

## TITLE PAGE

**Project Title:**           **Designing for Patient Safety: Developing Methods to Integrate Patient Safety Concerns in the Design Process**

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## STRUCTURED ABSTRACT

**Purpose:** The project aimed to develop consensus around important patient safety issues to be considered during various stages in the healthcare design process and to identify key activities, methodologies, and tools for improving facility design in terms of patient safety.

**Scope:** There is an urgent need for a strong methodology to identify and eliminate built environment latent conditions that impact patient safety during the planning, design, and construction of healthcare facilities. The project focused on developing the processes, tools, and approaches by which safe design features could be incorporated into building designs.

**Methods:** Resources and background materials for the seminar were developed by 1) reviewing literature for design tools/approaches and a framework for tool evaluation; 2) compiling opinion papers by industry and academic experts; and 3) developing a safe design roadmap for healthcare administrators. About 70 individuals with diverse backgrounds attended the 2-day seminar, which involved presentations and discussions in different formats – presentations, panel discussions, tours, and workgroups. After the seminar, the notes were analyzed and synthesized, and a survey was conducted to gain attendees' feedback.

**Results:** One of the key findings from the seminar was that it is critical to focus on patient safety issues during the predesign phase of a healthcare facility building project. This phase affects all key decisions made downstream in the project. Seminar attendees identified high-priority design activities for patient safety: articulation of project mission/vision, operational/future state planning, simulation, process-led design, measurable goals/metrics, ongoing check-ins, post-occupancy evaluation, and safety reviews. Highly rated design tools included simulation, process analysis, link analysis, balanced scorecard, FMEA, and others. Most attendees viewed the seminar as highly valuable and effective.

**Keywords:** Healthcare design process, patient safety, safe design tool, design activity

## **Designing for Patient Safety: A National Seminar**

### **Purpose:**

The basic premise of the project was that the built environment is a critical component of the healthcare system that impacts patient safety. Identifying and eliminating built environment latent conditions is critical to improving patient safety outcomes in healthcare. The seminar aimed to develop a strong foundation for integrating patient safety concerns during the facility design process by bringing together a multidisciplinary panel of experts using a 2-day conference format. The conference focused on understanding the issues that needed to be considered in the development of a patient safety risk assessment (PSRA) to be included in the 2014 Facility Guidelines Institute (FGI) *Guidelines for Design and Construction of Healthcare Facilities*. Specific goals of the project included the following:

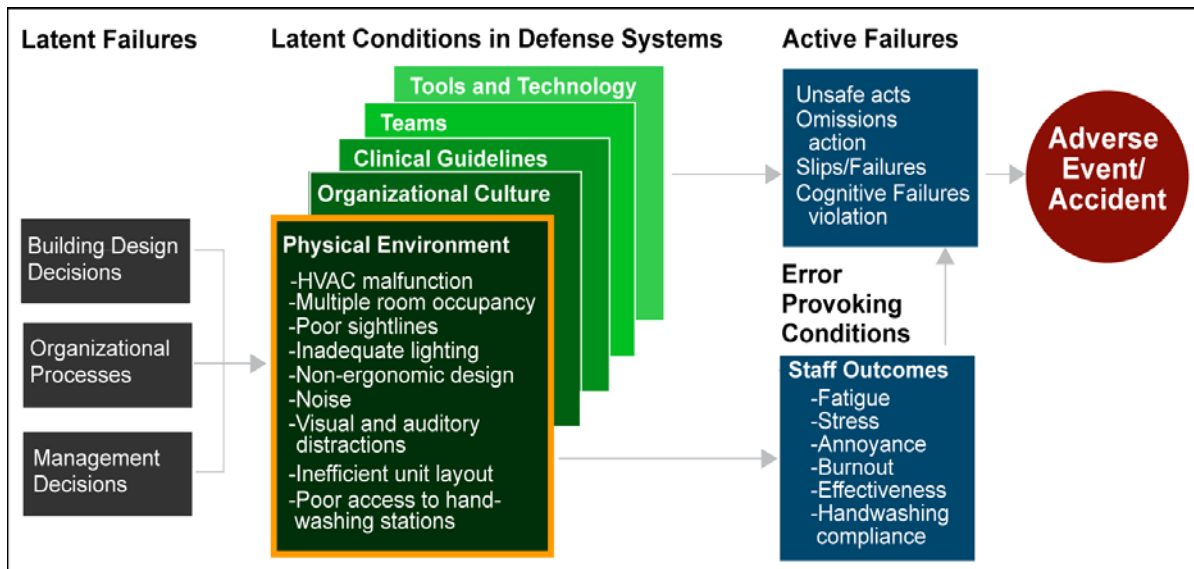
- Identify how safety concerns are identified and addressed during the planning and design process in other fields;
- Identify key methodologies and tools from other fields that can be adapted for use during the design of healthcare facilities;
- Develop consensus around key patient safety issues that need to be considered at different stages in the healthcare facility design process;
- Develop a set of questions/issues for the design team to address at each stage of the healthcare facility design process.

### **Scope:**

#### *Background*

Since the release of the 1999 IOM report, *To Err is Human* (Kohn, Corrigan, and Donaldson, 1999), patient safety improvements have remained elusive, despite a host of interventions (Watcher, 2010). Recent studies have demonstrated no significant improvement for a number of healthcare-associated conditions, including the failure to reduce postoperative, bloodstream, and catheter-associated urinary tract infections (AHRQ, 2010). Landrigan and colleagues' (2010) study of 10 North Carolina hospitals over 10 years found 25.1 harms per 100 admissions. Levinson's (2010) Department of Health and Human Services' Office of the Inspector General's report found that 13.5% of hospitalized Medicare patients experienced adverse events and another 13.5% experienced temporary harms. All these harms significantly impact the nation's healthcare bill, with 1.5 million errors estimated to contribute an additional \$19.5 billion dollars annually, as found in a medical claims study by the Society of Actuaries (2010). Perhaps these results reflect an incomplete understanding of the puzzle that quality healthcare represents.

It has become increasingly clear that the problem of patient safety does not lie solely in the hands of clinicians or frontline healthcare staff. The healthcare system has many inherent latent conditions (holes and weaknesses) that interact in complex ways, which result in adverse events (Reason, 2000). A growing body of research shows that features in the built environment, such as light, noise, air quality, room layout, and others, contribute to adverse patient safety outcomes like healthcare-associated infections, medication errors, and falls in healthcare settings (Joseph and Rashid, 2007; Ulrich et al., 2008).



Conceptual model based on Reason’s model showing the role of the environment as a latent condition or barrier to adverse events in healthcare settings.

Source: Joseph (2007)

The conceptual model in Figure 1, based on Vincent’s (1998) and Reason’s (2000) works, shows the role of the physical environment elements as the latent conditions that contribute to patient safety. Often, these latent conditions that adversely impact patient safety are built into the physical environment during the planning, design, and construction of healthcare facilities. For example, the location of emergency departments and intensive care units might necessitate the transport of critically ill patients over long distances, potentially causing patient complications. Handwashing sinks located in inconvenient or inaccessible locations might result in poor handwashing compliance among physicians and nurses.

Given the massive investment anticipated in healthcare facility construction in the next 10 years, there is an urgent need for a well-defined and standard methodology to identify and eliminate built environment latent conditions that impact patient safety during the planning, design, and construction of healthcare facilities. Design teams themselves are often unfamiliar with the possible built environment impact on patient safety and even less familiar with ways to incorporate these concerns into the design process. Although fields such as aviation and other high-risk industries have been able to harness human factors, engineering, and cognitive science to result in the preferred human response and consequent improved safety, no similar method currently exists for the design of new healthcare facilities or major renovation projects.

Brief introductory language around a Patient Safety Risk Assessment (PSRA) was included in the appendix of the 2010 *Guidelines for Design and Construction of Healthcare Facilities* from the Facility Guidelines Institute. The Joint Commission, many federal agencies, and authorities in 42 states use the Guidelines either as a code or a reference standard when reviewing, approving, and financing healthcare construction projects; surveying, licensing, certifying, or accrediting newly constructed facilities; or developing their own codes. Currently, the PSRA is very loosely defined, and the 2010 Guidelines do not provide any information on how such an assessment could be conducted. There is an excellent opportunity to draft a well-defined facility

life cycle risk assessment approach and evaluate existing safety tools to provide an evidence-based foundation for further development of the PSRA in the 2014 edition of the Guidelines.

The Designing for Patient Safety seminar sponsored by the Agency for Healthcare Research and Quality (AHRQ) and the Facilities Guidelines Institute (FGI) provided the opportunity to bring together interdisciplinary experts who have developed proven effective methods for addressing safety issues during the design process. Virtua Health was a key partner and host for the seminar. The new Virtua Voorhees facility that opened in May 2011 was designed using a process-driven approach from the start and served as a case study and tour site. The 2-day meeting served as a catalyst for developing consensus around the key issues to consider in the PSRA as well as the methods that will be most effective across the different phases of the facility life cycle. The information resources developed as part of this seminar as well as the consensus findings from the seminar provide the foundation for the PSRA. Additional white papers and specific tools that comprise the PSRA will be developed over the next 3 years so that concrete information will be available to guide design teams as they embark on a patient safety risk assessment during the facility design process.

### *Scope*

The focus of this project was on tools and approaches used in different fields to enable design teams to focus on safety issues in the design process. Another highly significant and related area of research focuses on how built environment features (e.g., location of handwashing sinks) impact safety outcomes (e.g., handwashing compliance). A brief summary (patient safety design framework) was developed on this related topic to provide context to seminar participants, but the seminar did not specifically focus on the impact of design on safety outcomes; rather, it focused on the processes by which safe design features were incorporated into building designs.

Because a key focus of this seminar was on developing a framework for a patient safety risk assessment, which would eventually be fully incorporated into the Guidelines, the project also focused on understanding the structure of other similar risk assessments in the Guidelines (e.g., the Infection Control Risk Assessment or ICRA) and their potential relationship with the proposed PSRA. As such, several members from the HGRC were invited as seminar participants so that they could provide their feedback and also help in developing consensus that could be carried back to the larger meeting of the HGRC.

### **Methods:**

The project focused on two key areas: development of resources and background material for the seminar, and seminar planning and logistics. Some key resources were developed to meet the goals of the project. These included 1) a literature review of design tools for patient safety and a framework for tool evaluation; 2) a compilation of opinion papers written by industry and academic experts; and 3) the development of a safe design roadmap for healthcare administrators. The team also focused on developing an agenda for the seminar that would best meet the goals for the project. The CHD project team conducted regular conference calls throughout the process with an advisory committee of five experts who provided guidance, suggestions, and comments.

### *Literature review and tool evaluation*

The literature review focused on the tools and approaches that were potentially useful for incorporating patient safety in the design process. The goal was to generate a set of tools or methods used to enhance patient safety in the design process that could be discussed and evaluated in the national seminar. The literature review involved several steps. First, a scan of design tools and approaches for patient safety was conducted in the fields of human factors, architecture, engineering, business management, and so on. The search was conducted in PubMed, EBSCO, and Internet search engines. Relevant articles, books, or other publications were reviewed. In addition, two compendiums around patient safety published by AHRQ in recent years were examined closely to identify relevant design tools (see Henriksen, Battles, Marks, and Lewin, 2005; Henriksen, Battles, Keyes, and Grady, 2008). Additional tools were recommended by the advisory committee and other experts in the field. The result of this step is a list of 14 design tools and approaches, including the following:

- Link analysis
- Root cause analysis (RCA)
- Failure mode and effects analysis (FMEA)
- Simulation
- Work sampling
- Balanced scorecard
- Process analysis
- Participatory ergonomics
- Lean
- Six Sigma
- Patient safety rounds
- Work design process
- Systems Engineering Initiative for Patient Safety (SEIPS)
- Socio-technical probabilistic risk assessment (STPRA)

Next, further literature search and reviews were conducted and focused on the tools/approaches identified in the first step. Relevant information, including the definition, the history, and the examples of use in healthcare settings, as well as the typical process of implementation, limitations, and additional resources were extracted from the literature for each tool/approach. The information for each tool/approach was synthesized into a brief summary that was about 1.5 to 3 pages long.

In the final step, the project team reviewed the 14 tool summaries and selected seven design tools (the first seven in the above list) for workgroup discussion on the national seminar (see below). The selection of tools was based on a set of criteria, including the relevance to the facility design process, the scope of use, and the documented effectiveness and validity of tools. It was also decided to focus only on actual design tools and exclude high-level design approaches or philosophies (e.g., Lean). Each workgroup was asked to evaluate one of these tools and the safe design roadmap. The tool summary as well as relevant research articles were provided to seminar participants 2 weeks prior to the meeting. A tool evaluation form was provided, and participants were asked to rate each tool on a scale of 1 to 5 on a set of criteria. Participants were asked to reflect on the following questions to support their rating:

Usability:

- Is the tool easy to understand and use by a multidisciplinary group?
- Is the tool already a requirement as part of any accreditation or government reporting systems?
- Do hospital teams commonly use this tool?

Relevance:

- Has the tool been used in the healthcare facility design process?
- Can the tool be easily modified use in this context?

Feasibility:

- Would this tool be too time consuming to use for a facility design project?
- Would it require significant resources (people, equipment, space) to use this tool?
- Does the use of the tool require special expertise or software?

Generalizability:

- Can this tool be used in many different types of healthcare settings, project scopes, and organizations?

Additional questions that were provided for discussion included:

- Is the tool reliant on information from other processes or phases? If so, does it build on a prior step in the process? What types of information is needed from previous steps?
- At what phase in the facility life cycle do you think this tool will be most applicable?
- Please provide any recommendations for modifying this tool to make it applicable for healthcare facility design.
- Are there any other aspects of this tool that you would like to share with the group?

*Opinion paper compilation*

Around 20 industry experts were invited to provide their perspectives on designing for patient safety – how patient safety can be addressed by design, and how safety considerations can be integrated into the design process. A total of 17 experts completed and submitted 1- to 2-page short opinion papers. The 17 authors represent diverse professional backgrounds, including architecture, interior design, human factors, engineering, medicine, nursing, infection prevention, and hospital administration. The opinion papers were copyedited and compiled into a document called *Perspectives on Designing for Patient Safety*. The document was provided to all participants ahead of the seminar to serve as the context for the discussions during the meeting.

*Development of a safe design roadmap/CEO checklist*

Recognizing that healthcare administrators are the final decision makers and the ultimate drivers of designing for patient safety, the project team placed high priority on developing a safe design roadmap or checklist for healthcare administrators to facilitate communication and the optimization of safe design principles. The project team worked with the advisory committee members who had healthcare administration experience to develop the questions that healthcare administrators should ask during the different design stages in a typical healthcare facility project, from strategic planning to occupancy, in order to improve patient safety. The purpose of the safe design roadmap is to provide CEOs and their leadership team with a facility project management tool that captures the opportunities to use physical environmental features to help

improve patient safety outcomes. The tool is divided into sections that correspond to the facility life cycle phases; each phase includes key questions and variables that shape facility planning and project decision making. Based on current research, the checklist variables guide senior leaders through the facility project management process, helping them integrate facility design into patient safety programs, specify patient safety goals, and identify corresponding facility features to incorporate in the design. Necessary supporting care processes and organizational culture transition activities are noted as well.

In addition, a design framework and consideration for safe design was developed based on previous work by CHD (Joseph and Rashid, 2007) and by Reiling and colleagues (2008). The conceptual framework and 10 design considerations for patient safety provided essential background material about the relationship between the design of the physical environment and patient safety outcomes. This information was provided to participants before the seminar to facilitate and stimulate discussion.

### *Seminar development*

#### Participants

In order to meet the goals of the projects – specifically as they related to understanding approaches from different fields – the CHD project team reached out to invite individuals with diverse backgrounds: architects, interior designers, planners, clinicians, hospital administrators, researchers, human factors experts, industrial engineers, guidelines experts, and facility managers. A list of invitees was compiled to include known experts on the topic as well as individuals who expressed strong interest in the topic. The invitations were delivered by emails and phone calls with follow-ups. About 70 individuals attended the seminar. The participants were assigned to seven workgroups. Each workgroup consisted of 9 to 10 participants from different backgrounds (see Table 1) including one Six Sigma black belt facilitator (part of Virtua staff). Also, given the strong focus on developing content for the Guidelines, each group included at least one person from the Healthcare Guidelines Revision Committee (HGRC) of the Facilities Guidelines Institute. A basecamp website was developed for the purpose of the seminar and secure accounts were created for all participants. All background materials were shared via the basecamp website. Participants were also encouraged to communicate with each other prior to the seminar through the basecamp site as well as through conference calls. Each workgroup was assigned different tools to evaluate. Summaries on those tools as well as relevant research papers were provided to workgroup members. They were asked to fill in their tool evaluation on forms provided prior to the seminar.

**Table 1. The composition of workgroups**

<b>Occupation \ Workgroup</b>	<b># 1</b>	<b># 2</b>	<b># 3</b>	<b># 4</b>	<b># 5</b>	<b># 6</b>	<b># 7</b>	<b>Total</b>
<b>Architect/Designer/Planner</b>	3	4	2	2	1	2	1	15
<b>Clinician/Hospital Administrator</b>	3	4	5	3	4	4	4	27
<b>Researcher</b>	2	2	1	2	2	2	4	15
<b>Human Factors/Patient Safety Expert</b>	1		1	3	1	1	1	8
<b>Facility Management</b>	1				1			2
<b>Total</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>9</b>	<b>9</b>	<b>10</b>	<b>67</b>



## Settings

The seminar was conducted at Virtua Health's Center for Learning, a meeting facility located on the first floor of the new replacement hospital, Virtua Voorhees. Virtua Health, a comprehensive healthcare system headquartered in Marlton, NJ, is one of CHD's Alumni Pebble Partners. Virtua Voorhees Hospital is a new 364-bed, state-of-the-art digital hospital and outpatient center. Virtua utilized a process-driven design approach to improve patient safety and healthcare efficiency in their new facility. As such, Virtua Voorhees served as an excellent case study for seminar participants. The Center for Learning includes five classrooms, a simulation lab, and four think tanks. All rooms were equipped with audio and visual capabilities plus a wireless internet connection. Virtua Health also provided the staff and resources to videotape seminar sessions. The majority of the seminar took place in the meeting rooms at the Center for Learning. The seminar also included a facility tour of the new Virtua Voorhees hospital, led by Virtua staff.

## Seminar Agenda

The seminar was conducted on October 12-13, 2011. The 2-day seminar was organized to enable the participants to fully understand and engage with the topic at hand. Table 2 below shows the final agenda for the seminar. The first day involved presentations and discussions in different formats – presentations, panel discussions, and tours. The content of the presentations was developed to expose this multidisciplinary group to a range of topics that would be critical to understand in order to participate in workgroups on day 2. Thus, day 1 included presentations about the Guidelines as well as different tools, approaches, and case studies that looked at the issue of incorporating patient safety concerns in the design process. Day 1 also included facility tours of Virtua Voorhees and discussions with Virtua team members about their experience during the design process. Day 2 was designed to enable participants to dive deeper into two main areas:

1. The potential framework of the PSRA and the types of activities that might be included in a PSRA: Participants were asked to identify key activities that would be important from the perspective of incorporating patient safety in various stages of the design process – broadly divided into predesign and design/construction (what), team composition and responsibilities (who), the time and procedure of conducted the activities (when and how), the tools, and the required documentation.
2. Evaluation of tools that might be most relevant for incorporating safety concerns in the facility design process: Participants were asked to rate the usability, relevance, feasibility, and generalizability of each tool and provide suggestions on how to modify and use the tool for safe design. Participants were also asked to provide comments and suggestions regarding the safe design roadmap, including its strengths, weaknesses, and aspects that needed to be improved.

Workgroup members presented their key findings to the entire group after each workgroup discussion. The PSRA workgroup session was followed by a consensus workshop to identify high-priority activities that could be included in the PSRA. Seminar participants ranked the PSRA activities identified by the group in predesign and design/construction phase as high priority, medium priority, or low priority. This information was then tabulated to identify the top five high-priority activities in predesign and design/construction phases. Participants performed a similar ranking exercise for the types of documentation that may be required as part of a PSRA.

Each workgroup presented its evaluation of their assigned tool and the safe design roadmap. This was followed by a short discussion.

**Table 2: The seminar agenda**

Time	Agenda item
<b>Day 1</b>	
8:30-8:45	<i>Welcome to Virtua</i> – Richard P. Miller, Virtua Health
8:45-9:00	<i>Welcome to the seminar</i> – Debra Levin and Anjali Joseph, The Center for Health Design
9:00-9:30	<i>Designing for safety: Challenges and opportunities</i> – Kerm Henriksen, AHRQ
9:30-10:00	<i>Performance-driven design at Virtua</i> – Tejas Gandhi, Ninfa Saunders, Michael S. Kotzen, Virtua Health
10:15-11:00	<i>Virtua breakout discussions: NICU, inpatient unit, &amp; ED design</i> – Virtua Health
11:00-12:15	<i>Tour of Virtua Voorhees Hospital</i> – Virtua Health
1:15-2:00	<i>Incorporating patient safety in the guidelines</i> – Linda Dickey, Skip Gregory, Ellen Taylor, FGI Health Guidelines Revision Committee
2:00-4:00	<i>Panel discussions</i> – John Reiling, Rob Tannen, Jonas Shultz, Tejas Gandhi, Bill Rostenberg
4:30- 5:30	<i>Mistake-proofing built environments and processes</i> – Keynote by John R. Grout, Berry College
<b>Day 2</b>	
8:54-12:00	<i>Workgroups – Session 1: Patient safety risk assessment (PSRA) processes</i> – All participants
12:45-2:00	<i>Workgroups – Session 2: Safe design tools and roadmap</i> – All participants
3:00-3:30	<i>Wrap-up &amp; Next steps</i> – Eileen Malone, Jim Lussier, Anjali Joseph

### Seminar follow-up

After the seminar, the easel notes taken at the seminar were transferred to an electronic transcript in Microsoft Word. The notes were then analyzed and synthesized. The information was compiled into three tables: 1) safe design activities in the predesign and design/construction stages as well as required PSRA documentation; 2) comments and suggestions about the safe design roadmap; and 3) the evaluation of safe design tools. In addition, an online survey questionnaire was sent to all the participants to gather their comments about the conference and suggestions for improvement. The questionnaire also included a question asking whether the respondents were willing to participate in the future development of the materials presented in the seminar.

### Results:

#### *Key activities by design phases (PSRA)*

The discussions throughout the seminar and specifically from the seven workgroups produced rich insights into the activities around designing for patient safety. There was extreme consensus that time and effort needed to be dedicated to focusing on patient safety issues during the predesign phase (strategic planning, master planning, operational planning, and programming) of the healthcare facility design project. The decisions made during predesign significantly impact the design parameters going forward and outcomes of the project from a safety perspective.

Attendees also noted that the design process should not be linear. Instead, the design activities should happen iteratively in small cycles. The design efforts should be an important part of the overall continuous improvement of patient and staff safety in any healthcare organization. Attendees identified the importance of assessing different design and operational solutions using

tools such as a priority matrix or d-FMEA. Some workgroups also suggested that business planning was as important as other phases and should be considered as a stand-alone design phase by itself.

The workgroups identified a range of activities that should be undertaken during predesign and design/construction phases to improve patient safety outcomes. Table 3 shows the top high-priority activities identified by most of the attendees.

**Table 3. High-priority activities in designing for patient safety**

<b>Design phase</b>	<b>High-priority activities</b>
Predesign	<ol style="list-style-type: none"> <li>1. Articulation of project mission/vision around patient safety – The majority of the attendees felt that the articulation of a clear statement around patient safety at the start of the healthcare facility design project was of paramount importance, as it sets the tone for the activities of the team through the course of the project. The project mission/vision statement should come directly from the organization’s strategic planning and gap analysis, which should be a continuous iterative process.</li> <li>2. Operational/future state planning – Attendees identified the importance of clearly defining future states and planning processes that would help in achieving those states prior to even embarking on the actual design of the building.</li> <li>3. Simulation/mock-ups – Attendees identified the importance of using simulation and mock-ups very early in the design process to help visualize key concepts and to identify possible built environment latent conditions.</li> <li>4. Process-led design – Attendees highlighted the importance of designing the care processes in parallel to the building design. The importance of flexibility in design to accommodate changing processes was also discussed.</li> <li>5. Define measurable goals/metrics – Attendees discussed the importance of collecting baseline data around key patient safety outcomes, such as falls, healthcare-associated infections, and medical errors; conducting a patient safety survey; and developing goals for improving these outcomes.</li> </ol>
Design & Construction	<ol style="list-style-type: none"> <li>1. Simulations/mock-ups – Simulations and mock-ups were considered the most important activity during the design and construction phases from the perspective of identifying built environment latent conditions</li> <li>2. Ongoing team check-ins at every phase – Attendees felt that safety priorities needed to be institutionalized and the teams needed to have regular check-ins during all phases of the project to ensure that safe design features were being implemented as envisioned.</li> <li>3. Post-occupancy evaluations (POE) – POEs were identified as a key activity to be undertaken once the building is completed and occupied to ensure that the building was effective in providing safe care and supporting the staff in conducting their work in a safe and efficient manner.</li> <li>4. Safety reviews – Similar to the check-in, the attendees felt the safety reviews would enable the team to review plans and construction documents using a patient safety lens.</li> </ol>

The seminar participants felt that the design team needed to be multidisciplinary to ensure that patient safety issues were effectively addressed and should include clinicians, administrators, facility managers, architects, consultants, human factors specialists, and researchers. The multidisciplinary team should be formed as early as possible. Various team members may lead the team effort in different stages; for example, administrators lead in the strategic planning stage, and designers lead at the design stage. Many different tools were identified for use at different facility design phases, including design FMEA (failure mode and effects analysis), process mapping, spaghetti diagrams, link analysis, Pareto analysis, safety culture surveys, quality function deployment (QFD), and more. Table 4 lists tools and documentation identified by attendees. The participants felt that conducting a Patient Safety Risk Assessment (PSRA, as currently referenced in the *Guidelines* appendix) might involve healthcare design teams documenting their findings from using these tools as well as documentation from other risk assessments, such as the Infection Control Risk Assessment (ICRA). Participants also identified an operational plan that documents key processes in the new facility as another potential requirement for a PSRA. It was also noted that caregiver safety should be addressed simultaneously with patient safety.

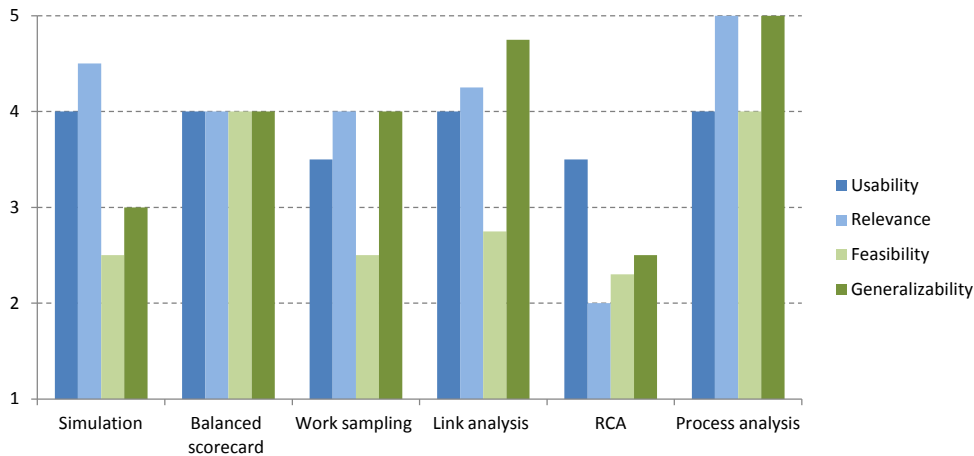
**Table 4. Tools and documentation recommended by seminar attendees**

<b>Design phase</b>	<b>Tools</b>	<b>Documentation</b>
Pre-design	<ul style="list-style-type: none"> <li>• Balanced scorecard</li> <li>• Benchmarking</li> <li>• Brainstorming</li> <li>• Case studies</li> <li>• Communication plan</li> <li>• Critical pathway analysis</li> <li>• FMEA</li> <li>• Focus groups</li> <li>• Lean and Six Sigma</li> <li>• Link analysis</li> <li>• Pareto analysis</li> <li>• Photo journal</li> <li>• Process mapping/analysis</li> <li>• Safety of culture assessment</li> <li>• Simulations/mock-ups</li> <li>• Spaghetti diagram</li> <li>• Statistics gathering</li> <li>• Task analysis</li> <li>• Time motion study</li> </ul>	<ul style="list-style-type: none"> <li>• Business case (line-item budget for safety)</li> <li>• Documentation of current safety issues and safety opportunities (data + RCA)</li> <li>• Measurable goals defined/metrics</li> <li>• Operational plan (flow diagram, narrative)</li> <li>• PSRA</li> <li>• Repetitive room design</li> <li>• Risk management matrix</li> <li>• Strategic plan</li> <li>• Vision/mission statement</li> </ul>
Design & Construction	<ul style="list-style-type: none"> <li>• Bump analysis</li> <li>• Flow assessment</li> <li>• FMEA</li> <li>• Link analysis</li> <li>• Operational safety risk assessment</li> <li>• POE</li> <li>• Priority matrix in patient safety issues</li> <li>• Safety plan during construction</li> <li>• Safety-related punch list</li> <li>• Safety review</li> <li>• Simulation</li> </ul>	<ul style="list-style-type: none"> <li>• Documentation of EBD and safety design elements</li> <li>• Construction documents</li> <li>• Risk matrix</li> <li>• Safety plan</li> <li>• POE documentation</li> <li>• Punch list</li> </ul>

### Tool evaluation

Each workgroup evaluated one of the seven design tools (see the Methods section). Most of these tools were considered relevant and applicable to the healthcare facility design process. Balanced scorecard, process analysis (process mapping), and link analysis were ranked high on all key criteria. Simulation and FMEA were also ranked high, and workgroups felt that these methods were already being used in the facility design process and could be modified to make it feasible for projects of different scopes. Teams felt that these methods could readily support the design teams in making key decisions that impacted patient safety. The balanced scorecard was suggested as helping with continuous monitoring for patient safety. Other tools, such as process analysis and root cause analysis (aggregated data from RCAs being most beneficial), would be critical during predesign and planning phases. FMEA, simulations, and link analysis could be effectively used at different design phases and could support decision making at varying levels of design detail.

**Figure 1. Ratings of design tools**



Note. Ratings on a scale of 1 to 5: 1 represents the lowest rating; 5 represents the highest rating.

As shown in Figure 1, almost all tools were rated high in terms of usability (ratings  $\geq 4$  for simulation, balanced scorecard, link analysis, and process analysis) and relevance (ratings  $\geq 4$  for all except RCA). The most feasible tools included balanced scorecard and process analysis. The most generalizable tools included link analysis, process analysis, balanced scorecard, and work sampling.

### Safe design roadmap/CEO checklist

The safe design roadmap was perceived to be a comprehensive tool including a lot of good content to facilitate multidisciplinary discussions and stimulate creative thinking around patient

safety. It was also noted that the roadmap provided an overarching structure or framework under which many specific design tools can be used to support different design phases. In addition, the attendees felt that the roadmap was a much-needed work in the field.

However, attendees also thought that the roadmap in its current format was less than desirable and made suggestions for improvement.

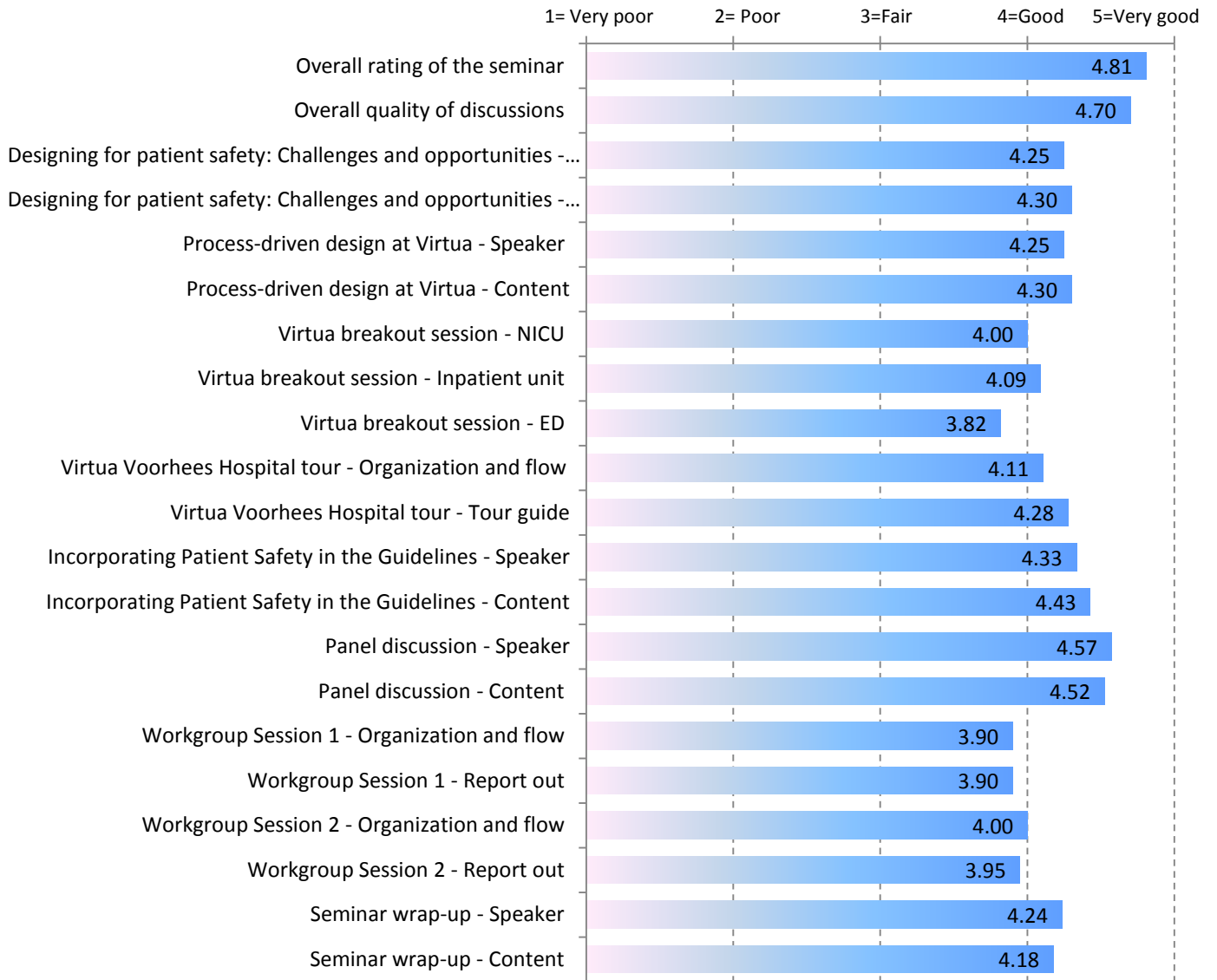
- First, as a tool specifically designed for CEOs or other administrators, it appeared to be too long and complex to be easily comprehensible and useful. One suggestion was to make the list of questions or checklist items shorter and more concise, supplemented by elaborated explanations and additional information related to the questions in an appendix or in sidebars or pop-ups. Another suggestion was to design different checklists for different team members (disciplines), such as administrators and designers, so that the CEO tool only included those questions/items pertinent to their decision making. It was also suggested to call the tool a roadmap or other similar names (e.g., guiding questions) to prevent users from expecting a short checklist of critical items.
- Second, attendees suggested providing supplementary information, including glossary terms, references, tools that could be used to address specific questions or topics, a reading list, and vivid examples (e.g., Pebble partners or other facilities), as well as succinct instructions for use.
- Third, more specific aims of enhancing patient safety should be articulated clearly and upfront. Similarly, the definition of safety and the roles or responsibilities of team members should be clarified at the beginning.
- Fourth, attendees also suggested that the roadmap should be made customizable to serve the various needs of various facilities.

#### *Participant feedback about the seminar*

A total of 21 participants responded to the post-seminar survey. Most of the seminar components were rated as good to very good by the respondents. Among them, the panel discussion in the afternoon of day 1 received the highest ratings. Figure 2 shows the average ratings of the sessions and the overall seminar. All respondents felt that sufficient information was provided, the seminar agenda was effective, and the discussions were helpful in providing structure to the PSRA in the Guidelines. Eleven respondents expressed willingness to contribute to the future development of the various components, including tools, opinion papers, the safe design roadmap, and the PSRA.

In the answers to open-ended questions, respondents reported that both the formal sessions and the informal interactions were highly valuable and met the needs of the industry. The seminar can serve as “a model for improving the design approach and tools for ‘performance improvement’ in general.” However, respondents also felt that the 2-day timeframe was too short and that there was not enough time to cover all the important issues in great depth. Probably because of the time limitation, some respondents thought that the facility tour did not provide enough exposure to the potentially interesting design features implemented through the Lean process improvement at Virtua.

**Figure 2. Participant ratings of the seminar components**



## List of publications and products

1. *Design for patient safety tool summaries*
  - Link analysis
  - Root cause analysis (RCA)
  - Failure mode and effects analysis (FMEA)
  - Simulation
  - Work sampling
  - Balanced scorecard
  - Process analysis
2. *Safe design roadmap*
3. *Opinion papers*
  - Design flexibility in, design errors out, by John Grout
  - Designing for safety: A systems perspective, by Kerm Henriksen
  - Collective accountability: Primum non nocere (First do no harm), by Eileen Malone
  - Leading a horse to water: A proverbial dilemma for patient safety, by Skip Gregory
  - Designing a healthcare setting with infection prevention in mind, by Linda Dickey and Judene Bartley
  - Perspectives on designing for patient safety, by James Lussier
  - Perspectives on designing for patient safety, by John Reiling
  - Design for healthcare is not special, by Rob Tannen
  - Using patient simulation within mock-ups to evaluate room design, by Jonas Shultz
  - Desperately seeking safety in the surgery and imaging environments, by Bill Rostenberg
  - Patient safe healthcare facilities by design, by Rosalyn Cama
  - The interior designer as safety expert and risk manager, by Jain Malkin
  - Designing the hospital to reduce harm and enhance staff and patient well-being, by Paul Barach
  - Patient safety issues: The critical link between patient safety and staff safety and the inclusion of human factors expertise in healthcare design, by Mary Matz
  - Human factors systems approach to healthcare facility design, by Pascale Carayon
  - Design for patient safety: Thinking at the intersection, by Ron Smith
4. Video clips from day 1 presentations (to be edited and available from the CHD website)
5. Webinar presentation at HCD Virtual Symposium – Dec 7: Joseph, A., & Taylor, E. (2011). Designing for Patient Safety: Findings from a National Seminar. Healthcare Design Conference Virtual Symposium.
6. Taylor, E. (2012). Designing for Patient Safety – Considering a Patient Safety Risk Assessment. Paper accepted for presentation at the 2nd International Conference on Human Factors and Ergonomics in Healthcare, a subset of the 4th International Conference on Applied Human Factors and Ergonomics 2012 (AHFE 2012), San Francisco, California, July 21-25, 2012.
7. Joseph, A., Quan, X., & Taylor, E. (2012). Designing for Patient Safety: Findings from a National Seminar. Healthcare Design, 1, 20-25.



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## **Appendix: Items available upon request**

### **Appendix I. Advisory committee members**

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President and CEO  
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### **Appendix II. Opinion papers**

### **Appendix III. Design tool summaries**

### **Appendix IV. Safe design roadmap/CEO checklist**

### **Appendix V: Design framework and considerations**

#### **Appendix V. Seminar notes compilation**

1. Design activities
2. Tool evaluation
3. Suggestions about the safe design roadmap