

Comparison of Overhead Utility Systems for Intensive Care Rooms



Introduction

Draeger's Ponta Beam has many potential advantages to offer for delivering services, utilities and gases in the ICU. Despite the advantages, it is an unfamiliar product to many healthcare systems. Hospitals have greater familiarity with articulated arm booms from the ICU, operating room and trauma rooms and need to be able to more effectively evaluate the beam for their clinical needs. The purpose of this study was to better understand how medical teams evaluate architectural solutions to medical gas delivery and compare user experiences with different overhead utilities in the ICU.

The SimTigrate Design Lab scanned the available literature to understand the evidence-based design literature addressing this topic and found little published evidence. This report is mostly informed on field observations of the use of booms in three hospitals, interviews with staff in other ICUs who have used the beam and a simulation conducted in a low-fidelity mockup with nurses, physicians and respiratory therapists from a hospital undergoing a renovation of their ICU patient rooms. The SimTigrate team produced analytic diagrams comparing alternative overhead solutions to evaluate their impact on the patient and family experience.

This white paper addresses the questions that are most pressing for clinicians facing a decision about the delivery of utilities and gases in an ICU environment, specifically:

- Does that beam meet the clinical needs of the nurses and providers taking care of ICU patients? Is it easy to use?
- What is the impact on the patient's experience?
- Are there any safety risks?
- Does the beam limit flexibility of the patient room as needs change? What is the impact on costs?

Observation and Feedback

Since little evidence was available to inform this study from the published literature, we sought feedback from users of different systems. The first step was to understand the needs of ICU clinicians and caregivers. Four researchers spent a day observing care

giver activities in medical intensive care patient rooms with a headwall system and in neurointensive care unit outfitted with overhead booms. The research team also visited two other intensive care units with overhead booms with various configurations and equipment to appreciate the different possible arrangements. In all of these settings the nurses, providers and specialists provided feedback to the research team discussed their needs and the challenges presented in delivering care at the bedside.

Many hospitals use headwall systems to deliver medical gasses and supply power at the head of the bed in patient care rooms even while these services and functions have been moved to the ceiling in operating rooms. As more and more care is being provided at the bedside of intensive care patients hospitals have replicated overhead service delivery solutions from the operating room to realize the same advantages of improved access to the head of the bed. In general this is a rational approach and results in a room that better supports patient care. Yet it is important to keep in mind that ICU rooms do not function exactly like operating rooms and therefore may have different needs.

Headwall

To understand the unique needs and requirements of intensive care patient rooms we started with field observations in a medical intensive care unit outfitted with headwalls. Staff universally stated that they felt that moving the utilities overhead would improve the care environment and make their jobs easier. Notable observations from watching MICU staff work in patient rooms with a traditional headwall:

- Providers need to see the monitor from the hallway so they can check patient status without entering the room. Often times the IV bags are hanging in front of the monitor blocking their view.
- Getting access to the head of the patient is tricky and risky. Clinicians have to climb over lines and cords while in a sterile gown, risking pulling out a line or contaminating themselves.
- When family members stand next to the bed to talk with the patient they block caregivers' access to the vent, monitor and IV pole.
- Moving the patient bed in and out of the room requires nurses or techs to line the beds up accurately

with the outlets on the wall and lean over to plug/unplug the bed.

- The room set ups are not standardized and in some rooms nurses have to move from one side of the bed to the other for medication administration and charting.
- There is not enough room at the head of the bed to arrange all the necessary equipment needed when performing some procedures, particularly if everything has to be plugged into the headwall and therefore has limited range of motion.

Overhead Boom

Many of the challenges presented by having services on the headwall of the patient room can be solved by adopting an overhead boom similar to those used in operating rooms. Field observations and discussions with caregivers in units with overhead booms yielded the following findings:

- Overall the staff like having overhead booms, particularly in units where they had previously used headwalls and can appreciate the improvements and reduce impediments
- The benefits of having services overhead are most apparent to caregivers in both neuro and cardiac intensive care units where access to the head of the bed is particularly important.
- While overhead booms free up floor space they are quite large and take up a lot of real estate in the patient room. This is not so much of an issue in generously sized rooms, but is significant in modestly sized patient rooms.
- Due to limited space in most patient rooms nurses routinely have to move both boom arms out of the way to move patients into or out of the room.

Nurses state that they value the flexibility to move the boom arms anywhere in the room, including switching them to opposite sides of the bed. But it should be noted that while rearranging the boom arms is possible this is not a trivial task and is rarely done except of when necessary to move the patient bed in or out of the room.

- One downside of the flexible positioning of the boom arms is that this allows the arms to be placed in a way that blocks critical views. In one unit it was reported that the boom arm occasionally interferes with the line of sight for the infrared camera which is used

to monitor patient safety, such as nocturnal seizure activity.

- Accessories, such as computers and televisions, are sometimes poorly integrated with the boom arms. In one unit the nurses reported repeated instances of computer hard drives falling and in a different unit nurses complained about the design an integrated television that was hard for patients to operate.
- Very few of the units evaluated had patient lifts in the rooms. In the one unit with an overhead patient lift the tracks were placed in a “U” shape to avoid interference with the boom mounts. Because the lift tracks do not go over the center of the bed the patient lifts are not convenient to use and therefore are used infrequently. See Figure 2A.



Figure 1 – Boom at the Marcus Stroke and Neuroscience Center. The CPU is mounted high on the column and not well secured.



Figure 2 A and 2 B – Emory University Hospital Midtown Surgical ICU. Top figure shows the ceiling track for the patient lift which is over the bottom third of the bed. The bottom image shows how the articulated arms of the boom overlap the patient lift track and therefore need to be pushed out of the way in order to use the patient lift.



Figure 3 – Emory University Hospital Neuro ICU. The overhead boom in these rooms facilitates easy access to the head of the bed, which is imperative for a Neuro ICU. Patient lifts were not incorporated into most of these rooms

Ponta Overhead Beam

Another option for managing the delivery of gases and utilities is a beam system that capitalizes on the advantages gained by shifting the access points overhead without replicating the functionality of the operating room style boom system. Discussions with bedside nurses and facility personnel from a variety of intensive care hospitals with the Ponta overhead beam shared the following observations:

- They all had consider using an overhead boom during their selection process but had selected the Ponta overhead beam for their units based on space or cost issues and have been happy with their decision.
- One of the biggest advantages of Ponta for these sites is the streamlined size of the Ponta system. Patient rooms are often quite small and space is tight, see Figure 5.
- Nurses take advantage of the ability to move the shuttles (columns that suspended from the beam) laterally to come closer together to support infants in incubators or patients in chairs and farther apart to support bariatric patients. See Figure 6. They also noted

that this allows them to be able to reorient patients to look out the window.

- The columns can be customized for the specific needs of the ICU clinic and standardized across all rooms such that the ventilator is always the same side of the patient bed. Facility staff said that they could make adjustments to the configurations without much difficulty, but the nurses said that they did not have a need for making such adjustments
- Most of the sites interview had chosen to install the beam parallel to the window which allows them to move the bed in and out of the room with ease.
- It was noted that the beam takes up less ceiling real estate when compared to the overhead boom. This was a key factor for why a surgical ICU choose to specify Ponta beam which made their overhead lift system more usable (with the overhead boom they had to position the arms just so in order to use the lift) and accommodated more options for procedure lights over the patient bed.
- The beam was less visually intrusive and was less likely to interfere with visibility between patients and the families or to block views to the window.



Figure 4 – Newcastle-Upon-Tyne, UK



Figure 5 – Grenoble Pediatric ICU with Ponta Beam



Figure 6 – Grenoble Neonatal ICU with Ponta Beam

On-site Mock-up and Simulation

With support from Draeger, HKS and Grady Health System we conducted three simulation sessions on the Grady campus in downtown Atlanta to give the nurses, providers and facility leadership an opportunity to try out the Ponta Beam under challenging care situations. An unoccupied conference room in a nearby administrative building was made available for the project. Draeger installed a steel structure and mounted a basic Ponta Beam module. See Figure 7. The dimensions of their future medical intensive care unit (MICU) room were demarcated with paper walls and tape on the floor to allow the participants to appreciate the scale of the system. Grady was able to provide some equipment and the rest of the critical pieces were mocked up with foam core as required.

Three simulation sessions were held to allow many people to visit the mock up and provide feedback. A critical care doctor with Grady scripted a complex patient scenario that was designed to require bulky equipment, access to the head of the bed and place many people in the room. The same scenario was used in each

of the 3 session with different people participating. This gave the group a better sense of how the beam would support their work, particularly during crises situations that stress the system.



Figure 7 – Ponta Beam installed in mockup at Grady



Figure 8 – Paper and foam core were used at the Grady mockup to provide realistic room dimensions and facilitate the simulation.



Figure 9 – Dr. Honig from Grady facilitating a complex care scenario in the mockup.

Throughout the simulation participants were asked to take note of their interactions with the beam and provide feedback. It was necessary to draw their attention to the beam especially at points where the beam was NOT obvious because it was working well and not disrupting their work flow. Most of the participants were nurses, doctors and leadership from the MICU, but we also had nurses from the Marcus Stroke and Neurosciences Center because they are the most familiar with using a boom and thereby in the best position to compare performance of Ponta with that of a boom. Other visitors to the mockup included architects and equipment planners working on the project and Grady facilities personnel.

At the conclusion of the simulation session participants were asked to complete a short survey to give their feedback. We also encouraged the MICU clinicians to visit the Marcus Stroke and Neurosciences Center to try out their booms.

Grady ICU Beam Simulation Survey Results

The 15 simulation participants from Grady who completed surveys rated the Ponta system positively in all categories. See below for a summary of the responses, by question. (The number of survey respondents providing each answer are listed.)

1. General Information

- 1.1. What is your age? [1] 30 or under [7] 31-50 [5] Over 50
- 1.2. What is your gender? [6] Male [7] Female
- 1.3. What is your job role?7 physicians, 5 nurses and 2 specialist
- 1.4. What is the name of your unit?.....
- 1.5. How many years have you worked in your current unit? From 1 to 29 years

2. Equipment organization

Please express your degree of agreement with the following statements about the equipment organization with the new beam system compared to other systems you are used to working with:

	Strongly disagree	Disagree	I don't see any difference	Agree	Strongly agree
The new beam system reduces the clutter around the bed			1	7	5
The new beam system better organizes the equipment				6	7
The new beam system is better for managing cables			2	5	6

3. Access to patients

Please express your degree of agreement with the following statements about access to patients and performing patient care activities with the new beam system compared to other systems you are used to working with:

	Strongly disagree	Disagree	I don't see any difference	Agree	Strongly agree
The new beam system allows easier access to the patient's head				5	8
The new beam system allows easier patient transfer in/out of the bed			5	5	2
The new beam system allows for better bed transport in/out the room		1	4	6	2
In situations where multiple care teams are in the room, the new beam system permits easier access to the patient				8	5

4. Access to equipment

Please express your degree of agreement with the following statements about access to medical equipment with the new beam system compared to other systems you are used to working with:

	Strongly disagree	Disagree	I don't see any difference	Agree	Strongly agree
The new beam system allows easier access to gases, outlets and suction			1	10	2
The new beam system allows better visibility to monitors & equipment			1	9	2
The new beam system reduces the need to reach over the patient to access equipment				7	4

5. Flexibility

Please express your degree of agreement with the following statements about flexibility of the new beam system compared to other systems you are used to working with:

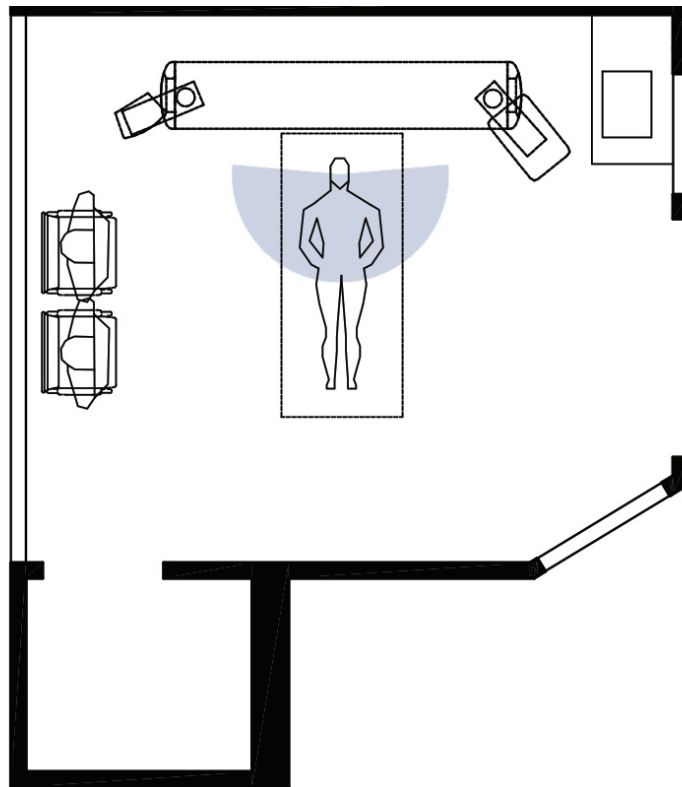
	Strongly disagree	Disagree	I don't see any difference	Agree	Strongly agree
With the new beam system, it is easier to bring additional equipment close to the bed			2	9	2
With the new beam system, it is easier to move equipment around the bed as needed			2	8	3
In the new beam system, it is easier to move different parts as needed			1	9	3
In the new beam system, it is easier to set up the equipment			2	10	1

Spatial Comparison

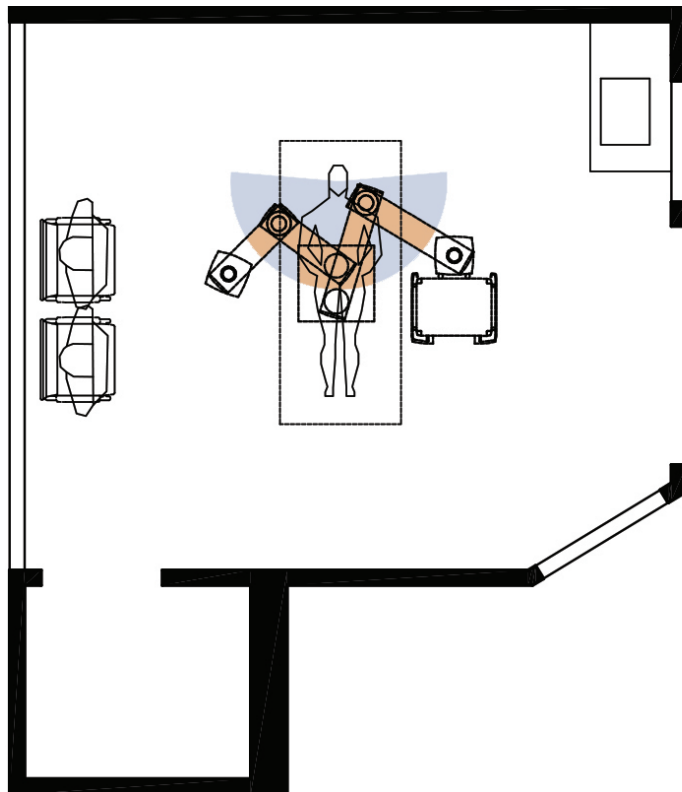
For a more detailed and objective comparison of the alternative overhead solutions we created a series of drawings comparing the Ponta Beam with a ceiling boom as they would be installed in the proposed MICU

room. These figures demonstrate the difference between the systems in terms of what the patient would see from the bed, how their connection with visitors might be disrupted and potential interactions with a traverse track overhead patient lift system.

Ponta Beam

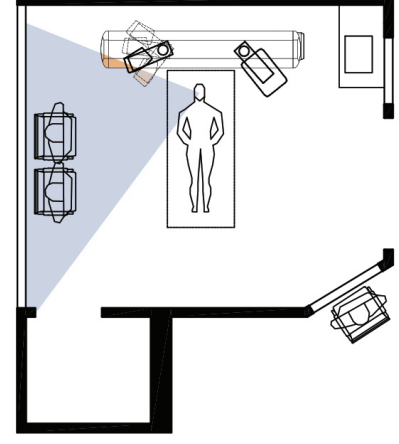
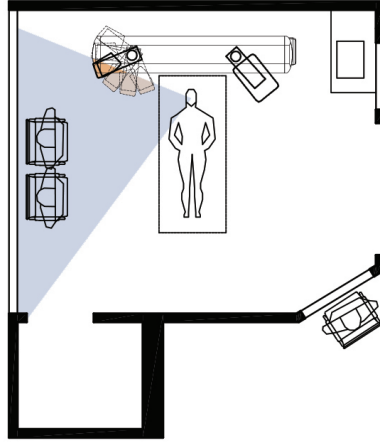
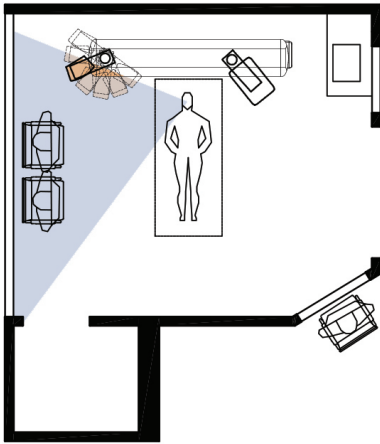


Traditional Boom

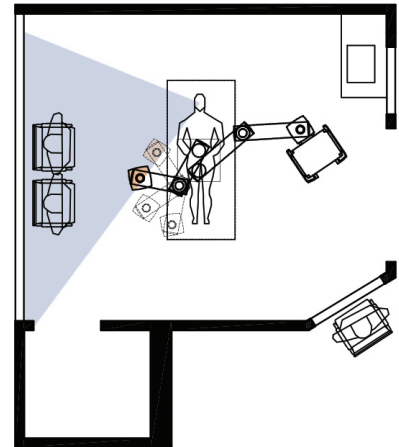
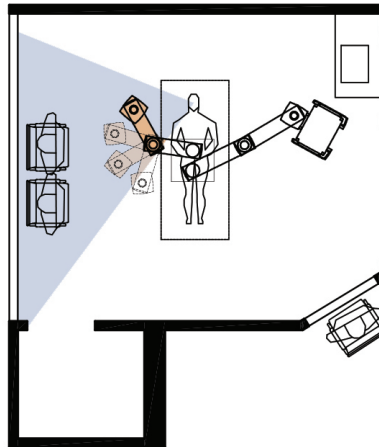
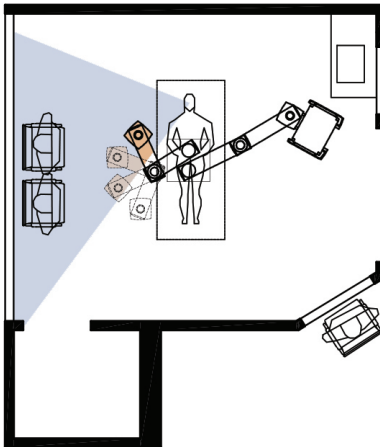


Patient Experience: The experience of the patient when lying in bed is often ignored in design decision-making but is important. Both the boom and beam are directly in the line of sight for the patient, but the Ponta Beam is much simpler and less obtrusive. The articulating arms of the boom are more cluttered and serve as a constant reminder of the medical environment.

Ponta Beam

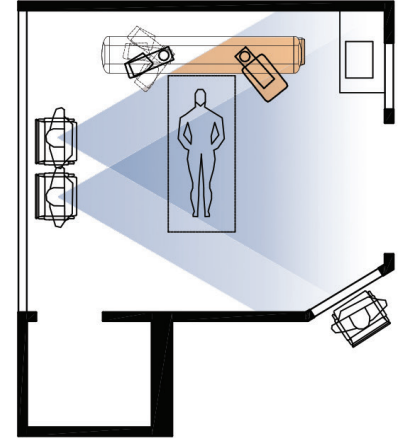
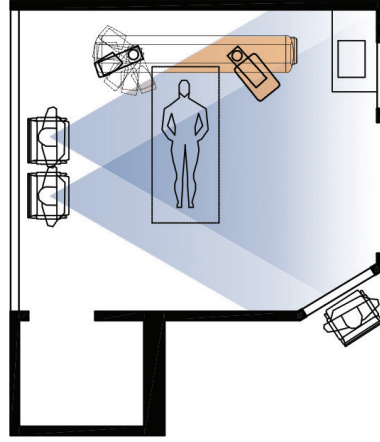
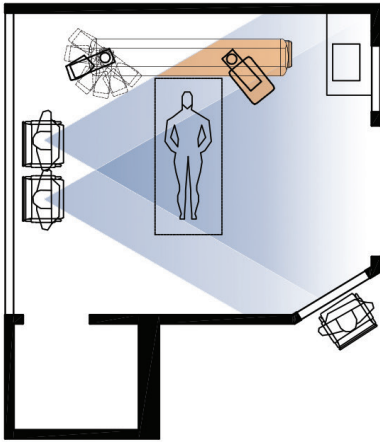


Traditional Boom

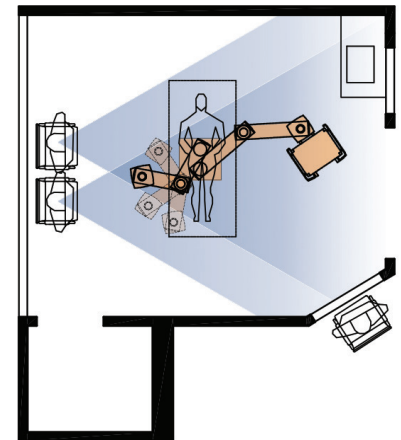
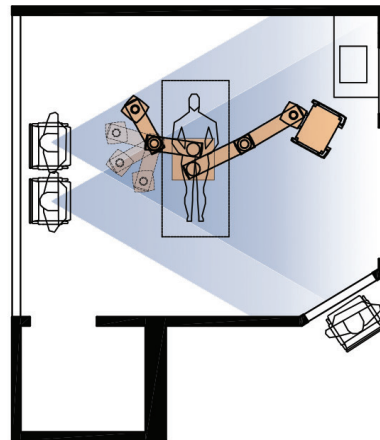
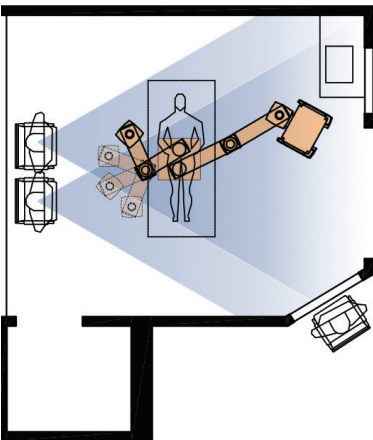


Patient Experience: Social support from visitors is important for recovery. The above images show the patient's view to the guest chairs and indicate the potential intrusion into their visual field. Because the boom can be extended along the length of the bed it has more potential to block the patient's view.

Ponta Beam

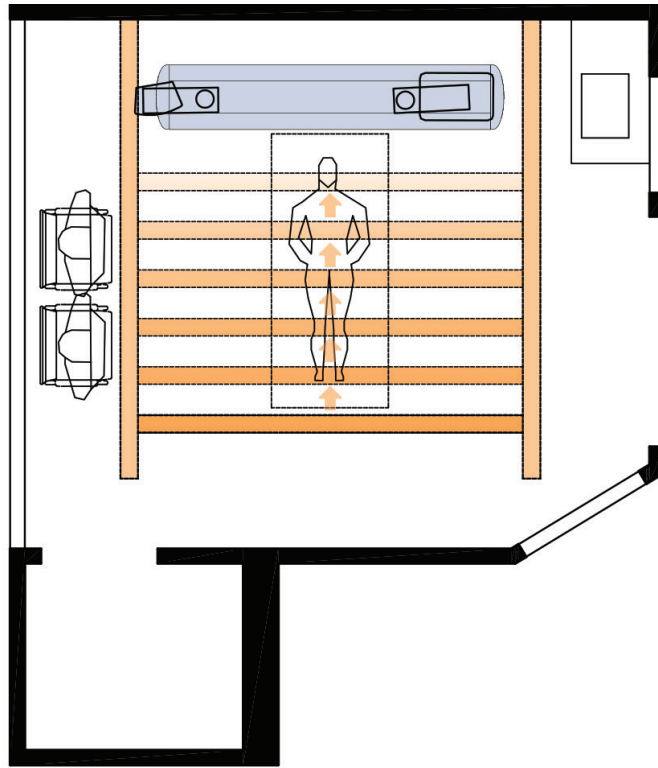


Traditional Boom

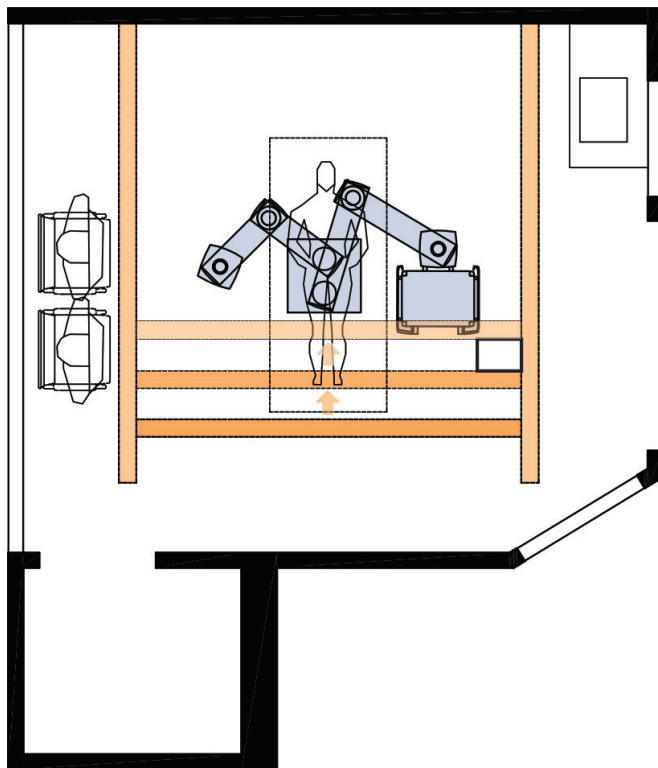


Visitor Experience: *The boom's ability to extend along the length of the bed comes with the disadvantage that is it more likely to block visitor's view to the patient.*

Ponta Beam



Traditional Boom



Ceiling Lift: Ceiling real estate is at a premium in the ICU. Many ICUs are installing traverse track patient lifts which give the best access. This system is possible with both the Ponta Beam and the boom, but as the diagram shows the range of the cross bar is more limited by the boom and requires that the boom arms be pushed all the way forward and that the bed be moved further away from the wall to gain access to the patient's center of gravity.

Conclusions

From the site visits and in depth conversations with intensive care stakeholders it is clear that ceiling mounted solutions for delivery of utilities are far superior than the traditional headwall. Moving equipment off the wall and onto the ceiling eliminates dangerous clutter at the head of bed and frees up floor space. In critical care situations clinicians need unobstructed access to the patient's head to be able to quickly and safely provide care. When utilities are located on the headwall patients are tethered to the wall by tubes and wires which clinicians have to carefully navigate around to avoid tripping or disconnecting tubing.

Once the commitment has been made to go with an overhead solution, healthcare facilities still have a choice to make about the form and configuration of the overhead system. The biggest difference in systems on the market today is the way in which the overhead system is mounted to the ceiling. Overhead booms, developed for operating rooms, originate directly over the center of the patient and have articulating arms push the utilities out to the side of the bed. Draeger has developed the Ponta beam system specifically for inpatient room placing a beam perpendicular to the bed the boom system closer to the head of the bed than the center minimizing the bulky infrastructure directly over the patient.

Through detailed spatial analysis of a specific ICU room layout comparing the overhead beam with a boom we have confirmed the key differentiators that users pointed to from their experiences. Due to the smaller size of the beam, it is much less intrusive of the patient room environment than the bulkier boom. This translates into less obstruction between patients and their visitors, and between caregivers and equipment they need to see. Furthermore, the beam can be mounted closer to the wall, as opposed to over the center of the bed, which combined with the smaller profile provides a better view for the patient. Overhead booms, and their massive articulating arms, present patients with an omnipresent reminder of their medical surroundings. Perhaps the biggest advantage of the Ponta beam is the fact that because it is not mounted directly over the center of the bed that space is available for overhead patient lift tracks, making the patient lift more effective and easier to use, which results in more frequent use.

No matter which solution a hospital selects it is very important that the clinical team that will work in the space invest the time and energy to work develop a standardize module that meets their specific needs.