Reimagining the ED: Ideas for Shaping the Emergency Department of the Future

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Today in the United States, nearly 50 percent of all hospital care begins in the emergency department (ED) and, over the last 20 years, ED patient volume has increased by 23 percent as many Americans use the ED to access primary care services.[1] Many factors have contributed to these trends, including:

- The aging of the baby boomer generation
- Increased longevity of people with chronic diseases
- Gaps in provision of care for behavioral health patients
- Limited operating hours of primary care providers
- Lack of affordable insurance and other issues affecting individual access to medical care
- Requirement of the Emergency Medical Treatment and Labor Act (EMTALA) for EDs to treat everyone, whether they have insurance or not

Solutions to these challenges will require major shifts in how we use health care as patients, how health care organizations deliver health care, the physical and behavioral health of the community at large, and the alignment of medical incentives in the United States. However, while the U.S. health care system struggles to determine

[1]David Marcozzi et al. *"Trends in the Contribution of Emergency Departments to the Provision of Hospital-Associated Health Care in the USA."* *International Journal of Health Services* 48(2): 267-88.

how to address these difficult and complex issues, there are changes that can be implemented now to improve the function and flow of emergency department services and facilitate provision of quality patient care.

Workshop Foundation: Evaluating Current Issues in the ED

On September 18, 2017, FGI and the American College of Emergency Physicians (ACEP) hosted a workshop titled "Reimagining the ED" at the Healthcare Facilities Symposium and Expo in Austin, Texas. More than 100 ED clinicians and design professionals and design students gathered to consider the challenges clinicians encounter in EDs every day and to look for opportunities to improve ED functionality through design. The idea was to envision how design could be harnessed to improve emergency department flow and functionality and correct issues that inhibit staff effectiveness or interfere with the delivery of patient care.

The Reimagining the ED workshop attendees gathered around 13 tables to consider design solutions to current difficulties experienced in emergency departments around the United States.

The workshop was coordinated by Mazzetti+GBA, a health care engineering and technology consulting firm, and designed and facilitated by social impact design firm DC Design, which uses human-centered design as the foundation of its work. To help the organizers frame the workshop activities, DC Design, led by Founder/CEO Durell Coleman, performed empathy interviews with 25 clinicians prior to the workshop to better understand the needs of these ED professionals. DC Design also interviewed architects and other health care designers and providers.

Clinicians were asked to come to the workshop with several challenges they face every day in mind. There was no additional priming on challenges, and there was no requirement that challenges identified have a built environment design implication.

Attendees began the workshop in small multidisciplinary teams, where they discussed the needs of clinicians and other medical staff who work in EDs. Specific problems that impede the clinicians' work were identified and solutions were conceived using the team members' combined knowledge.

Although most areas of focus brought up by the clinicians (e.g., patient flow, use of ED rooms, triage) are not usually thought of as design challenges, the participants found they could use a design thinking approach to generate new ideas with great promise for ameliorating the identified problems. In fact, the workshop discussions and outcomes suggest that exploring how facility design could be used to reduce specific ED challenges is an area ripe for research. Specifically, the following directional research questions are viable: How might patient flow be improved through design? How might design help create spaces that can flex to deal with instantaneous (surge) and long-term increases in emergency room census? How might design be used to help clinicians deliver timely, safe, and appropriate care to their patients?

In the end, three primary issues rose to the top of the clinicians' list of concerns: (1) improving arrival and front-end operations, (2) reducing patient length of stay, and (3) improving the experience of behavioral health patients. Workshop participants devised a number

Participants

On the day of the workshop, more than 100 doctors, nurses, architects, and design students gathered to brainstorm and prototype ideas to improve the design of emergency departments. This large group was broken into 13 smaller, more manageable teams of about eight persons each. Each team included:

- Two to three clinicians (nurses or physicians)
- Three designers (architects, planners, or interior designers)
- One architecture student, who also took the perspective of a patient at times (from Texas A&M University)
- One facilitator (most facilitators worked with two groups)

Other participants sprinkled among the groups included owner representatives (managers, facility staff, or planners) and a few regulators (authorities having jurisdiction and other code interpreters or enforcers).

of innovative ideas that would benefit from further research and development; these concepts are further described in the rest of this paper.

Workshop Method: Human-Centered Design

The work of the groups followed the principles of human-centered design and was organized into three distinct areas: (1) a stage and presentation area, where Durell Coleman and Ben Smalley of DC Design focused the full group's attention using discussion of concepts and exercises; (2) ideation tables, where teams met to brainstorm, collaborate, and design solutions; and (3) an open work area, where each team built models and tested ideas.

The teams were asked to identify specific challenges that clinical staff encounter in the emergency room setting and to determine which of these they believed to be the most significant. Throughout the day, DC Design and the table facilitators kept the teams focused on two questions:

- What are the challenges that impede optimal health care delivery to patients in an ED?
- What designs can we create to address these challenges?

To work through these questions, the teams applied the five stages of the human-centered design process:

(1) Empathize (understand challenges faced by clinicians/patients in the ED).

(2) Define (create actionable statements to address key challenges).

(3) Ideate (brainstorm solutions).

(4) Prototype (develop design solutions).

(5) Test (try out solutions).

At their tables, the teams developed and debated solutions, continually refining both the problem and the solution through each phase of the workshop. DC Design encouraged the groups to consider their work within the context of four design scales:

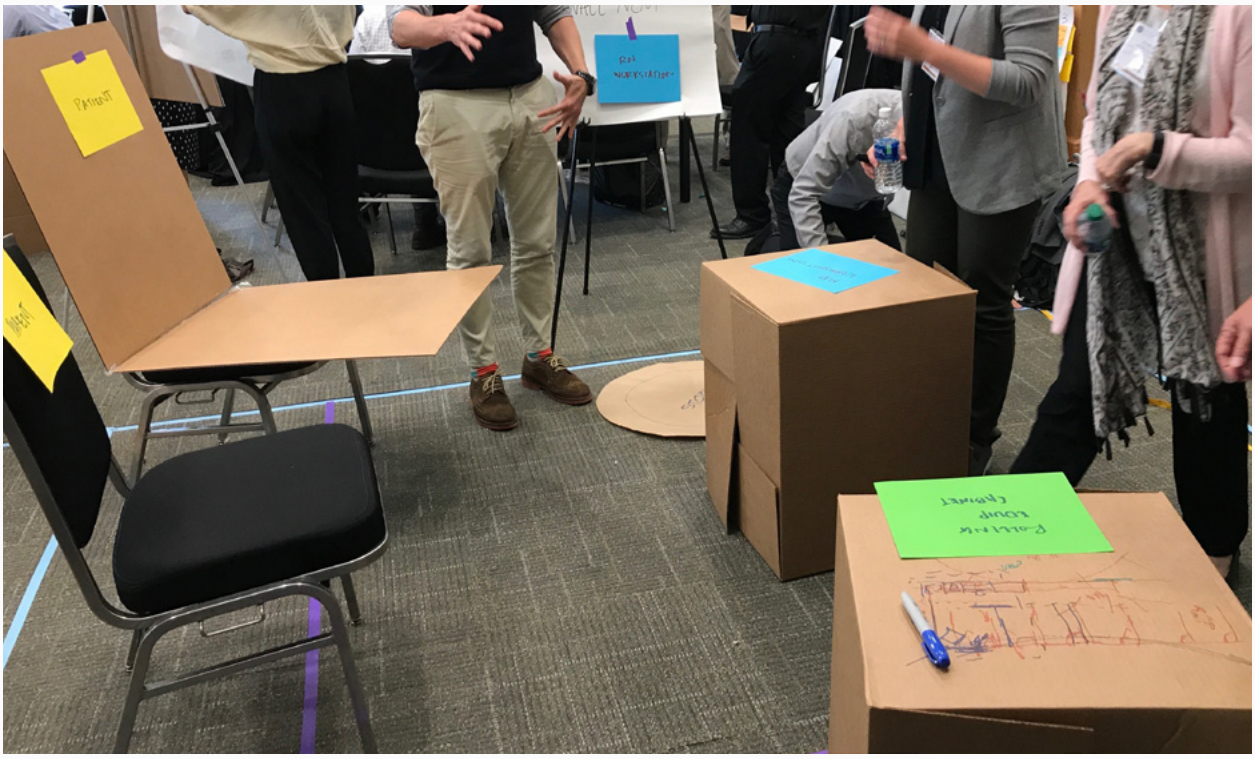
(1) Device level

(2) Room level

(3) Department (ED) level

(4) Department as part of a larger hospital/system

After they selected an ED problem to focus on, workshop participants worked out design solutions on paper.



The work groups used 3-D models to test the practicality of their design solutions.

Some teams focused on designing new treatment spaces to fill a perceived gap while others looked to technology for solutions. Once a team had chosen a single issue and conceived a solution, the group developed prototypes to help them refine and test their solution hypothesis. Groups had the option to move to the open area to create a full-scale mockup of their design. The open area had been set up—with considerable assistance from the Texas A&M students—with supplies, sheets of cardboard, cardboard mockups sized and built to mimic medical equipment (e.g., stretchers, recliners, and crash carts), and colored taped lines on the floor to provide the minimum dimensions for ED treatment rooms and bays from the 2014 *Guidelines*.

The groups were encouraged to be creative with their solutions, but at the same time to keep them achievable so they could potentially be used to address existing problems. Others in the room provided feedback on the prototypes, reviewing the innovations both as

professionals and as patients. If an identified solution was not achievable, the team was encouraged to take a different tack on the problem. Facilitators moved about the room throughout the day to monitor progress at the tables and open areas, answer questions, and help focus each group's effort.

Following the Human-Centered Design Process

Although the participating clinicians were a small sample of ED clinicians, the outcomes from the workshop can lead to improvements in ED planning, research, policy, innovation, and design. In some cases, the results provide insight into specific areas/challenges that require further inquiry. Others, particularly those stemming from clinician experiences, reveal specific challenges that can immediately be addressed to lessen problems in the ED. Some insights will have implications relevant to the baseline FGI *Guidelines* requirements or suggest topics for development as FGI Beyond Fundamentals materials. It is hoped the results from the workshop may also stimulate development of transformative ideas that reimagine how emergency care is defined and delivered in the United States.

Step 1: Identify Challenges through Empathy

The first step of the human-centered design process is to empathize with those affected by the situation being studied, in this case to understand and relate to the challenges faced by clinicians and patients in an ED. At the workshop, architects interviewed clinicians about the problems and issues they face, and each group then identified and recorded five key challenges they would attempt to resolve during the course of the day.

Challenges identified have been categorized and are listed in Table 1 (Key Identified ED Challenges). The table is ordered on a continuum from challenges that have clear built environment implications (near

the top) to challenges that do not have clear built environment implications (near the bottom). This list represents the challenges faced by clinicians and their patients. Clinicians were not asked to focus on built environment challenges.

*These challenges are listed in more detail in Appendix B: Summary of Key Challenges.

Table 1: Key Identified ED Challenges*

Suboptimal layouts
Difficulty with facility capacity and flexibility, especially in surge conditions
Suboptimal flow/throughput
Suboptimal patient environment and experience
Work environment not conducive to staff attraction, retention, and joy
Suboptimal use of "waiting time" (non-exam room time)
Ineffective processes for behavioral health and other long-term patients
Ineffective triage
Suboptimal information and communication with patients
Variability in patient population/need
Effective use of technology to enhance department
Coordination with external resources (labs, beds, consults)
Culture, structure, and communication not conducive to optimal results

Categorization of these defined challenges is helpful because they represent a consensus in each group on the key solvable challenges facing EDs today. The categories they fall into are as follows:

- Flow: Patients are not flowing optimally through the emergency department.
- Capacity: EDs are experiencing greater numbers of surge events as more people use them for basic services.
- Patient experience:
  - Patients need an improved "front-end" experience.

- Clinicians need better processes to provide appropriate levels of care for:
  - Mid-acuity patients (ESI level 3)
  - Behavioral health patients
- Delivery of care needs to be flexible to better address the needs and experiences of specific patient types.

Considering these challenge categories helps give some general direction to how provision of services in an emergency department might be improved. However, it is important to note that the challenges identified by the workshop groups do not fit neatly into the categories. For example, the patient experience challenges have flow and capacity implications and, in many cases, were cited specifically as issues that hampered flow and capacity.

Step 2: Define Actions to Address Key Challenges

Once the workshop groups had determined which identified challenges they wanted to focus on, each group used the process of ideation (i.e., brainstorming) to conceive a focused design solution(s) by asking the question "How might we . . . ?" respond to that common ED problem. Through this exercise, the groups developed specific, targeted solutions to the issues they had determined were most disruptive. Some of the prevailing opportunities identified during the exercise included "how might we":

Facility Design as a Point of Leverage for Change

It's important to note that key challenges in the ED may be addressed at various points of leverage. Change to the built environment is only one leverage point. Other potential leverage points include use of technology, process improvement, education and training, and staff changes (or staffing level changes). In addition, changes to policy and law may serve as leverage points to effect change.

Leverage points may be used in combination to help address challenges, merging multiple methods/pathways. These leverage points may affect a challenge even though a connection may not be obvious. In other words, changes to the design of facilities may serve a role in ameliorating identified challenges, even if that effect is not immediately apparent.

Most of the challenges identified during the Reimagining the ED workshop are not primarily facility design challenges, although facility design may be part of a viable solution. Therefore, how facility design may be leveraged to help relieve these challenges is a potential avenue for research.

- Improve the overall patient care experience by reimagining front-end operations?
- Improve the patient's journey from arrival to the point of treatment?
- Identify and deliver the right care in the right setting?
- Treat and release patients without bringing them into the main ED?
- Create adaptable patient care spaces to address ever-changing capacity needs?
- Improve the flow of ESI (Emergency Severity Index) level 3 patients through the ED?
- Design a better environment and process for behavioral health patients?

Step 3: Ideate, or Brainstorm Solutions

In the next step of the process, workshop participants began devising solutions to their group's identified challenges. Participants were not constrained to choosing only built environment solutions, although they were asked to consider built environment implications of any solution they pursued. Since this was a workshop conducted by FGI, and most of the non-clinical participants were experts in the built environment, participants may have been predisposed to focus on built environment solutions. Nevertheless, the problems the workshop attendees identified as most disruptive were generally not design concerns such as treatment rooms that are too big, too small, or altogether inappropriate. Rather, the primary problem in most EDs was revealed to be the operational processes involved in getting patients into those rooms.

Table 2 (Defined Challenge and Primary Proposed Solution by Work Group) associates the ultimate design solutions developed by each Reimagining the ED workshop group with the challenges they identified in Step 1.

Table 2: Defined Challenge and Primary Proposed Solution by Work Group*

	Defined Challenge	Proposed Solution
1	How might we improve the way patients journey from arrival to the appropriate treatment?	Registration kiosk for low-acuity patients
2a	How might we create adaptable, dignified care areas to address ever-changing capacity needs?	Fully flexible multi-acuity area
2b	How might we create adaptable, dignified care space to address ever-changing capacity needs?	Pop-up treatment alcoves
3	How might we improve the overall patient healthcare experience by reimagining front-end operations to identify and deliver the right care in the right setting?	Modules for subacute treatment and consult
4	How might we optimize the care patient experience and throughput of intermediate complexity patients?	Modular treatment pods in four-bed configuration
5	How might we utilize situational awareness to optimize appropriate and timely acute care?	ED as front porch (cognitive control tower)
6	How might we define a better environment and process for mental health patients?	Dedicated behavioral health ED
7	How might we design space to meet demand and how to expand to increased volume?	Flexible treatment room
8	How might we design a better system/process for unscheduled care that provides the right care to the right patient population at the right time and in the right place/environment and at the right price?	Behavioral health module
9	How might we improve the ESI level 3–5 patient's perception of care and time to disposition?	Patient conveyor belt
10	How might we improve the flow of ESI level 3 patients through the ED operations efficiently?	Dedicated level 3 unit
11	How might we provide the patient with appropriate care in a timely manner?	Streamlined flow and front-end processes
12	How might we provide effective and efficient staff flow to provide better patient care?	Flexible vertical bay rooms
13	How might we create an efficient, collaborative environment that helps the team maintain patient privacy and provide patient-centric care?	Check-in kiosk

*Some groups proposed solutions that had multiple interwoven features; in those cases, only one aspect of the solution is presented in Table 2. See the full synopses of group work in Appendix C: Summary of Ideas/Design Solutions for further details.

Step 4: Prototype, or Develop, the Design Solutions

During the first prototype phase, each group split into two and prototyped and tested an idea/aspect of an idea. Then the groups reformed to review what they learned and decide on a particular direction for the remaining prototyping steps. The groups were given the option to continue working separately if it made more sense to pursue separate avenues. Group 2 decided to continue working separately.

Step 5: Test the Design Solutions

Although each group identified and attempted to resolve a particular concern, all the solutions the groups came up with fell into three main categories:

- Arrival and front-end operations, including triage and patient sorting and waiting
- Overall length of stay
- Need for better spaces for treatment of behavioral health patients

Following are brief summaries of the issues and solutions put forth by each group, organized in the categories above.

Ideas for improving arrival and front-end operations

Considerable discussion focused on patient arrival, sorting, and waiting processes and how technology could be deployed to make these encounters more efficient. Some work groups further refined this discussion by recognizing the inherent congestion caused by patients who come to the ED for concerns/treatment that may be better suited for primary care physicians and facilities.

Improving arrival and front-end operations would affect several other identified challenges, including the need for faster throughput and a better ED experience for everyone. In fact, one group indicated the current triage model is arcane: "we are not at war." This comment

reflects the belief that the triage model used in contemporary emergency departments is based on battlefield triage dating back to the 1930s[1] rather than the realities of the current health care system.

Groups focusing on improving arrival and front-end operations attempted to find ways to reduce the admission bottleneck, help streamline flow through the emergency department, and provide a better ED experience for patients. For example, one group explored the idea of providing a registration kiosk for low-acuity patients, while another group developed the idea for a vitals-monitoring bracelet that could be used to assess and monitor patients in the waiting area.[2] Such approaches could result in reduced stress and better flow for triage and front-end operations.

[1]The term "triage" came into common use in the 18th century from the earlier French word "trier," which means "to sort, separate, or select."

[2]The group did not ultimately pursue the vitals-monitoring bracelet idea, but it is a concept worthy of further attention.

Ideas for reducing patients' length of stay in the ED

A number of work groups identified the problem of treating low-acuity, non-emergency patients in spaces designed for patients who require a bed. Some solutions recommended smaller treatment spaces for these "vertical" patients, while others recommended creating treatment rooms that could easily and quickly be converted to hold multiple low-acuity patients during peak hours. All agreed that provision of such spaces would speed up delivery of care for low-acuity patients and reduce the amount of time they—and consequently all patients—spend in the ED.

As one way to identify these low-acuity patients, multiple groups discussed the idea of zoning the ED by Emergency Severity Index (ESI) level. Creating ESI zones would support more flexible and efficient use of space and could decrease patient waiting times. Each area in the ED would be designed with patient care stations sized appropriately for the type of patient seen there.

The workshop attendees noted that the proposed low-acuity and flexible-acuity treatment spaces would necessitate changes to requirements in the 2014 (and subsequently 2018) FGI *Guidelines for Design and Construction* requirements for hospitals and outpatient facilities. To accommodate use of these proposed low-acuity and flexible-acuity treatment spaces in emergency departments and

Table 3: Emergency Severity Index*

SI Level	Description of Patient
Level 1	Requires immediate life-saving intervention
Level 2	Unsafe to remain in the waiting room for any length of time; should be seen as soon as possible
Level 3	Presents with a primary complaint that requires in-depth evaluation; needs two or more resources to treat
Level 4	Safe to wait; needs one resource to treat
Level 5	Safe to wait; needs no resources to treat

*Based on information in: AHRQ, Emergency Severity Index (ESI): A Triage Tool for Emergency Departments (https://www.ahrq.gov/professionals/systems/hospital/esi/esi2.html).

freestanding emergency facilities, minimum square footages for some ED patient treatment spaces would need to be reduced in the *Guidelines*.

Ideas for improving the experience of behavioral health patients

Two workshop groups addressed the concerns surrounding behavioral health services provided in the ED setting. Citing the tendency to hold these patients in the ED for two to three days before placement in an inpatient unit or transfer to a psychiatric hospital,[3] the groups identified the need for spaces better suited to this patient population. Because the ED is not specifically designed to provide care for the behavioral health population and the typical patient stays longer and requires different attention than typical ED patients, the flow and throughput of the entire emergency department is negatively affected when suitable behavioral health facilities are not provided. Effective solutions will both help behavioral health patients and improve overall ED operations and flow.

[3]In many instances, EDs have an overflow of behavioral health patients due to a lack of behavioral health inpatient beds; thus, buttressing inpatient care for these patients might help alleviate ED concerns.

Applying What Was Learned

For any health care facility design project, bringing together representatives of various disciplines that reflect the concerns of the health care organization, patients, family and caregivers, and clinicians is a good way to preemptively identify opportunities to improve both operational and design issues. Thus, health care organizations looking to improve operations in their EDs will find many potential solutions in the ideas generated by the Reimagining the ED workshop groups of clinicians, designers, and other stakeholders. Identifying operational processes that can impact the function of an ED early in project planning makes it easier and potentially less costly for health care organizations to implement practical design solutions specific to their facilities.

As outlined above and in more detail in the appendices of this paper, the major opportunities for improvement identified during the workshop concerned the arrival/reception/waiting process, dedicated and flexible treatment spaces for low-acuity patients, and accommodations to reduce the prolonged stays of behavioral health patients in traditional EDs. The challenges cited—and the solutions developed to respond to them—suggest that both design and process change can be effective levers to improve ED care.[4] However, to make it possible for facility designs to more effectively address the issues raised by treating patient populations with different acuity levels and other variability in patient needs and expectations, the rules, codes, and regulations that define ED spaces will need to be enhanced. With this goal in mind, specific ideas developed at the workshop are worthy of further inquiry, particularly both design and operational approaches that rely on innovation, new technology, and improved operations and efficiencies to streamline the triage process.

As one workshop group advised, though, when considering the options identified, it is important to remember the ED is not a "place" but a "process," a point that underscores that many problems seen in EDs are the result of operational processes rather than design issues. Further, the primary factors of many identified problems were neither design nor operational, but issues that result from

[4]The FGI *Guidelines* documents do not address the operational aspects (e.g., patient flow, triage process, etc.) of the health care facilities they cover.

demographic changes, behavioral health and insurance deficiencies, and EMTALA requirements. For this reason, quite a few of the identified problems might not require specialty operational or design solutions if the overall health care system were doing a better job of addressing the larger issues that bring many patients to the ED.

Nonetheless, because adopting and implementing regulatory changes to improve ED flow can be slow and difficult, it is an important first step when health care organizations and designers work together to address operational and design problems through careful project planning.

Appendix A: Workshop Sponsors, Organizers, Facilitators, Student Volunteers, and Attendees

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DC Design

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Healthcare Facilities Symposium and Expo

Mazzetti+GBA

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Appendix B: Summary of Key Challenges

Each group was asked to identify key challenges the group's clinicians face in the emergency department. The table lists all challenges identified (with the specific words used by each group). These challenges have been categorized by the authors. The categories are generally listed in order from most built environment-implicated to least built environment-implicated.

Categories (Derived)	Original Challenges
Suboptimal layouts	Location of charting/IT and supplies
	ED expanded organically – no overall plan
	Travel distances in ED – patient and clinician/no space for people to work collaboratively
	Need for better lines of sight and better staff access to patients
Difficulty with facility capacity and flexibility, especially in surge conditions	Limited capacity – insufficient surge/flex space
	Flexibility
	Non-traditional patient (hallway) care locations + ESI-3 patients (intermediate complexity)
	How to grow ED in facilities where space is an issue
	How to divert patients so ED growth is not necessary
	Managing variability - peaks and valleys, capacity awareness, flow
	Space/design - adequate number of rooms, flexibility/scalability and include support spaces
	Optimize ED/in patient capacity; integrated ED – in patient flow capacity
	Patient flow (door to disposition)
	Flexibility of space for patient care
	Inflexible space
	Mass casualty event – how to manage in winter
	Flexibility for different acuity levels
	Running out of beds --> don't board ED patients

Categories (Derived)	Original Challenges *(continued)*
Suboptimal use of "waiting time" (non-exam room time)	Redefine the waiting area to enhance its usefulness or eliminate it
	Flexible design
	How to support patient care outside the exam room
	Ineffective use of internal waiting area
Ineffective procedures for behavioral health and other long-term patients	How to manage and improve the experience and outcome for the extended stay patient (behavioral health)
	Boarding
	Special spaces for mental health (peak 300% of resource)
	Boarding vs. observation area
	Mental health – used for holding pending transfer or admittance, observation
	Behavioral health
	Behavioral health resources
Suboptimal patient environment and experience	Environmental challenge - how can the environment enhance the well-being of the clinician and patient
	Improving the patient experience, and in turn improving the provider experience
	Transparency in patient care process for all care staff
	Longest waiting time
	Patient privacy in cramped space
	Creating a better patient and family experience
Suboptimal flow/throughput	Flow efficiency
	Hospital capacity affecting ED throughput
	Process impedes progress
	Throughput – moving patient through the ED visit
	Can't go on bypass
	Flow
	Flow – management of patient movement including boarding and/or behavioral health patients
	Chair or vertical-patient pod (best use of physicians and triage)
	Turnover of ED rooms
	Maximize efficient workflow for staff - see patients faster
Work environment not conducive to staff attraction, retention, and joy	Health care provider experience - bringing the joy back
	Staff – ability to attract, retain and provide safe working environment

Categories (Derived)	Original Challenges *(continued)*
Ineffective triage	How can the triage process be brought into the 21st century and be relevant
	Rethinking triage – triage outside of the emergency department
	Identify the truly emergent patient (as opposed to non-emergency) to get them to the point of care
Suboptimal information and communication with patients	Need to improve the dissemination of information to the patient and family; improve the waiting experience
	Patient privacy
	Communication
	Patient expectations/satisfaction - keeping patients informed of times to treatment, when they will see doctor, etc.
	Access and wayfinding that enhance patient experience
	Face time with doctor; how long/where am I in line? Test results, eye contact, language of caring
	Communication with patients to establish expectations
Variability in patient population/need	Changes in patient population profile, including growing elderly/infirmed, behavioral health and substance abuse
	Managing violent patients
	Specialized patient needs (geriatric/psych)
Effectively use technology to enhance department	Integration of technology - for financial support, virtual café, care-in-place
	Application of technologies that impede patient treatment including EMR, computer type/location, communication systems
	Using technology to both gather data and keep patients informed
Coordination with external resources (labs, beds, consults)	Getting response from external resources - consults, bed availability, lab/radiology, holding/observation
Culture, structure, and communication not conducive to optimal results	Silos – institutional, systematic, physical and cognitive, lack of integration
	"ED as front porch" – change mindset, staffing

Appendix C: Summary of Workshop Ideas and Design Solutions (by Work Group)

Ideas for Improving Arrival and Front-End Operations

Registration kiosk for low-acuity patients (Table 1)

Participants: *Kevin McCausland, Bryan Langlands, Rebecca Read, Dr. Sasha Litwin, Alberto Salvatore, Azadeh Mahmoudi, Margaret Montgomery (table facilitator)*

Key challenges:

- How can the triage process be brought into the 21st century and made relevant?
- How can the dissemination of information to the patient and family be improved? How can the waiting experience be improved?
- Environmental challenge – how can the environment enhance the well-being of the clinician and patient?
- How can the experience and outcome for the extended-stay (behavioral health) patient be managed and improved?
- Redefine the waiting area to enhance its usefulness or eliminate it. Use flexible design.

Chosen primary challenge: How might we improve the way patients journey from arrival to the appropriate treatment?

Proposed solution: This group envisioned an approach in which, prior to registration, a person who is not sick or in need of immediate treatment (ESI levels 3, 4, and 5) would be asked to register at a kiosk instead of at triage. The "self-sorting" check-in kiosk would

capture the individual's name, medical history, vitals, height/weight, and reason for the visit. The person would be connected with appropriate services based on the information entered.

If the situation were not urgent and could be remedied through a doctor's appointment, the kiosk would make an appointment for the patient either on the same day or the following day and print an appointment card. If the patient's situation required clinical input, a telemedicine consultation would take place at the kiosk; this consultation could provide treatment recommendations, prescription orders, or other care as needed. If it appeared the patient needed to be seen in-person upon arrival, he or she would be directed to the appropriate treatment area in the ED.

The goals for such a registration kiosk would be to improve patient satisfaction by reducing both waiting times and the number of ED visits by directing certain patients to more appropriate treatment settings without violating the Emergency Medical Treatment and Active Labor Act (EMTALA) requirement to see all-comers.

ED as front porch—or cognitive control tower (Table 5)

Participants: *Anne Zink, Bret A. Nicks, Jennifer Ries, Colleen Newland, Deswood Etsitty, Zhipeng Lu, Joseph Sprague (table facilitator), Hao Huang (student)*

Key challenges:

- Hospital capacity affects ED throughput
- Non-traditional patient (hallway) care locations + ESI-3 patients (intermediate complexity)
- Transparency in patient care process for all care staff
- How to grow ED in facilities where space is an issue
- How to divert patients so ED growth is not necessary

Chosen primary challenge: How might we optimize the care, patient experience, and throughput of intermediate complexity patients?

Proposed solution: The primary challenge identified by this team was the need to optimize appropriate and timely acute care for patients entering the ED. Knowing the ED is often viewed as the front door to the hospital, they wanted to improve flow by medically screening patients and directing them to the appropriate destination as they enter the ED.

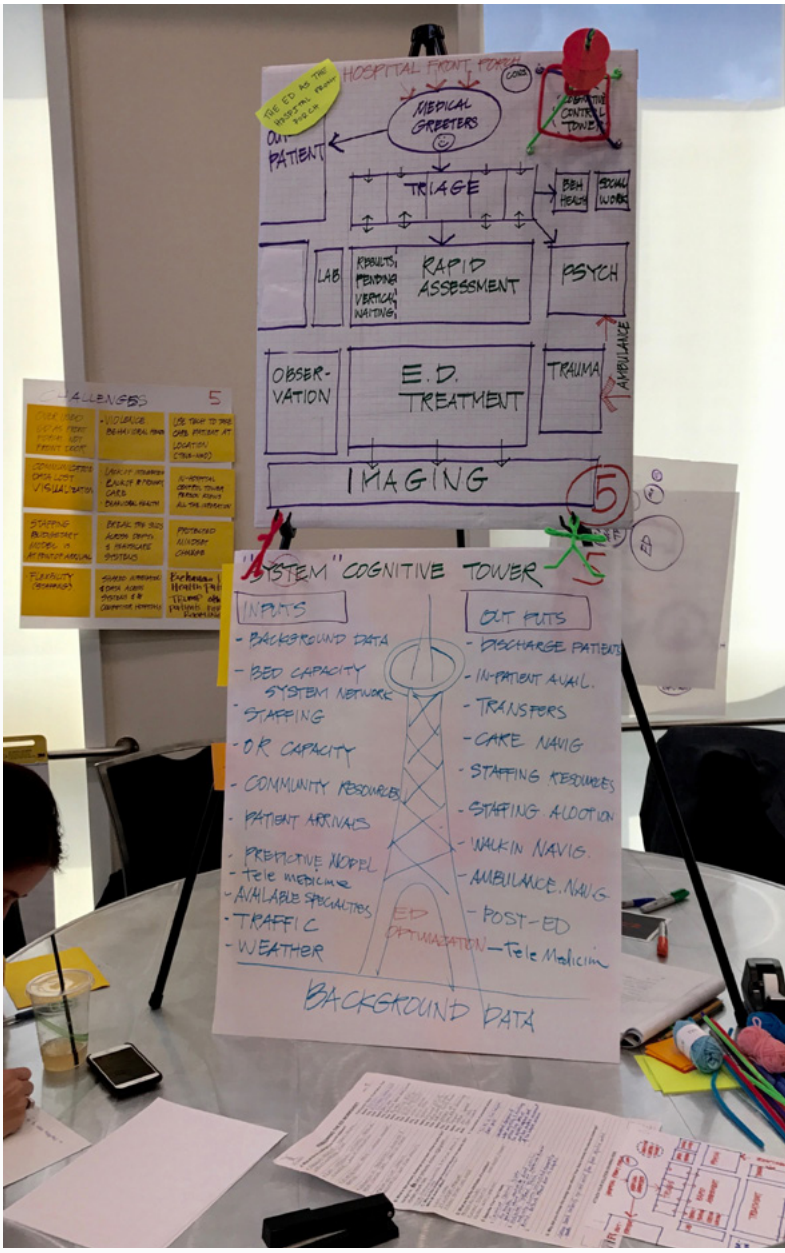
The group's design solution was to create a "cognitive control tower." Inspired by air traffic control, this solution would improve flow by directing patients to appropriate and available resources. The group also recommended adding language to the *Guidelines* that would allow use of 40-square-foot patient care stations for "vertical" patients, but they warned that such design solutions wouldn't make a difference "if we don't control flow from the cognitive control tower."

Check-in kiosk (Table 13)

Participants: Noah Tolson, Joan Albert, Shary Adams, Doug Browne, Suzana Tsao, Jim Lennon, Virginia Pankey (table facilitator), Tianchan Nie (student)

Key challenges:

- Creating a better patient and family experience
- Maximizing efficient workflow for staff - see patients faster
- Flexibility for different acuity levels
- Running out of beds --> don't board patients
- Create better lines of sight/better staff access to patients



This diagram illustrates the concept of a "cognitive control tower" or kiosk to assess and route patients as they enter the ED.

Chosen primary challenge: How might we create an efficient, collaborative environment that helps the team maintain patient privacy and provide patient-centric care?

Proposed solution: Table 13 focused their efforts on creating an efficient front-end environment for the ED care delivery team that would also ensure patient privacy and patient-centric care. Their solution would provide a kiosk where patients could input their symptoms with the support of a nurse-navigator. After completion of the assessment, the kiosk would provide direction and assistance (e.g., it could direct a patient to "go to Bay 4 for further assessment"). The kiosk could also be used to coordinate continued care and process patient discharges.

In addition, the group recommended zoning EDs according to ESI level, with flexibility provided via movable partitions. They indicated that, above all, EDs need to be designed to readily adapt to daily crises.

Streamlined flow and front-end processes (Table 11)

Participants: Susan Stiber, Martin E. Wolfe, Thomas Spiegel, Gary Goldberg, Dusica Stankovic, Kurt Neubek, Paige Hanna, Sheila Ruder (table facilitator), Weishi Wang (student)

Key challenges:

- Identify the truly emergent patient (as opposed to non-emergency) to get them to the point of care
- Getting response from external resources - consults, bed availability, lab/radiology, holding/observation
- Turnover of ED rooms
- Communication with patients to establish expectations
- Special patients' needs (geriatric/psych)

Chosen primary challenge: How might we provide the patient with appropriate care in a timely manner?

Proposed solution: This group sought to reduce the length of patient stays by making the most effective and efficient use of internal and external resources, patient communication, and front-end processes. To achieve such optimization, they recommended introducing triage-only rooms where physician and tech teams would assess patients. From there, the patients would be directed either to the fast-track area or to the main ED.

Bathrooms and lab processing would be placed at the entry to make it easier and faster to receive lab results. Radiology would be integrated into the ED and placed proximate to trauma rooms as CT scans are most often needed for trauma patients. Fast-track areas could be implemented quickly during peak hours to take the load off the main ED.

Ideas for Reducing Patients' Length of Stay in the ED

Patient conveyor belt (Table 9)

Participants*: Robin M. Wood, Kerri Layman, Marsha Whitt, Chris Grossnicklaus, John Flath, Vivian C. Stone, Robert Dehler (table facilitator), Mitra Azimi (student)*

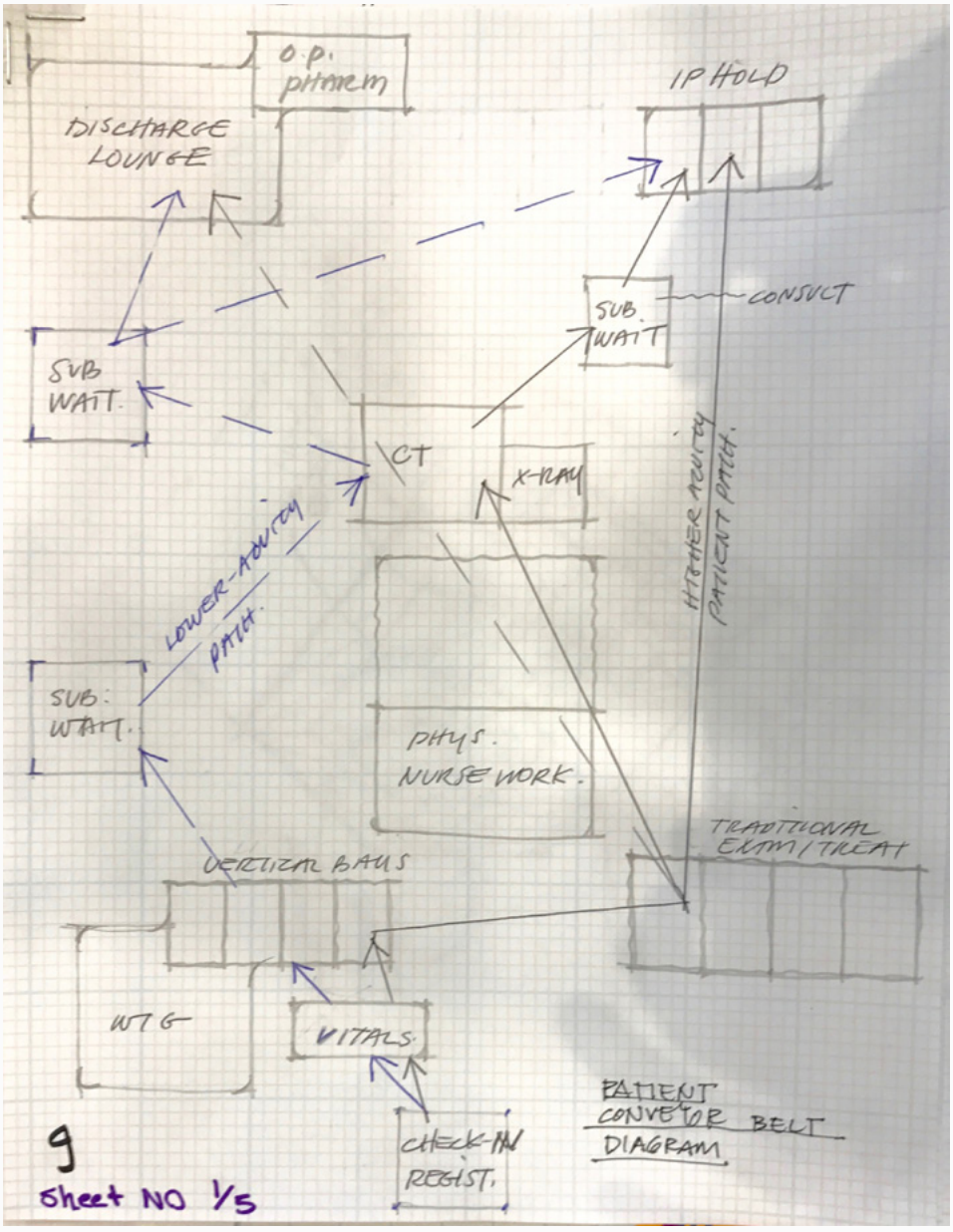
Key challenges:

- Patient flow (door to disposition)
- Location of charting/IT+ supplies
- Flexibility of space for patient care
- Behavioral health
- FACETIME - how long, where am I in line? test results, eye contact, language of caring

Chosen primary challenge: how might we improve ESI level 3-5 patient perception of care and time to disposition?

This diagram illustrates a conveyor-belt model for treating patients and moving them through the ED.

Proposed solution: This group sought to improve the experience of ESI level 3–5 patients who come to the ED by creating a forward-flowing conveyor belt model in which patients would move to different locations as they proceed through diagnosis and treatment. Rather than waiting in a single room, patients would be seen in a unit that combines departments, shares services, and creates efficiencies while reducing clearances and overall square footage in the ED.



Dedicated level 3 unit (Table 10)

Participants: *Eric T. Boie, David Meek, Amy Douma, Michael Perry, Joseph Robertson, Robert Dehler (table facilitator), Yu Zhang (student), Sreedevi Sooryanarayana (student)*

Key challenges:

- Behavioral health resources
- Managing(?) violent patients
- Ineffective use of internal waiting area
- Chair pod (best use of physicians and triage)
- Longest waiting time

Chosen primary challenge: How might we improve the flow of the ESI level 3 patient through the ED operations efficiently?

Proposed solution: Table 10 explored ways to improve the flow of ESI level 3 patients through the ED. As the largest group to visit the ED, these patients usually experience the longest waits and the highest degree of uncertainty. The solution to this situation by the group identified was to design a dedicated level 3 unit specific to these patients. With 24 patient care stations divided by low- and high-acuity but still within level 3, this unit could be designed to allow staff to flex the spaces to accommodate level 4 and 5 patients based on demand.

Modular treatment pods

A few of the groups suggested use of a modular patient care station or "treatment pod," a fast-track design element that has been employed successfully in Europe. Interactive patient screens can be included in these stations to support provision of faster consultation and treatment for low- to medium-acuity patients. One group recommended 40 square feet as the minimum size for such a space. For comparison, the smallest ED treatment space currently allowed by the *Guidelines* is the 80-square-foot bay in a multiple-patient treatment room.

Modules for subacute treatment and consult (Table 3)

Participants: *Kate Galpin, Barry Lann, Josh Stewart, Jennifer Cayton, Daniel A. Wood, Andrew Pendley, Kathryn Gallagher (table facilitator), Chetna Shaktawat (student)*

Key challenges:

- Improving the patient experience, in turn improving the provider experience
- Supporting patient care outside the exam room
- Rethinking triage – triage outside of the emergency department
- Using technology to both gather data and keep patients informed
- Health care provider experience – bringing the joy back

Chosen primary challenge: How might we improve the overall patient experience by reimagining front-end operations to identify and deliver the right care in the right setting?

Proposed solution: This group asked how the overall patient experience in the ED might be improved by reimagining front-end operations to identify and deliver the right care in the right setting. Their solution was to turn existing space that isn't patient-centric into treatment areas where resources are brought to the patient in comfortable, furniture-based modules. In these spaces, which would be akin to first-class international flight seating compartments, social services could be provided via video call (e.g., FaceTime) or monitors, and patients could receive medications, prescriptions, fluids, blood draws, and discharge instructions. This group would like to see provisions for subacute treatment areas without med/gas outlets, fixed walls, or dedicated hand-washing sinks added to the *Guidelines*.

Modular treatment pods in four-bed configuration (Table 4)

Participants: *Tim Knapp, Stephanie Furniss, Yvonne Nagy, Benjamin Bassin, Tyler W. Barrett, Kathryn Gallagher (table facilitator), Di Chen (student)*

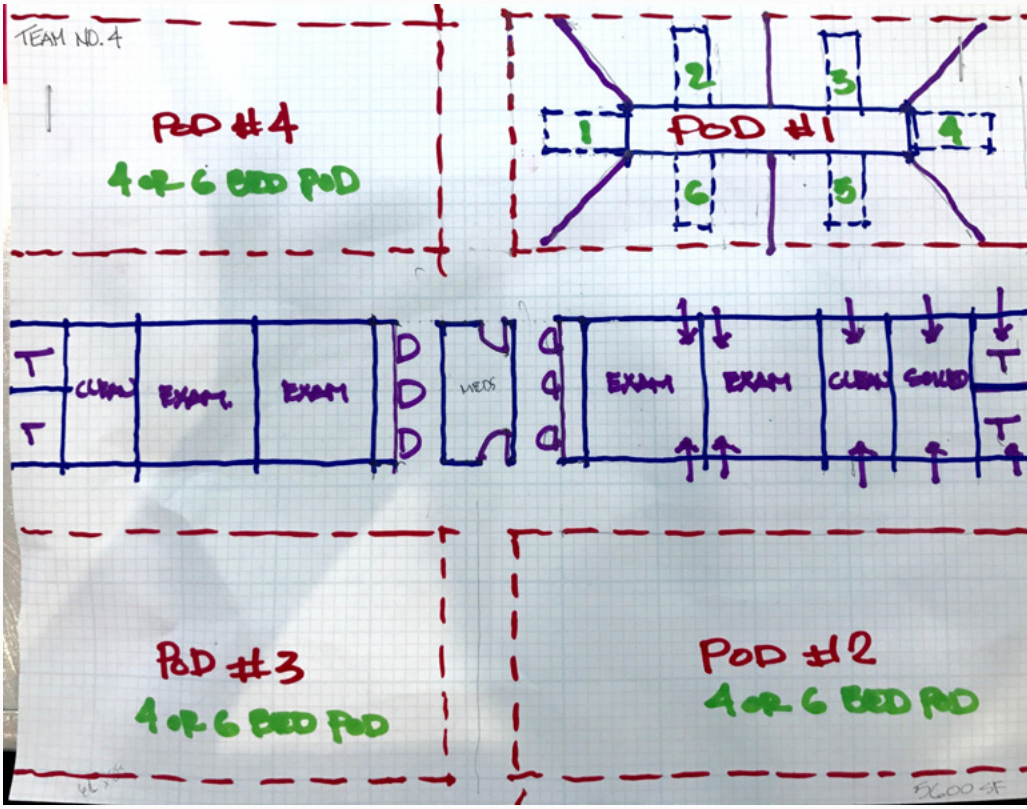
Key challenges:

- Hospital capacity affects ED throughput
- Non-traditional patient (hallway) care locations + ESI-3 patient's (intermediate complexity)
- Transparency in patient care process for all care staff
- How to grow ED in facilities where space is an issue
- How to divert patients so ED growth is not necessary

Chosen primary challenge: How might we optimize the care, patient experience, and throughput of intermediate complexity patients?

Proposed solution: In this take on the low-acuity treatment pod concept, modules of either four or six patient care stations form a low-acuity unit with provisions for shared nursing services and

medication areas. These multi-pod modules would be scalable to encourage flexibility and sized to require minimal renovation when added to an existing ED. The result would allow low-acuity patients to be seen in a distinct and appropriate treatment space with better privacy than makeshift treatment spaces carved out of hallways.



The layout sketched here shows low-acuity treatment modules of four or six "vertical" pods, or patient care stations, which can be flexed for use as larger treatment spaces when needed.

The pods would incorporate enhanced technology to make throughput more nimble and would be dynamic enough to allow for future growth and flexibility. Use of such multi-pod modules would go a long way toward ensuring patients receive care in treatment areas designed for such purposes rather than in hallways, as is commonly found in today's overcrowded EDs.

Fully flexible multi-acuity area (Table 2-A) and pop-up treatment alcoves (Table 2-B)

Participants (2-A): *Jeffrey C. Metzger, David Vincent, Mary Butler, Alberto Salvatore (table facilitator), Behzad Yaghmaei (student)*

Participants (2-B): *Robert G. Klever, Jr.; Teresa Wilson; Sue Ann Barton Tonia Burnette; Alberto Salvatore (table facilitator), Jiazi Liang (student)*

Key challenges:

- Limited capacity - provide surge/flex space
- Flow efficiency

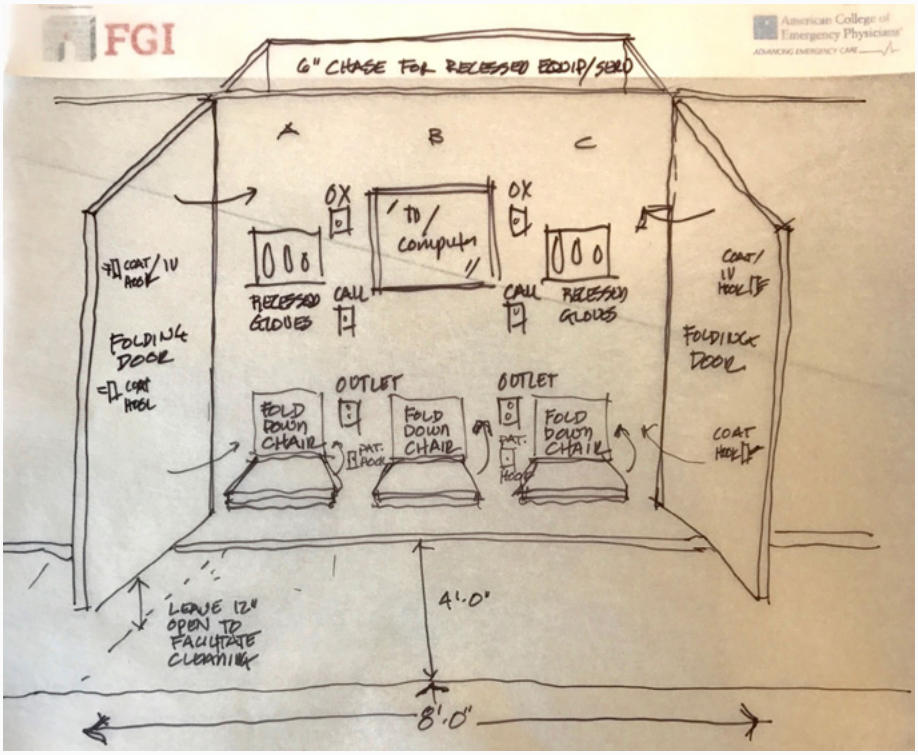
- Patient privacy
- Communication
- Flexibility

Chosen primary challenge: How might we create adaptable, dignified care spaces to address ever changing capacity needs?

Proposed solutions: To accomplish the goal chosen by Table 2, the participants split into two groups and developed two different solutions.

Fully flexible multi-acuity area: Table 2-A suggested creation of a flexible modular treatment area that could accommodate both low- and high-acuity patients and easily transition to meet changing ED needs. Their design featured one contiguous space with fixed head and foot walls and movable side walls that can transition from two 13' x 20' resuscitation rooms to four 13 'x 10' examination rooms to six vertical patient examination spaces.

Pop-up treatment alcoves: Table 2-B suggested providing a 12-foot-wide corridor in the ED to accommodate patient overflow during peak hours and surges in demand. The additional 4-foot width would enable transformation of one side of the corridor into pop-up treatment alcoves for low-acuity patients. When treatment spaces were plentiful, these alcoves would be hidden behind two panel doors. Oxygen and power would be supplied on the wall, and interior hooks on door panels would accommodate patient belongings or patient IVs. This pop-up space could be quickly deployed when needed.



Pop-up patient care stations located in a hallway and hidden behind folding doors when not in use would allow an ED to quickly add more treatment spaces when needed. The hallway would be 12 feet wide, 4 feet of which would accommodate these pop-up stations when they are in use.

Flexible treatment room (Table 7)

Participants: *Eric Glasser, Kellye J. Johnson, Susan Beggerow, Tina Wu, Janet Woods, Enrique Unanue (table facilitator), Jiazi Liang (student)*

Key challenges:

- Space/design - adequate number of rooms, flexibility/ scalability, and inclusion of support spaces
- Throughput - moving patient through the ED visit
- Patient expectations/satisfaction - keeping patients informed of times to treatment, when they will see doctor, etc.
- Boarding vs. observation area
- Mental health - are for holding patients pending transfer or admit, observation

Chosen primary challenge: How might we design space to meet the demand from these patients? How can we expand to increase volume?

Proposed solution: Table 7 recommended provision of single-patient treatment rooms large enough to accommodate two or three recliner patients when demand surges. These flexible spaces would be intermingled throughout an ED that includes typically sized single-patient treatment rooms and multiple-patient treatment rooms with bays. These larger-than-usual single-patient rooms could flex as needed to provide one, two, or three treatment stations.

Flexible vertical bay rooms (Table 12)

Participants: *Cemal B. Sozener, Ryan Smith, Ira Chilton, Mary Frazier, Marysol Imler, Michael Poscovsky, Sheila Ruder (table facilitator), Yingzhe Duan (student)*

Key challenges:

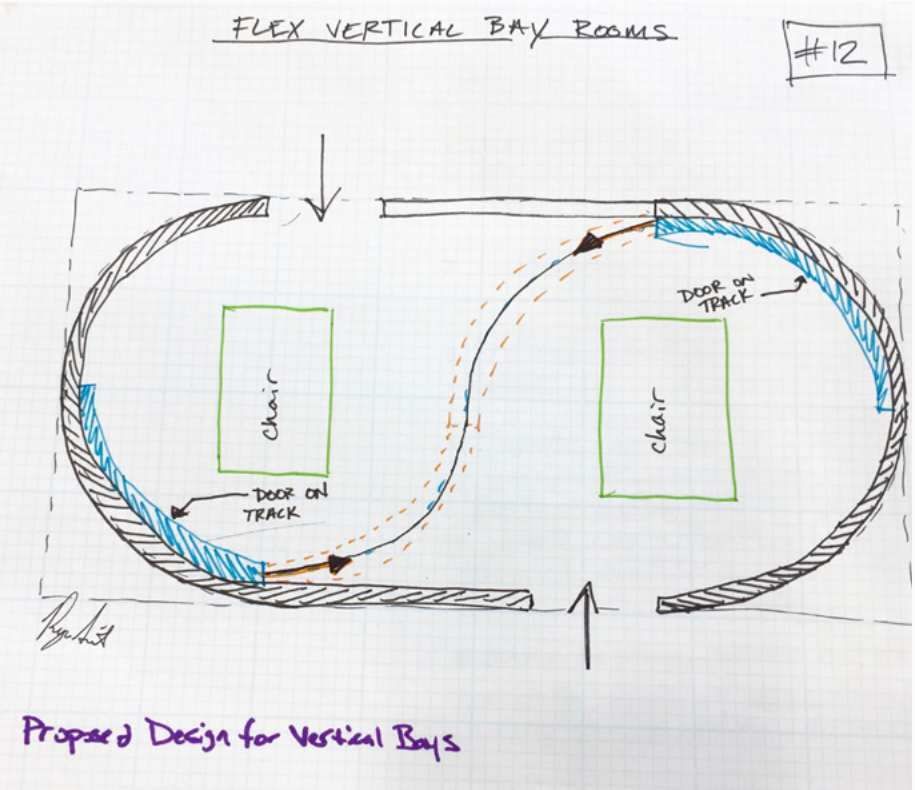
- ED expanded organically - no overall plan
- Inflexible space
- Patient privacy in cramped space

- Travel distances in ED - patient + clinician/no space for people to work collaboratively
- Mass casualty event - how to do in winter

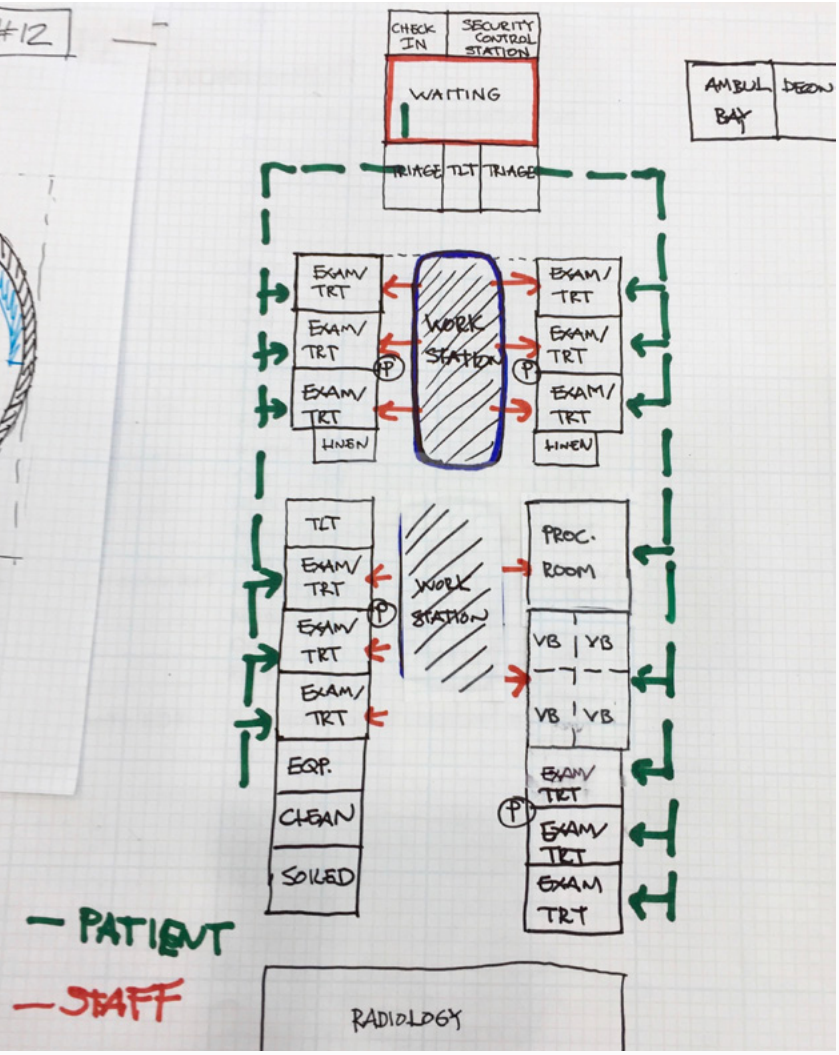
Chosen primary challenge: How might we provide effective and efficient staff flow to provide better patient care?

Proposed solution: This group focused on designing a physical environment that would foster an effective and efficient staff flow to support better patient care. Their solution aims to minimize travel distances and overall footsteps for staff, increase proximity to patients, and encourage staff collaboration.

The group would like to see EDs incorporate flexible-acuity rooms that could expand to accommodate two bays for "vertical" patients when needed. To achieve flexibility in space use, they recommended



This design for "vertical" patient care stations could be converted from a single-patient space to two bays by closing doors on a track.



In this layout, standard ED treatment rooms are mixed with flexible-acuity rooms that could be converted from single-patient treatment spaces to two pods for "vertical" patients.

sizing rooms such as clean and soiled workrooms so they could be used as treatment rooms when needed. One interesting feature of this group's plan is the provision of a pneumatic tube at each grouping of three treatment rooms for easy supply delivery.

Ideas for Improving the Experience of Behavioral Health Patients

Behavioral health module (Table 8)

Participants: *Michael Manning, Gerald Puchlik, James Augustine, Tracey McGee, Kevin Schlaht, Enrique Unanue (table facilitator), Lisa Valdivia (student)*

Key challenges:

- Staff – ability to attract, retain, and provide safe working environment
- Flow – management of patient movement, including boarding and/or behavioral health patients
- Application of technologies that impede patient treatment, including EMR, computer type/location, communication systems
- Access and wayfinding that enhance patient experience
- Changes in patient population profile, including growing elderly/infirmed, behavioral health, and substance abuse patients

Chosen primary challenge: How might we design a better system/

process for unscheduled care that provides the right care to the right patient population at the right time, in the right place/environment, and at the right price?

Proposed solution: Table 8 sought to design an emergency care system/process that could provide the right care to the right patient population at the right time in the right environment. Because behavioral health impacts all EDs, regardless of size, this group suggested creating a behavioral health unit that could flex as part of the greater ED environment. This module would comprise four patient treatment rooms with windows and dedicated support areas, including a nurse/control station, equipment storage, supplies, interview/intake room, patient lockers, patient toilet room with shower, and a security system. Medical care would not be provided in the behavioral health module; rather, the unit would provide a secure and safe space for stabilized patients in need of behavioral health support services.

Dedicated behavioral health ED (Table 6)

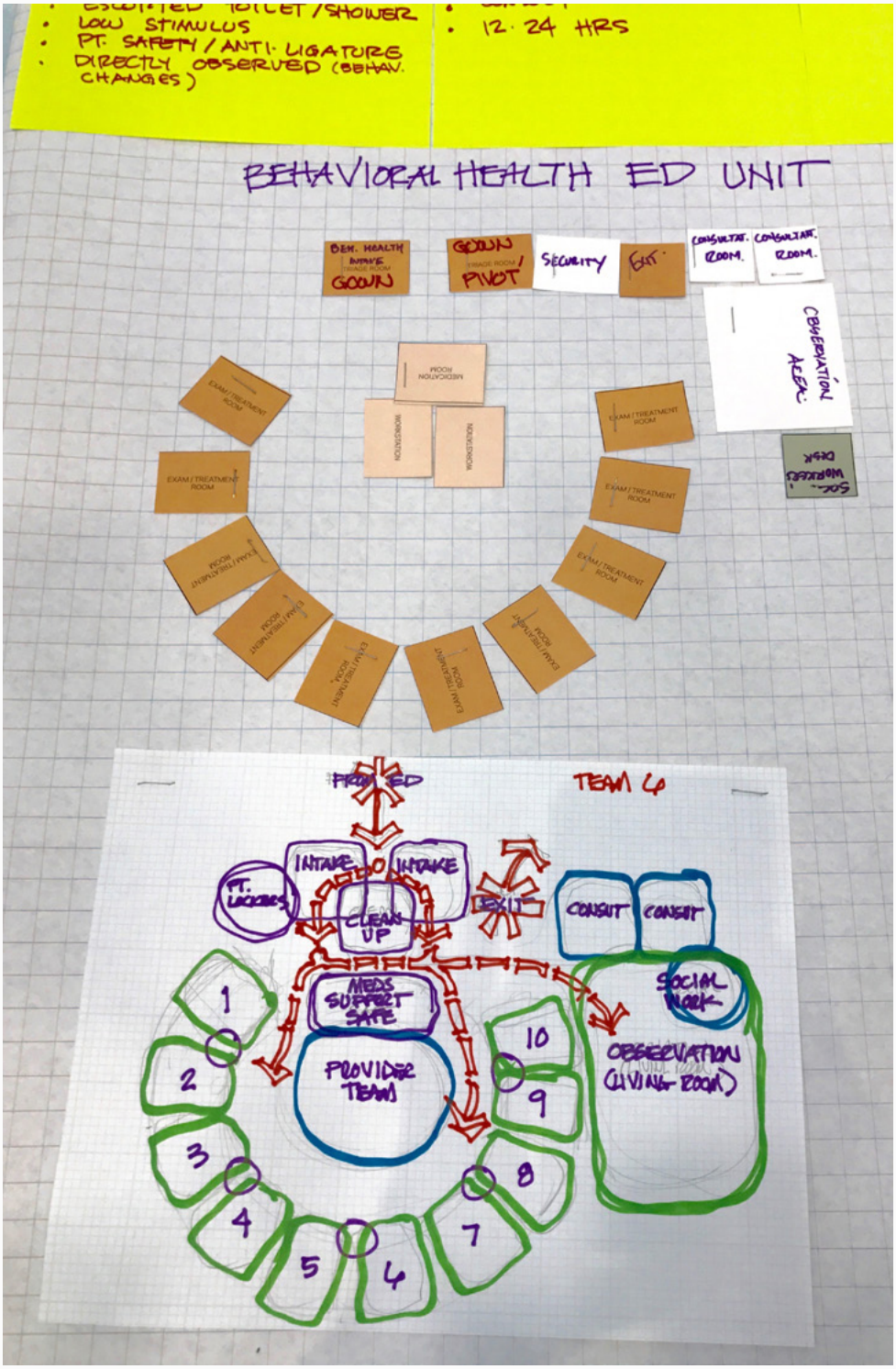
Participants: *James Morrison, Steve Carr, John VanLandingham, Sean Foster, Amy Stuhlfauth, Joseph Sprague (table facilitator), Hardik Jariwala (student)*

Key challenges:

- Boarding
- Process impedes progress
- Can't go on bypass
- Special spaces for mental health (peak 300% of resource)
- Flow

Chosen primary challenge: How might we define a better environment and process for mental health patients?

Proposed solution: This group's approach was to create a dedicated behavioral health ED separate from the conventional medical/surgical ED. Behavioral health patients without other medical issues



This plan illustrates a dedicated behavioral health ED, which would allow staff a view of all treatment rooms from a central clinical work space and support early intervention of social workers.

do not need the resources of a conventional ED treatment room, but they often stay in the ED for two to three days. This long duration ties up ED rooms that could otherwise be used to treat patients with medical issues.

The group's solution would route behavioral health patients who come to the traditional ED to an adjacent dedicated behavioral health ED. There, behavioral health patients would benefit from early involvement of social workers, experience a visible security presence, and have access to psychiatric observation rooms—sized to maximize efficiency and designed for patient and staff safety—and spaces for hygiene, patient gowning, and personal effects. This model could also be adapted for pediatric patients.

Additional Ideas for Improving the Patient Experience

Although not all ideas conceived by the work groups during the ideation were deemed a priority for improving ED design and function, several of these were good ideas that merit further discussion.

Double-door treatment spaces

Three groups identified a newer type of space in which double-door rooms straddle the border between the ED reception/waiting area and staffed ED spaces. Similar to exam rooms in clinics, non-emergency patients would be assigned to one of these rooms and a physician, nurse, and/or tech team would travel from room to room seeing patients. Most groups suggested these spaces would require a 6' x 10' clear floor area to have the clearances necessary to accommodate a treatment recliner, computer on wall or wheels, ophthalmoscope, medical gases, physician stool, visitor chair, and two doors on opposite walls.

Vitals-monitoring wearables in the waiting room

One suggestion for managing incoming ED patients more efficiently was use of a vitals-monitoring bracelet for every patient in the waiting area. The bracelet would record real-time patient stats that would be tracked by a tech specialist in charge of assessing and monitoring patients, alleviating time constraints on the triage nurse.

Amenity-filled waiting room

To ease the stress of ED waiting areas, one group suggested a reimagined waiting room that embodies the concept "Starbucks meets resource center." Such a space might include lounge seating, an espresso/food bar, personal grooming services such as manicures and massages, and segmented areas where patients and accompanying visitors could research medical issues, sign up for primary care, and learn about educational opportunities.

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ABOUT THE AUTHORS

Bryan Langlands, AIA, ACHA, EDAC, LEED GA, is a principal, senior medical planner, and regulatory expert based out of the New York office of NBBJ. He helped NBBJ become recognized in 2018 by *Fast Company* magazine as the "Most Innovative Architecture Firm in the World." Mr. Langlands has worked with many of the top U.S. academic medical centers and health care systems, including NYU Langone Health, Mt. Sinai, PennMed, Geisinger, Children's Hospital of Philadelphia, Jefferson Health, University of Rochester Medical Center, and Vanderbilt University Medical Center. He was a member of FGI's 2018 Health Guidelines Revision Committee and is a member of the Steering Committee of the 2022 Health Guidelines Revision Committee as well as chair of the 2022 Beyond Fundamentals Oversight Committee. Mr. Langlands was named one of the 2018 HCD10 award recipients for his work with FGI and his collaborative work regarding low-acuity patient treatment station in emergency departments.

Durell Coleman, MS, is the founder of DC Design, a social impact design firm that uses human-centered design to addresses the world's biggest problems. Trained in mechanical engineering and sustainable design at Stanford University's Institute of Design (d.school), Mr. Coleman's clients include governments, foundations, and nonprofits working to address challenges affecting marginalized communities, including those interfacing with the criminal justice, foster care, education, and health care systems. He is an expert in multi-stakeholder, human-centered design and is one of the subjects of the PBS documentary "Extreme by Design," which is used as a teaching aid for design thinking around the world.

Troy Savage, MESc, MDiv, is a project manager at Mazzetti, a global MEP engineering design and technology consulting firm specializing in complex, critical systems, particularly in health care. As a civil engineer by training, former university sustainability coordinator, environmental scientist, and ordained minister, Mr. Savage uniquely contributes to Mazzetti's vision of creating better, healthier environments—for people and our ecosystem. He pairs facilitation, care, and process improvement techniques with engineering knowledge to help individuals and organizations navigate strategic and operational change. He also leads interactive presentations and workshops across the country, including leading the planning efforts for the "Reimagining the ED" workshop.