

With this study we have demonstrated that the use of a computerized patient tracking system in a large multidisciplinary pediatric outpatient clinic can significantly decrease the amount of time patients spend in the clinic as well as improve examination room utilization. The improvements associated with use of the patient tracking system can largely be attributed to better communication between staff in that most of the improvements are related to substantial decreases in the numerous waiting times associated with patient visits. However, the system also appears to have heightened the staff's awareness of overall flow through the clinic. This likely explains the decrease in average total time caregivers spend in examination rooms.

Many organizations have invested large sums of money, time, and personnel in the development and implementation of information technologies without realizing substantial cost savings or improvements in productivity [2,3]. In those organizations that have realized major benefits from the adoption of information systems, this success has only been achieved when the system has been designed to serve process requirements, and the organization has focused on the implementation and post-implementation management of the information system to insure its adoption and proper use [4,5].

The success associated with the deployment of our patient tracking system is as much related to the information system itself, as to the way it was developed, implemented and supported. Physicians and non-physicians have enthusiastically embraced this computerized patient tracking system and fostered its usage among their peers. This is very different than our previous experiences with the implementation of a computerized physician order entry system [6]. Before developing and implementing the patient tracking system, we conducted a careful review of current work and information flow in our clinic and we redesigned several outmoded processes [1]. With the patient tracking system we have used information technology as an enabler of process redesign rather than using information technology as a means of transforming work processes [7].

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