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**Title**: Work system design for patient safety: the SEIPS model

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**Main Focus**: Describes a new framework for understanding structures, processes, outcomes, and their relationships, within the health care setting. Expansion of previous models, emphasizing structure over individuals, and incorporating non-care processes as well as organizational and employee outcomes.

**Attendance**: Karen Chen (presenter), Dominic Breuer (discussant), Awatef Ergai (discussant), Iulian Ilies (scribe), James Benneyan, Margo Jacobsen, Camille Chicklis, Kyle Cunningham, Sara Nourazari, Melike Can, Kais Doghri, Lily Brito, Tamim al-Tamimi, Anne Shutt, Nicole Rameriz, Joyce Schmulson, Nadine Hill (phone), 3 folks from Maine (phone), 2 folks Tufts (phone).

**Summary**: This paper introduces the SEIPS model of work system and patient safety developed by the Systems Engineering Initiative for Patient Safety, an AHRQ-funded multi-disciplinary research center at the University of Wisconsin-Madison. The paper describes the general framework of the SEIPS model, including precursor models, as well as its application in a pilot healthcare setting. The model integrates approaches from human factors and systems engineering – more specifically, the work system model, a macro-ergonomics framework developed previously within the same research group – with concepts from healthcare quality engineering, in order to improve patient safety. The SEIPS model can therefore be traced to the Reason/Vincent adverse events model, with which it shares the comprehensive list of contributing factors; and to Donabedian’s model of quality, with which it shares the structure-process-outcome organization. The main aim of the paper is to demonstrate how the hybrid SEIPS model can be used to guide the assessment of the current system state, as well as the subsequent evaluation of the system after its redesign. The underlying work system model describes how a person performs a range of tasks using various tools and technologies in certain physical environments and under specific organizational conditions. The model is thus human-centered, and can be used to assess the examined system from the perspective of various participating individuals, both patients and care providers. Each one of these five components of the work system can be a contributing factor towards patient safety incidents, and the same holds for the interactions between them. Indeed, a core concept of the SEIPS model is the interaction between these different components, and the corresponding effects on care and non-care processes, which in turn influence patient, employee, and organizational outcomes. The authors also emphasize the need to consider system design and not to focus on the care process alone: the same person performing the same task within different environments could result in substantially different outcomes, and therefore systems should be designed to fit the human component. Central to this is the concept of balance: if one component does not function optimally and has a negative impact on outcomes, other, more flexible components could be adjusted in order to provide a positive offset. In particular, the authors assert that the SEIPS framework can identify both facilitators and barriers to optimal performance, information that can then be used for system redesign. As an initial application of the model, the authors briefly report on a pilot study on five outpatient surgery centers, where the goal was to identify safety threats and then plan context-appropriate mediating efforts. This was done in two phases: first, several different methods – ranging from questionnaires to process observation to review of floor plans and job descriptions – were used to understand the current state of each system; second, the subsequent system redesign was evaluated using structured questionnaires for employees and surveys for patients. No details are given in the paper on how the initial assessment informed the redesign process, or on the actual redesign methods. However, the authors provide several additional examples of other areas in healthcare where the proposed model could be applied.

**Discussion:** The current paper provides an easy-to-read introduction to the SEIPS model, but does not offer any specific instructions for its application or any quantitative results. The proposed framework itself appears to have wide applicability, but is not very structured – which, depending on the specific application, may be an advantage or a disadvantage. Indeed, similarly to most other macro-ergonomics approaches, SEIPS is predominantly qualitative rather than quantitative. It does not offer a structured, step-by-step framework for system assessment and/or (re-)design, and typically results in descriptive paragraphs, whose utility and value is not particularly evident. In this sense, it is more akin to a mental model, which simply provides a list of components to keep in mind when assessing a specific system. This limitation has been partially addressed in the more recently published SEIPS 2.0 successor model, but a clear step-by-step methodology has not been described yet. What distinguishes SEIPS from other macro-ergonomics approaches is its reduced emphasis on the customer (here, the patient) – the main focus of SEIPS appears to be more on the care provider than the patient, though both can fill in the role of the person within the underlying work system model. Other potential shortcomings of the proposed model are: the balance concept is not necessarily accurate – the lowest performance component could function more like a bottleneck than as a partial limitation that can be overcome through increments in other factors; it does not address several human resources issues of particular relevance to healthcare, including the hierarchical structure of personnel (nurses vs. physicians), and the need to adjust staffing in response to variable needs under the constraint of a limited supply; the qualitative nature makes it hard to evaluate utility – there are no published studies so far showing the efficacy of the SEIPS model – indeed, most studies so far originate from the same research group, making the model appear as an internal affair, without external validation. Ambivalent aspects identified during the discussion include: human-centeredness is a clear advantage for the proposed model, particularly the incorporation of the interaction between person and task, but this aspect is insufficiently highlighted, though it would be of great use e.g. when analyzing settings where people work around poorly-designed systems; the model appears to require extensive familiarity with the examined system through its extensive list of factors to be considered, however this can allow one to develop a wider view of the problem and identifying seemingly unrelated critical factors. Several members of the audience have previous exposure to the model, and/or have attended the short course on SEIPS offered at UW. Their experience suggests that the main focus of the model is on the interactions between the five components of the work system, whereas the components themselves are rather static. Correspondingly, applications centered mostly on reassigning tasks and promoting teamwork. In a non-healthcare setting, the model helped identify both facilitators – typically tools or technology – and barriers – usually organizational aspects – through structured interviews, and then used the balance concept to find pathways for outcome improvement. One discussant shared that while they did not used the SEIPS model per se so far, they have employed its core concepts in system redesign, where it helped by providing a broader perspective on the factors that need to be considered in order to prevent further adverse events. Using SEIPS for redesign rather than design, i.e. retrospectively rather than prospectively, appears to be more common, with the latter application seeming more of a thinking exercise. All discussants agreed that having additional structure or a clear methodology – e.g., a specific form to follow, perhaps within a six-sigma framework – would be very useful, and would stimulate further utilization of this model, including in their own institution. Also necessary are some quantitative methods for measuring outcomes, which would then also allow the determination of the overall utility and value of the model. Current opportunities for application of the SEIPS model at HSyE include the three EHRLL projects, and in particular the one on opioid use; this would fit with the overall aim of EHRLL to learn from applying different methodologies towards quality improvement in healthcare.