. ANALYZING THE REQUIREMENTS FOR A COMPUTER BASED OPTIMIZATION OF THE MEDICATION PROCESS

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Introduction: Although patient safety is a major task for health care systems, medication errors occur every day in

every country worldwide [1]. These errors are fatal for both, the affected patients, and the involved medical staff. In addition errors increase costs. This is especially critical within intensive care units (ICUs), where medication errors occur frequently. In average critically ill patients are subject to about 1.7 medical errors per day, often leading even to life-threatening situations [2]. Rothschild et al. found that medication errors account for 78% of serious medical errors in the ICU [3].

In this context scientific studies often imply that medication errors are in most cases related to human failures resulting from a combination of time pressure, work load, lack of resources and quick decision making [4, 5, 6]. But in such complex work environments as medical work systems only a well-adapted combination/ integration of the involved medical staff members with the used technology and underlying organization can guarantee a safe or at least fail-safe treatment environment. Therefore user and usage oriented technological solutions and computer based supporting tools are required, which can only be designed based on a sufficient process knowledge and user integration [7].

Methods: For this reason we have developed the following ergonomic analysis approach for the identification of technological user requirements together with the Clinic Ernst von Bergmann in Potsdam (Germany), while iteratively testing it for the computer based optimization of the medication process within the ICU:

1. Task Identification and Process Analysis Together with the Involved Medical Staff Members (= Process Experts) [7]
2. Risk Analysis and Assessment of the Analyzed Processes
   Using the FMEA-Approach (as described below) [8]
3. Optimization of the Analyzed Processes Using the TOP-Approach (as described below) [9]
4. Risk Analysis and Assessment of the Optimized Processes Using the FMEA-Approach (as described below) [8]
5. Assessment of the Achievable Process Optimization Using the Results of the FMEA-Assessments [8]

Within this methodological approach the FMEA-Procedure (FMEA = Failure Mode and Effect Analysis) is used for the systematic assessment of the existing risks for potential process failures by calculating their risk priority number according to DIN EN 60812 by the assessment and multiplication of each potential failure's severity (S) and occurrence (O) on a scale between 1 (= low) and 10 (= high) and their possible detection before a damage occurs on a scale between 1 (= easy) and 10 (= hard). The resulting risk priority number (RPN) then allows to identify potential process failures with the highest failure risk and optimization potential [8].

For the identified process failures optimization proposals are developed using the system ergonomic TOP-Approach focusing on technological process improvements first, before relying on organizational re-designs or personal behavior changes due to the fact, that the two later ones can easily by-passed at any time [9].

Results: Within the exemplary analysis of the medication process within the ICU of the Clinic Ernst von Bergmann in Potsdam (Germany) the following 7 major process tasks have been identified, which have no predefined order, but are rather iteratively processed whenever necessary:

1. Definition of (patho-)physiological status; 2. Definition of therapeutic goals; 3. Drug prescription; 4. Preparation of drug application; 5. Drug application; 6. Monitoring of therapeutic effect; 7. Documentation.

Analyzing their sub-processes together with the involved medical experts lead to the following potential failures and their risk priority number (RPN): lack of knowledge about medication specifics (RPN = 576), lack of documentation (RPN = 224), lack of communication (RPN = 150), increased workload (RPN = 150) etc. For these potential failures an optimized computer based medication process could lead to a reduction of the risk priority number by more than 50%. The optimization proposals are based on information technology (following the TOP-Approach described above), the potential can only be realized in close cooperation with industrial partners.

This constructive approach has to be complemented by a corrective approach e.g. a Critical Incident Reporting Systems (CIRS).

Conclusion: The optimization potential clearly show how effective a constructive re-design process could be for patient safety and staff satisfaction (see also Figure 1).

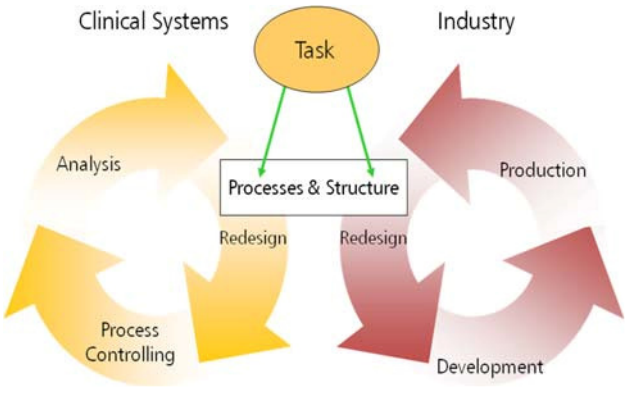

Fig. 1. Constructive re-design of clinical work processes and technological solutions.

REFERENCES

1. Lösungskonzepte zur Patientensicherheit Band, Lösungskonzept 6, Mai 2007 (2007): Gewährleistung der richtigen Medikamente bei Versorgungsübergängen; In: WHO-Kollaborationszentrum für Lösungskonzepte zur Patientensicherheit Gedächtnisprotokoll; http://www.who.int/patientsafety/solutions/patientsafety/PatientSolutionsGERMAN.pdf; Zugriff: 15th Sept. 2009; 2.35 pm (MEZ).
2. Donchin, Y., Gopher, D., Olin, M, Badihi, Y., Biesky, M, Sprung, CL., Pizov, R., Cotev, S. (1995): A look into the nature and causes of human errors in the intensive care unit. In: Crit Care Med (23), 294–300.
3. Rothschild, JM., Landgrian, CP., Cronin, JW. Kaushal, R., Lockley, SW., Burdick, E., Sone PH., Lilly, CM., Katz, JT., Czeisler, CA., Bates, DW.(2005): The critical care safety Study: The incidence and nature os adverse events and serious medical errors in intensive care. Crit Care Med (33), 1694–1700.
4. Kohn, L., Corrigan, J., Donaldson, M. (2000): To Err is human. National Academies Press.
5. Rasmussen, J. & Duncan K. & Leplat, J.(1987): New Technology and Human Error. John Wiley & Sons.
6. Reason, J. (1994): Understanding adverse events: human factors. In: Quality in Health Care, No. 4, pp. 80–89.
7. Marsolek, I. & Friesdorf, W. (2006): Work Systems and Process Analysis in Health Care, In: P. Carayon (Editor): Handbook of Human Factors and Ergonomics in Healthcare and Patient Safety. Mahwah, New Jersey: Lawrence Erlbaum Associates, 649–662.
8. DIN EN 60812 (11/2006) Analysetechniken für die Funktionsfähigkeit von Systemen – Verfahren für die Fehlzustandsart- und –auswirkungsanalyse (FMEA).
9. Friesdorf, W. & Marsolek, I. (2008): Fehlerhafter Umgang mit Medizingeräten. In: Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen 102 (9), 563–567.

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