Can computerized physician order entry systems increase security?

Henriette Mabeck[a]

[a] *Danish Institute for Health Services research, Copenhagen*

Abstract

When computerized physician order entry systems (CPOE) are introduced there is a general expectation that the system can reduce medical errors and make work flow more efficient. This study asks why potential security problems continue despite intentions in CPOE. The study show how the organisation focus on implementation and forget to analyse potential adverse drug effects, and how hidden elements has influence on work flow and security.

Linear models are selected as basis, but the linearity doesn't reflect real life conditions. The article argue that diversity and local evolution influences how users use CPOE in practise, CPOE can't determine users work flow, users act according to values, practical factors, existing routines etc. Physical elements, culture, routines and habits affect CPOE. Therefore it is necessary to continue to study details in CPOE used in daily work.

The conclusion is there is a need for more socio technical studies that can enlighten how CPOE work in medical practise and someone who has responsibility to secure focus on improving security and efficiency.

Keywords:

Computerized physician order entry system, CPOE, Socio technical studies, medical errors, implementation, security and quality in health care

Introduction

In Denmark there is a general expectation that CPOE as well as other systems can reduce medication errors and increase efficiency in medical practise (1-4).

On the other hand there is a large number of articles that presents different examples of unintended effects from using CPOE or other it systems in medical practise (5-9).

The question is why security factors and potential security problems aren't analysed in connection to implementation of CPOE, when it is expected to reduce errors? And why does work flow that contains potential security continue unchanged after implementation?

This article enlightens two problems that reduces security because nobody pay's attention to these factors.

First users focus on implementation and making CPOE adapt daily work practise and security is forgotten

Second nobody pay's attention to the influence of small things, invisible things that suddenly become important when using CPOE (10;11).

Materials and Methods

This is a socio technical qualitative case study. The study was conducted at an University hospital in Denmark. There where two sites from the same ward included in the study. Only one ward full filled the two inclusion criteria:

- The ward should have used the system more than one year and

- The ward should be interested in participation.

Ethnographic methods as observations and interviews constitutes data material (12). Approximately 200 hours of observation and 28 interviews was conducted over a 2 year period. Documents and internal reports were collected and analysed.

Data was collected in two periods with one year between. A semi grounded theory approach was used collecting, categorising and analysing data. In the first data collection period open observations where used. Analysing and categorising data revealed areas of interest. Those areas where explored further in the interviews and following observations (13)

The theoretical frame of understanding technology and organisation was socio technical and information ecology (14;15). Technology is understood as an element that combines organisation in a mutual dependent relationship. Organisations are diverse. Every organisation is unique shaped by the evolution is has lived through. The consequence is that organisation has made it's own definitions and understanding that are locally understood (16;17).

This means that organisation and technology are mutual dependent and technology doesn't determine user behaviour or user choice when using technology. When used the organisation and technology will affect each other and make a new organisation and a new technology (11;18;19).

Results

Results are presented as three examples.

- The shift from argument to implementation

- Continuing of potential medication risk
- New patterns and influence of a bin

From argument to implementation

Documents from the organisation show there is a general expectation that CPOE will increase efficiency and reduce security. The hospitals homepage content document subjects as vision, expectations from physicians, nurses, evaluation, methods for implementation, architecture.

The organisation has produced a central document that analyses the medication process. The process before is drawn as three separate processes. The medication process with CPOE is presented as one simple process. The drawings of the medication process before and after illustrate how CPOE is expected to reduce work task and increase efficiency. The illustration of the medication process after CPOE is presented in figure 1. At left the original figure, at right a model. The point is medication is presented as a very simple and linear process.
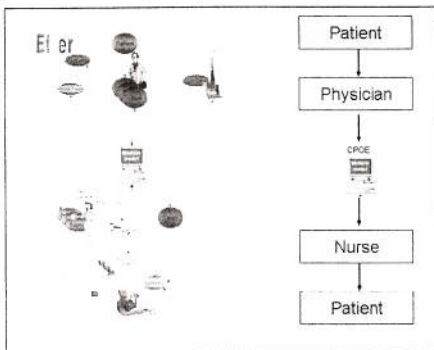

Figure 1: Left side medication process from a central internal report (20), right side translation of the process.

Even that security is an essential argument, there is no documents analysing or describing problems or potential problems in medication. There isn't any description or analyses investigating efficiency or economic factors related to medication or work flow in medication process.

Continuing of potential medication risk and new risk

The main elements in organisation medication haven't changed after CPOE.

Iv medication is given at the same time to all patients three times a day. This is practical because it makes it easier to the nurses to remember medication. Observations show how 1-2 nurses prepare intravenous medication several hours before medication time, and the nurses who prepare medication isn't the same nurses as the nurses that gives the medication.

The nurses that prepare medication pick a patient list from CPOE. Then they find ordered medication and place medication, needles, swaps etc. in a small sleeve. On medication bags they place a label with patient name and identification number. At medication time the assigned nurse pick up a sleeve with medication and register in CPOE. The nurse who prepares medication only read in CPOE, she doesn't register in CPOE.

Figure 2: Prepared medication in sleeve

As figure 2 shows there is a risk of medication falling out or nurses picking the wrong sleeve. Nurses tell they are aware of this potential risk and that it hasn't changed after CPOE.

Because it is the assigned nurse who gives medication to her own patients there are 3-5 nurses in the medication room at the same time.

When CPOE was introduced there wasn't economy to rebuild the medication room. At first there wasn't a pc in the room, and nurses had to leave the room to use CPOE, when they should give medication or sign in CPOE. It was clear this was too unpractical and continued to many security risks. Due to a very creative staff the ward removed shelves in a cupboard and placed a labtop in the cupboard.
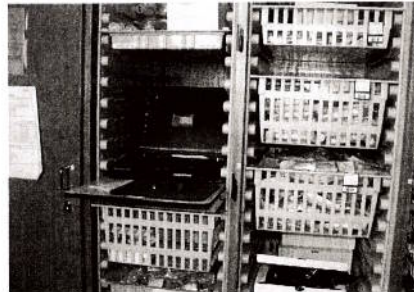

Figure 3: Labtop in cupboard to register medication in CPOE

Because the pc is placed in a cupboard it is a little awkward to use it. The work organisation where 3-5 nurses has to use it synchronously makes the situation worse. I will return to this later.

New patterns and influence of a bin

CPOE is designed with the best intentions to improve security. Therefore there is a demand to register when

medication is completed. CPOE is designed so it isn't possible to start new medication before previous medication is registered as completed in CPOE. Before CPOE nurses just remove medication bags and throw them away. There were not registration of completion.

Interview show how several nurses tell about situations where the nurse who had completed medication had forgot to register this in CPOE before she left the ward after duty. Nurses tell they feel they don't have any choice and they must sign for a task they haven't performed. They supply and tell they fell uncomfortable signing for another. The result of the extra control built in CPOE is that it is possible to place responsibility but in use it isn't certain there is similarity between the nurse who completed medication and the nurse who has signed. If the nurse wants to give medication she must sign because the system lock and it is impossible to enter new medication before earlier medication is completed.

Before CPOE nurses didn't have to sign for completion and they just throw used medication bags in the nearest bin placed everywhere. Now nurses must sign in CPOE. Therefore it is practical to return to medication room where there is a pc because they can throw the medication bag and sign at the same time. This pattern causes increased traffic in medication room.

The demand for signing after completion entails at least two problems in relation to security. First that nurses are forced to sign task they haven't performed. The result is that the signatures in CPOE are not reliable. Second it is known that noise and many persons makes disturbance that can increase risk of medication errors. The new pattern where nurses return to medication room brings along a risk of potential medication errors because there already is plentiful of persons in the room.

Discussion

Why doesn't CPOE full fill the expectations of increased security? Does it result from defect in the system? The organization? The staff?

An article from a Danish researcher gives an example on how he in his first job wrote an objective report of pro et cons related to centralisation or decentralisation of schools. When the report returned it was revised so only arguments related to centralisation was left. The researcher concluded that it wasn't an objective report that was asked for and that political decision isn't made on an informed objective basis.

Before a decision paper is presented there is a process where power defines knowledge and Flyvbjerg concludes *"power defines what gets to count as knowledge"* (21).

In the case of CPOE there are lots of arguments beyond questioning in the procurement phase. Who can argue against improving security and reducing adverse drug effects? The problem arise when the system is introduced, then focus shift from improving security to ensure CPOE a success. Reports and actions from practise show nobody remember to analyse risk factors because the organisation use energy and power to implement CPOE and make it work.

When focus is concentrated on implementation and making CPOE fit it isn't surprising that several potential risk situations are neglected and forgotten. There is gab between expectations related to security and focus areas in implementation process. Users are faithful to decision makers and try to make CPOE become a success by securing that it works.

This study reveals examples where security isn't improved and CPOE efficiency seem to be reduced. The basis for design was a simplified linear (figure 1). The local conditions the influence of environment, routines, hard ware choice etc. wasn't taken serious. The system was designed from a theoretical and idealistic idea. Nobody was aware of influence from local diversity. The medication process was based on an idea of a global process.

Technology was interpreted as a deterministic factor that could determine and force users to act linear and predictable: It was expected users do as the linear model foresee. Interruptions, simultaneous actions and shifting staff and shift work weren't included.

The medication model did not include factors originating from the diversity emerged from local evolution and local routines and environment. Expectations were that users act predictable and not autonomously.

This study reveals that users act according to fundamental values. Medication work is developed according to local tasks and factors. Physical elements as hardware, tables, rooms etc have influence on organisation of local work. Local history as well as task and routines affect integration and use of CPOE.

This study point at a model where different elements as furniture, hardware, paper based information, staff, meetings etc. constitutes a basis for understanding medical practise.

The linear model does not reflect real life in medical practise. There is a need for socio technical studies where developers and medical practitioners work together to make a model that reflect diversity and complexity in medical practise.

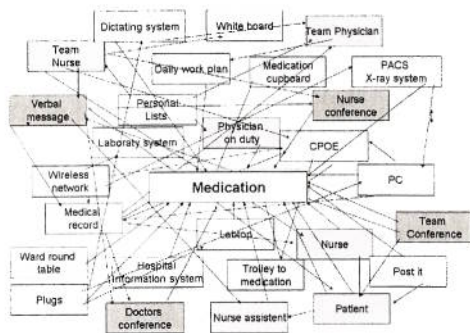Figure 4 show how medication process is affected by different elements that are connected in a crosswise network.

Figure 4: Elements from medication process

The medication network is enormous and confused and it illustrates the complexity in practise. It is difficult to get an overview of the relations of elements in medication, but if the elements are arranged and categorised it looks as in figure 5.
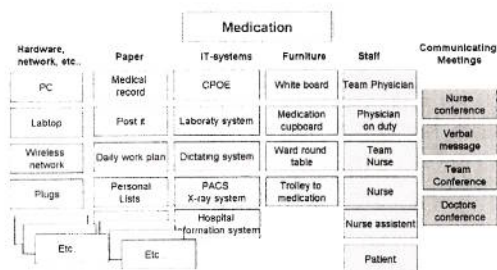

Figure 5: Categorising of elements in medication process

Figure 5 show the elements but not the network that ties the elements together. Figure 5 show important categories in medication and the local elements, that has role medication.

Comparing figure 1 with figure 4 and 5 show medication is more than information transmission. The media information is transmitted by is important to remember in connection to information technology. It is not enough to have the best system if the hardware doesn't work. Therefore it is necessary to analyse how different media enters work flow and communication when CPOE is introduced.

CPOE doesn't stand alone. It is a brick or piece between lots of other pieces. Together all pieces constitutes medication in the local practise.

This study shows how important it is to study use of it in medical practise real life and observe the daily work and discuss findings and astonishments with staff. The study also shows how that it is important to analyse security and to have someone who continuously focus on security, when CPOE is introduced. When nobody has this responsibility it is forgotten.

Conclusion

When nobody has focus on security after procurement this is forgotten and implementation and adaption become the main task. Someone must have responsibility to help practise analysing work organisation and keep focusing on the initial goal – improving security and efficiency.

The study exemplifies how a linear model isn't sufficient to understand medical practise. CPOE enters a complex network constituted of different elements both physical and non-physical. CPOE isn't alone and therefore CPOE alone can't improve security or efficiency.

The study reveals there is a need for socio technical approach that takes diversity and local environment serious. There is a need to analyse complexity and correlations of participating elements in the medication process and conduct observations of real life work situations to improve practise.

Whether CPOE can increase security depend on how much focus security gets from leaders, organisation, developers etc. The initial question therefore must be answered with a maybe.

Acknowledgements

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Address for correspondence

Henriette Mabeck: henriette@mail-mabeck.dk