CO-DESIGNING AN EC135 AIR AMBULANCE CABIN

Sean Jalleh
North Carolina State University
sean.jalleh@gmail.com

1 INTRODUCTION

The practice of inter-hospital transfers for patients started in the 1980s and has evolved from basic military models into complex integrated systems of care. Hospitals have formed integrated networks, which include specialized hospitals with distinct expertise in specific medical fields that include cardiac, trauma and stroke. This has allowed for highly trained personnel and equipment to be situated at these specialized hospitals allowing patients at other hospitals to gain access to therapeutic interventions or additional diagnostics through inter-hospital transfers (Thomas & Arthur, 2012). This has resulted in better patient outcomes.

However, the helicopter cabin for transferring patients has remained largely unchanged despite the change in protocols and type of patients who are transported in them. Although the crew of flight paramedics is able to deal with the complex requirements of transferring the critical patients through their skills and having the required equipment, the cabin seems to impede the paramedics' work. This study was done to understand the process of transferring patients so as to co-design with the medical flight crew an up-to-date Air Ambulance cabin specifically for inter-hospital transfer.

2 JUSTIFICATIONS

2.1 HEALTHCARE CONTEXT

According to the US Census Bureau, people over the age of 65 currently constitute 13% of the US population at 40.3 million, which is the largest in any decennial census (United States Census Bureau, 2010). With this aging baby boomer generation, the number of patients arriving by ambulance has increased over the past five years, driving a rising demand for ambulance services and it is projected that this will increase further. (Son, 2012)

The National Hospital Ambulatory Medical Care Survey shows that 30% of arrivals into the Emergency Department are patients aged 65 years and older, with 43% being admitted into hospital for treatment, the largest percentage in terms of age group. (Center for Disease Control and Prevention, 2010) Patients in this age group tend to suffer chronic health conditions and are usually heavier uses of ambulance and hospital services.

Through 1999 through 2008, the number of patients transported by Air Ambulance in the US has increased by 35% from 200,000 to 270,000 with the number of dedicated helicopters for HEMS increasing 88% from 360 to 677. The number of locations that Air Ambulances operate from has also increased by 30% within the same timeframe. (Government Accountability Office, 2010) The current estimated number of air ambulance flights for rotor wings in the US is 400,000 with 150,000 for fixed wing aircraft (Association of Air Medical Services, 2011a) and yet these flights only constitute 19.3% of total ambulance services (Son, 2012). There is opportunity for growth in the use of the Air Ambulance.

The largest proportion for Air Ambulance flights are inter-facility transports at 70% with attending to the gravely ill in the field being 30% with a very small percentage of transports used for medical team or medical equipment transport to disaster areas. (Association of Air Medical Services, 2011b)

There have been numerous benefits of inter-facility transportation of critically injured or ill patients via Air Ambulance. These include increase in functional survivals, better pain relief administration for patients, reduced length of hospital stay, streamlined inter-facility transfer processes, low incidents of adverse events during medical transportation, reduced 'out-of-hospital' time, faster access to therapeutic interventions and additional diagnostics for cardiac, trauma and stroke victims, and transport team having extensive experience dealing with critically ill and injured patients. (Thomas & Arthur, 2012)

With the projected increase of patients over the age of 65, the growth rate for the use of the Air Ambulance, the numerous benefits of transferring patients across hospitals through Air Ambulance and a large percentage of air medical transport already being used for inter-facility transport, there is a large and growing need in this area of research.

2.2 BUSINESS CONTEXT

The Patient Protection and Affordable Care Act of 2012 (PPACA) was signed into law on March 23, 2010. It introduced strategies to improve Medicare, reduce the number of uninsured people, control costs, and improve quality and efficiency in healthcare. (Rangel, 2009) The healthcare reform influenced consolidation of the ambulance industry due to the bundling of payments and this encourages air medical operators to work directly with a Medicare carrier such as hospitals to offer hospital-based ambulance services (Son, 2012). This influences the private operators to partner with hospitals to enable a more cost-efficient model of reimbursement.

The private operator that the author worked with has a hospital-based service. It was leaned that the company recently acquired United Rotorcraft to 'develop interior configurations to allow for design, development, testing, manufacturing and installation of industry leading advances in avionics and interiors'. (United Rotorcraft, 2012) This clearly shows that there is a market need for expertise in this area, especially due to the design process of helicopters that focuses on the functional requirements rather than usability requirements (Thomas, 1998). This greater need for consolidation increases the importance of having cabin design expertise so as to develop design requirements that can be standardized across a large network of EMS helicopters.

3 SCOPE OF THE PROJECT

The project was to answer the following main research question with sub-research questions below.

"How might co-designing with medical flight crew result in an improved air ambulance cabin that enhances their experience of transferring patients across hospitals"

- "What design methods may be employed to co-design with medical flight crew, who work in a highly regulated environment?"
- "What design dualities may be used to frame and accommodate the multi-faceted personalized requirements of the air ambulance cabin?"
- "What are the usability and emotional impact that can be augmented in the medical flight crew through the spatial design to facilitate an enhanced experience of transferring patients across hospitals?"

4 DESIGN METHODS

Numerous design methods were deployed to understand and surface the inherent opportunities.

4.1 CONTEXTUAL INQUIRY

Contextual Inquiry is an immersive, contextual method of observing and interviewing that reveals underlying (and invisible) work structure. (Martin & Hanington, 2012)

Figure 1. Interior of an Air Ambulance for a level 1 trauma center.

4.2 BUSINESS ORIGAMI

Business Origami enables teams to paper-prototype the interaction and value exchange among people, artifacts, and environments in a multi-channel system. (Martin & Hanington, 2012)

Figure 2. Relationships between people, artifacts, and environments for the inter-hospital transfer process.

4.3 USER JOURNEY MAP

A User Journey Map is a visualization of the experiences people have when interacting with a product or service, so that each moment can be individually evaluated and improved. (Martin & Hanington, 2012)

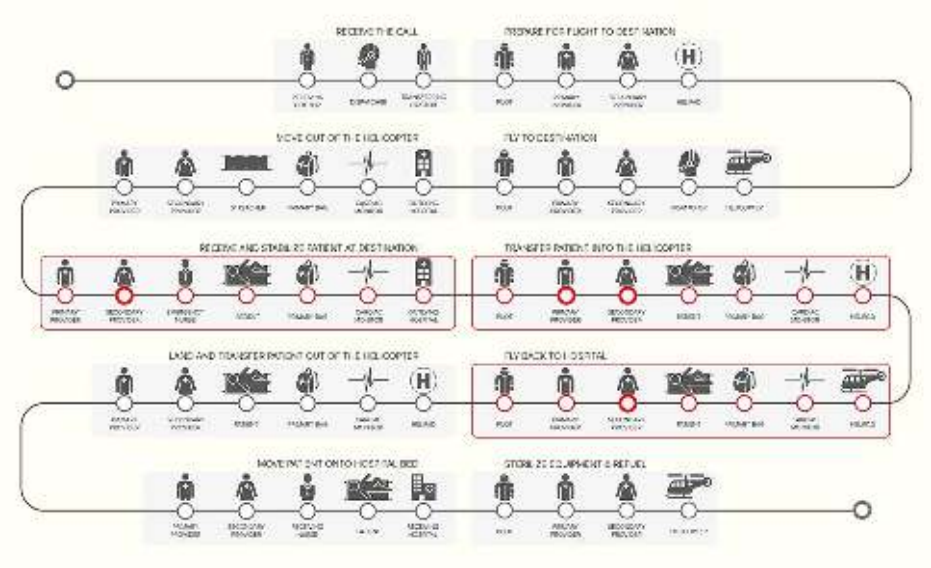

Figure 3. Graphical representation of the inter-hospital transfer process with key processes highlighted in red.

4.4 WORK INVENTORY (Adapted from Personal inventory)

Personal inventories allow the designer to see and understand the relevance of objects in a user's life from the participant's point of view, to inspire design themes and insight. (Martin & Hanington, 2012)

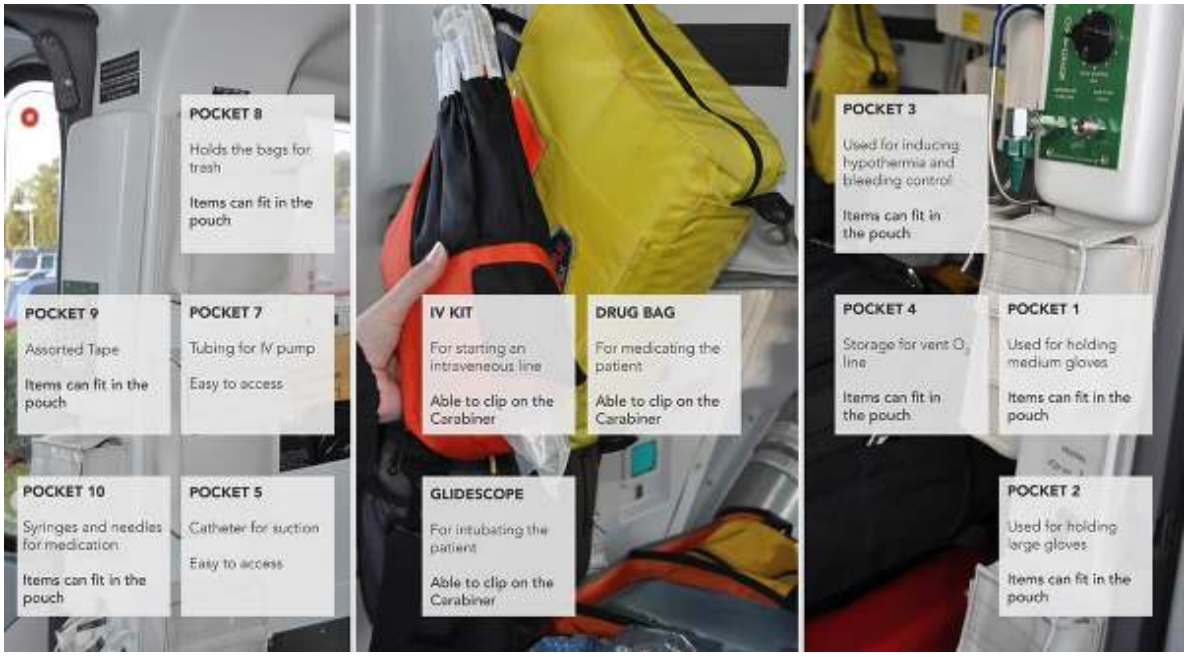

Figure 4. Understanding the reasons for placement of inventory within the helicopter.

4.5 TOUCHSTONE TOUR

The touchstone tour is designed as a conversation that uses artifacts and the environment as touchstones for questions and insights. (Martin & Hanington, 2012)

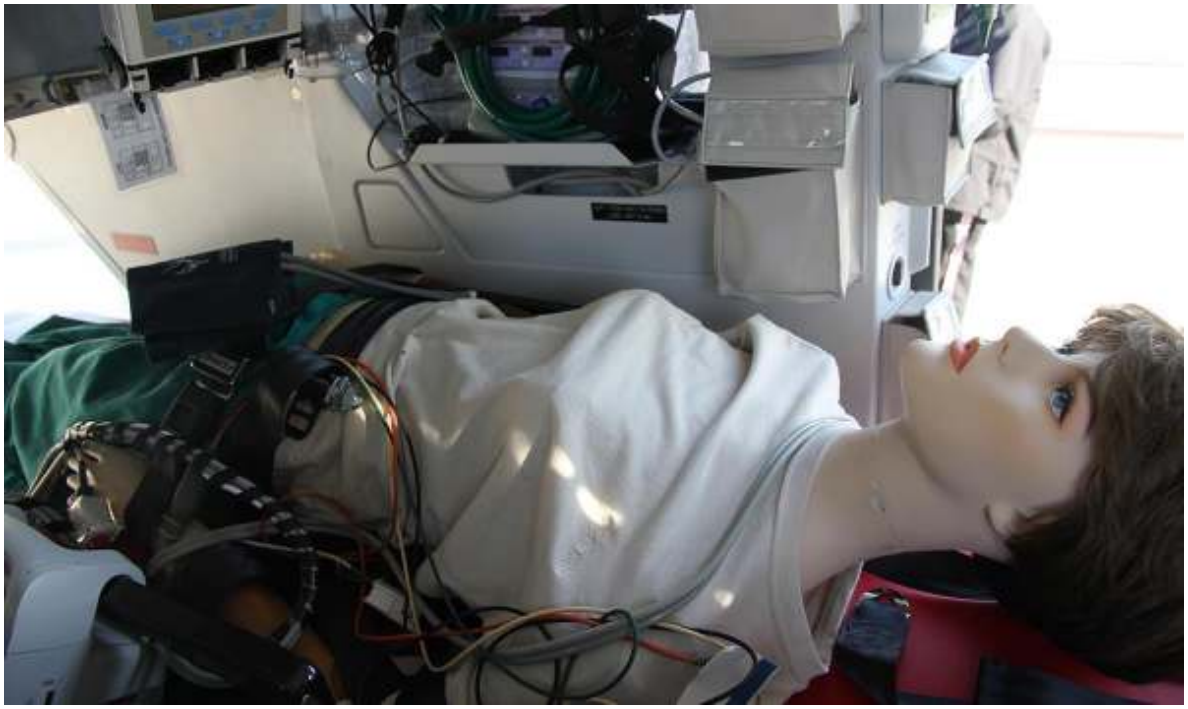

Figure 5. Using a mannequin to for simulation of interventions done in the helicopter and to overcome HIPAA limitations.

4.6 AEIOU FRAMEWORK

AEIOU is a framework reminding the researcher to attend to, document, and code information under a guiding taxonomy of Activities, Environments, Interactions, Objects, and Users. (Martin & Hanington, 2012)

Figure 6. Consolidating the learning to identify themes and insights from the process.

5 DESIGN DUALITIES

Inspired by IDEO's Wounded Warrior Home Project (Yuan, 2011), the following dualities were conceptualized to consolidate the learning and balance competing qualities for the Air Ambulance Interior.

- Shared accessibility, Distinct responsibility
- Fixed layout, Flexible Workspace
- Concealed storage, Displayed Inventory
- Diminished senses, Enhanced senses
- Provider-centered, Patient-focused

6 PROPOSED SOLUTION

The proposed solution is an overarching system that has three distinct units of a storage unit for treatment packs, a storage unit for high priority items and movable seats that can store their high usage items.

Figure 7. Solution that allows for storage that is easily accessible but yet does not impede accessibility to the patient.

Figure 8. Flexible workspace to allow for access to more of the patient by being able to move the provider seats accordingly.

Figure 9. Flexible seat orientation to accommodate for different types of patients who have different medical conditions.

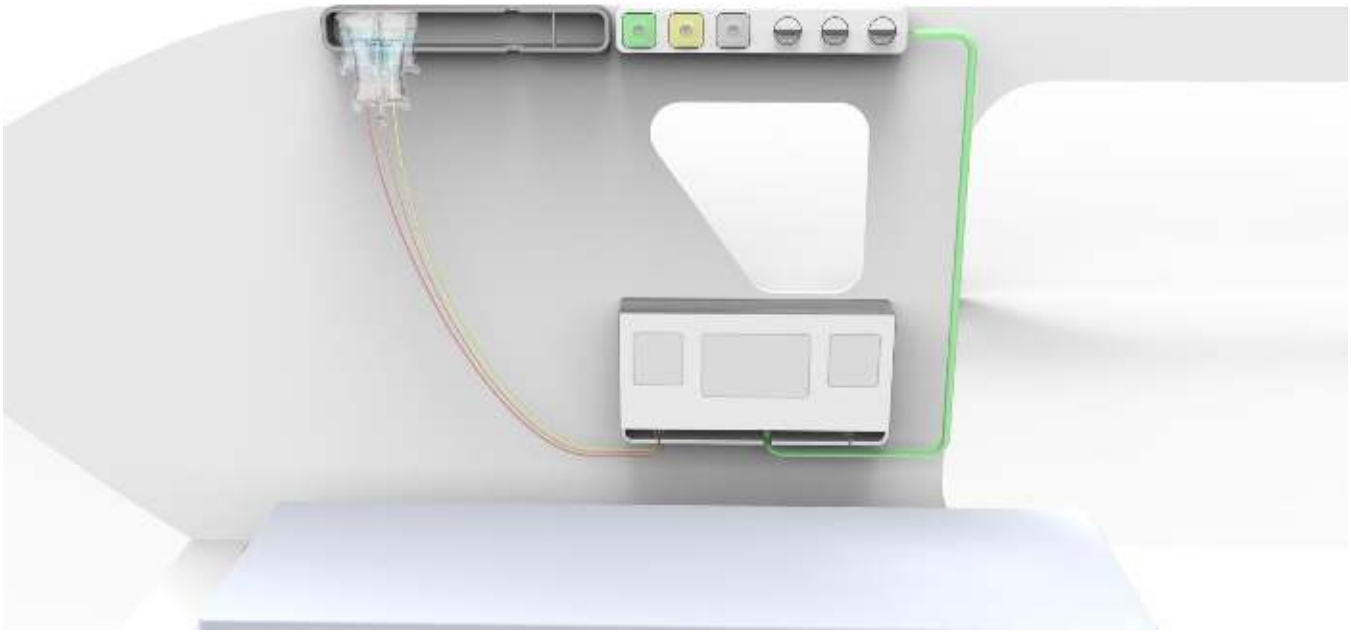

Figure 10. Consolidation of equipment with clear color coding to aid in identification of medication and controls.

Figure 11. Treatment packs that are stored in the storage units that allow for quicker access to specific medication and equipment.

BIBLIOGRAPHY

Association of Air Medical Services. (2011a). Air Med "101." *Fact Sheets and FAQs*. Retrieved October 15, 2012, from http://www.aams.org/AAMS/Media_Room/Fact_Sheets___FAQs/aams/MediaRoom/FactSheetsandFAQs/Fact_Sheets_and_FAQs.aspx?hkey=4ca2897d-5805-4ae4-bd31-e9e50e7e2981

Association of Air Medical Services. (2011b). MedEvac Transport = Speed, Access, Quality of Care. *Association of Air Medical Services Media Room*. Retrieved October 15, 2012, from http://www.aams.org/AAMS/Media_Room/aams/MediaRoom/Media_Room.aspx?hkey=a16680aa-66f3-46e0-9904-7f20f44db5d1

Center for Disease Control and Prevention. (2010). *National Hospital Ambulatory Medical Care Survey: 2009 Emergency Department Summary tables*.

Government Accountability Office. (2010). Air Ambulance - Effects of Industry Changes on Services are Unclear. DC, USA: Government Accountability Office.

Martin, B., & Hanington, B. (2012). *Universal Methods of Design*. Beverly, MA, USA: Rockport Publishers.

Rangel, C. H.R. 35 90 (111th): Patient Protection and Affordable Care Act (2009).

Son, A. (2012). *Ambulance services in the US* (No. 62191). IBISWorld.

Thomas, F. (1998). The Making of Helicopters: Its strategic implications for EMS Helicopter Operations. *Air Medical Journal*, 57–64.

Thomas, S., & Arthur, A. (2012). Helicopter EMS:Research Endpoints and Potential Benefits. *Emergency Medicine International*, 1–14.

United Rotorcraft. (2012). About United Rotorcraft. *United Rotorcraft - An Air Methods Division*. Retrieved October 15, 2012, from http://www.airmethods.com/unitedrotorcraft/about-us#.ULEltOOe8_k

United States Census Bureau. (2010). *The Older Population: 2010*. U.S. Department of Commerce.

Warren, J., Fromm, R., Orr, R., Rotello, L., Horst, M., & Medicine, A. C. of C. C. (2004). Guidelines for the inter- and intrahospital transport of critically ill patients. *Critical Care Medicine*, *32*(1), 256–261.

Yuan, L. (2011, Nov 30). *Architecture for Recovery: IDEO and Michael Graves design a home for disabled military veterans*. Retrieved September 1, 2012, from www.core77.com: http://www.core77.com/blog/architecture/architecture_for_recovery_ideo_and_michael_graves_design_a_home_for_disabled_military_veterans_21224.asp