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### Implementing RFID to Improve Medication Safety

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It has been calculated that in the UK – as well as in many other countries – more people die from adverse drug events (ADE) than from road traffic accidents. A British study shows that 5% of hospital admissions are due to adverse drugs events – of which two thirds are considered preventable. Furthermore, one in ten patients will suffer an adverse drug event while in the hospital.

Errors occur at all stages of the medication process, starting with inadequate prescribing decisions, followed by errors of distribution and administration of the drugs, failure to identify the right patient, absence of follow-up and inadequate adherence of the patient. Missing information and failure to communicate appropriate information are also relevant factors that can lead to errors. Medication errors are therefore not simply human errors of the physician, but also a deficiency of the complex medication process. It has been convincingly demonstrated that two types of medication errors are most relevant. The most important are errors of prescribing. 70% of the severe preventable adverse drug events go back to a prescription error. Second most important is failure of patient identification, which is the most dangerous error of distribution. Luckily there are solutions to both problems. Unfortunately these solutions are not widely implemented yet.

Most often, prescribing errors occur because information on the drug, the patient or application rules is not available during the prescription procedure. Electronic systems, which make this information available to the physician, have the potential to prevent these errors. It has been shown that more than 80% of prescribing errors can be prevented by electronic prescribing using a computerised physician order entry system (CPOES), with clinical decision support (CDS). It has become a national strategy in the United States as well as in several European countries, to make electronic prescribing coupled with decision support, available to all physicians. In Germany, this is included in the ongoing electronic health card project.

For patient identification, several options are available. Barcode wristbands have been often discussed and studied, but unfortunately, the acceptance of bar code systems is not optimal. The reason is that the reader has to be brought very close to the bar code on the wristband. Nursing staff needs one hand to hold the patients' arm and the other to hold the reader. Furthermore, the risk of contamination of the reader is not negligible and the risk of transmitting infectious diseases is considered too high a price to pay for a better identification of the patient. RFID based patient identification can solve that problem.

At the Klinikum Saarbrücken, a tertiary care hospital in the south-western part of Germany, RFID based patient identification has been combined with electronic prescribing and decision support, so that the right patient gets the right drug.

To prevent prescribing errors, drugs are ordered using clinical-decision support software. The software receives all relevant information on the patient – including lab values – from the hospital information system. When the physician prescribes medication electronically, the system reviews the patient's background to detect potential errors or risks. If drug dosing deviates from the dosing suggested for this patient, the physician gets direct feedback (especially if dose adjustment due to renal impairment or age is relevant). Clinically relevant drug interactions also trigger an alert. An actionbased management proposal is always integrated, as user-friendliness is one of the system's priorities. Critical success factors of

CPOES have been identified: Besides providing physicians with clinically relevant warnings and active management options, CPOES should not bother physicians with an excessive number of irrelevant warnings (so called alert-overkill), if it wants to be well accepted. If electronic prescribing systems just translate information from the drug information that accompany products into warnings, the result will be 90% clinically irrelevant warnings – and physicians will deactivate the checking function within 2 days. Considering that decision-support is not a technical but a socio-technical approach, CPOES with CDS will not only improve quality and safety of care, but also cost effectiveness.

Preventable adverse drug events are not only dangerous for the patient they are also very expensive for the hospital. Length of stay is increased for patients with adverse drug events and it has been calculated that ADE causes 10% of hospital days.

Nevertheless it is difficult to quantify the cost savings by RFID alone, because the costs related to failures of patient identification are not routinely measured. Cost effectiveness of electronic prescribing is easier to demonstrate. It has been shown that use of the CPOES at Brigham and Women's hospital in Boston, USA, and the software used at the Klinikum Saarbrücken has contributed to savings of about 20% of direct drug costs. The single most important factor is that the software is able to detect impaired renal function and flag drugs that require dose-reduction in renal function. A study at a university hospital in Switzerland has shown that in routine care – without CPOES – only one in three necessary dose reductions is carried out; unnecessarily increasing treatment costs by 14%. Since 34% of the patients in a department of internal medicine have impaired renal function and 85% of these patients get drugs that warrant dose reduction, this is a very relevant and expensive problem. Another factor is the discontinuation of drugs that the patient does not need – or that may even cause problems or harm. In particular, potentially inadequate drugs for elderly patients are frequently maintained when a patient is admitted to the hospital. Medication reconciliation activated by the software used at the Klinikum Saarbrücken can detect this kind of interaction, thus helping the physician contribute to patient safety by stopping unnecessary high-risk drugs. Considering the amount of data that exists on the more than 50,000 drugs available on the market, it is clear that information technology, wisely designed and implemented, is a must for improvement of medication safety.

If CPOES is combined with RFID for patient identification and utilised as a system to increase medication safety, it is easy to demonstrate its cost savings and quality improvement potential. Once a RFID wristband system is implemented, its applications go beyond medication safety.

Other uses of this system to consider are matching blood transfusions with correct recipients, and the identification of patients in operating theatres. In both cases, RFID has an added value over bar coding. For example, not only can patients be identified before operations, but types of procedures and relevant information (such as the precise location to operate) can also be recorded on the chip.

Increasing demand for patient safety and the decreasing cost of RFID chips will be driving forces for a broad use of RFID in hospitals. However, developing readers that work beyond a distance of 50-80 cm would be a major improvement: This would allow for normal distances between patients and doctors in hospital, and ensure convenient patient identification without any risk of contamination.



The RFID wristband that has been developed and optimised for patient comfort and acceptance by two commercial project partners.

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