Site Selection

- Muncie, IN
- IU Health Ball Memorial Hospital
- Post-Anesthesia Care Unit (PACU)

PACU Inventory & Analysis

- Equipment
    - Headwall
        - Oxygen
        - Air
        - Vacuum
    - Sphygmomanometer or automated blood pressure-measuring device
    - Intravenous supports
    - Pulse oximeter
    - ECG
    - Area for charting and storage of bedside supplies (suction catheters, needles, syringes, gloves, face masks)
    - Emergency cart (airway equipment, self-inflating bags, emergency drugs)
    - Defibrillator
- Materials & Finishes
    - Wood tile flooring in each unit
    - White tile flooring to demarcate means of egress
    - Neutral browns and dark blue wall pain
    - Sliding wood panel partitions to provide privacy in between each unit
    - Medical curtains are used to close off end of units
- Item locations
    - All mandatory technology is located on headwall
    - Mobile carts that house tools and equipment are easily accessible and can be moved around the space
    - Soiled linens carts located in the foot of the patient's bed
- Biophilic applications
    - Wood paneling for the sliding partition doors
    - Wood pattern on the laminate used in each unit
    - Tan and blue colors used on the walls
- Possible biophilic locations
    - Shape of the PACU pods
    - Finishes of the ground, surround and overhead
    - Partitions between each unit
    - Artificial lighting
    - Moving the PACU from closed interior to exterior wall
    - Offering some PACU units that are for individual use as well

PACU Inventory & Analysis

- Fixed items
  - Medical equipment
    - Opportunity to not have every item on the head-wall if fixed partitions are used on the sides of the patient bed
  - Medical carts
    - Location in the room can be moved around, but there needs to be space or storage for medical carts
- Other observations
  - All HVAC is located in the ACT
  - Each unit has a numerical value easily located in the ceiling or on a bulkhead
  - Only one zone of lighting in the space and it doesn't appear to be able to be manipulated
  - No obstacles are located in the floor plan that might obstruct the movement of the patient and any necessary equipment
  - The location of every item is based around the location and size of the patient bed
  - The space offers a lot of flexibility and the ability to create an environment that directly responds to the unique needs of each patient

Program Goals

- Improve patient recovery
  - Evaluate current PACU design methods through surveys and design intervention
  - Evaluate the research used to group the 14 patterns of biophilic design into 3 categories and select a collection of patterns to be tested
  - Create a series of architectural elements based around the category most closely related to patient recovery and then test those elements through VR
- Improve patient care
  - How can the context of the PACU space be better integrated into the design to improve the patient treatment process?
  - Can biophilic design play a role in improving the working environment and task performance of the caregiving staff?
- Create a new design evaluation matrix
  - Redevelop the HEART matrix in order to test the selected patterns through virtual reality experiences tested by doctors, nurses and patients

Performance Metrics

1. Use the Google HEART metric:

- Happiness: How people feel about your product? (E.g. Use the survey to track Satisfaction and Ease of use)
- Engagement: How people are using your product? (E.g. # of 7-day active users, # users starts a new search per day)
- Adoption: New users (E.g. # of accounts created in the last 7 days)
- Retention: Existing users (E.g. % of users who use the feature again)
- Task Success: Complete actions (E.g. # of users who can accomplish a task)

2. Aim to have a minimum of 80% positive feedback in order to use that element

HEART Matrix

	GOAL	SIGNALS	METRICS
HAPPINESS	Users feel that the new site offers a better environment that the current Ball Memorial PACU	satisfaction rating from survey	minimum of 80% satisfaction rating / perceived comfort in the space
ENGAGEMENT	For the user's input to help decide how the new elements can create a healthier PACU	Users rankings of the different applications of the biophilic patterns when applied to the design	rankings that receive 80% will be used in final design / at the most top 4 will be included
ADOPTION	Caregiving staff to have better working space and integration of needed equipment	satisfaction rating from survey	
RETENTION	caregiving staff want to use the new design elements in other spaces throughout the hospital	satisfaction rating from survey	
TASK SUCCESS	Caregiving staff accomplish work tasks	number of successful work tasks completed from VR model	equipment is easy to find / time to walk through space /

Biophilic Patterns to be Explored

Pattern 1: visual connection with nature
- Green wall, artwork, landscapes

Pattern 2: non-visual connection with nature
- Natural ventilation, textured materials, sun patches, warm/cool surfaces, nature sounds, highly textured fabrics/-textiles

Pattern 3: non-rhythmic sensory stimuli
- Breezes, babbling water, animal/insect movement, materials that move or glisten, water reflections, moving shadows, nature sounds

Pattern 4: thermal & airflow variability
- Solar heat gain, shadow and shade, hvac delivery strategy, systems controls, glazing treatment and operability

Pattern 5: dynamic & diffuse light
- Direct sunlight, sunlight from multiple angles, task and personal lighting, accent lighting, dimmer controls, cir-cadian color reference

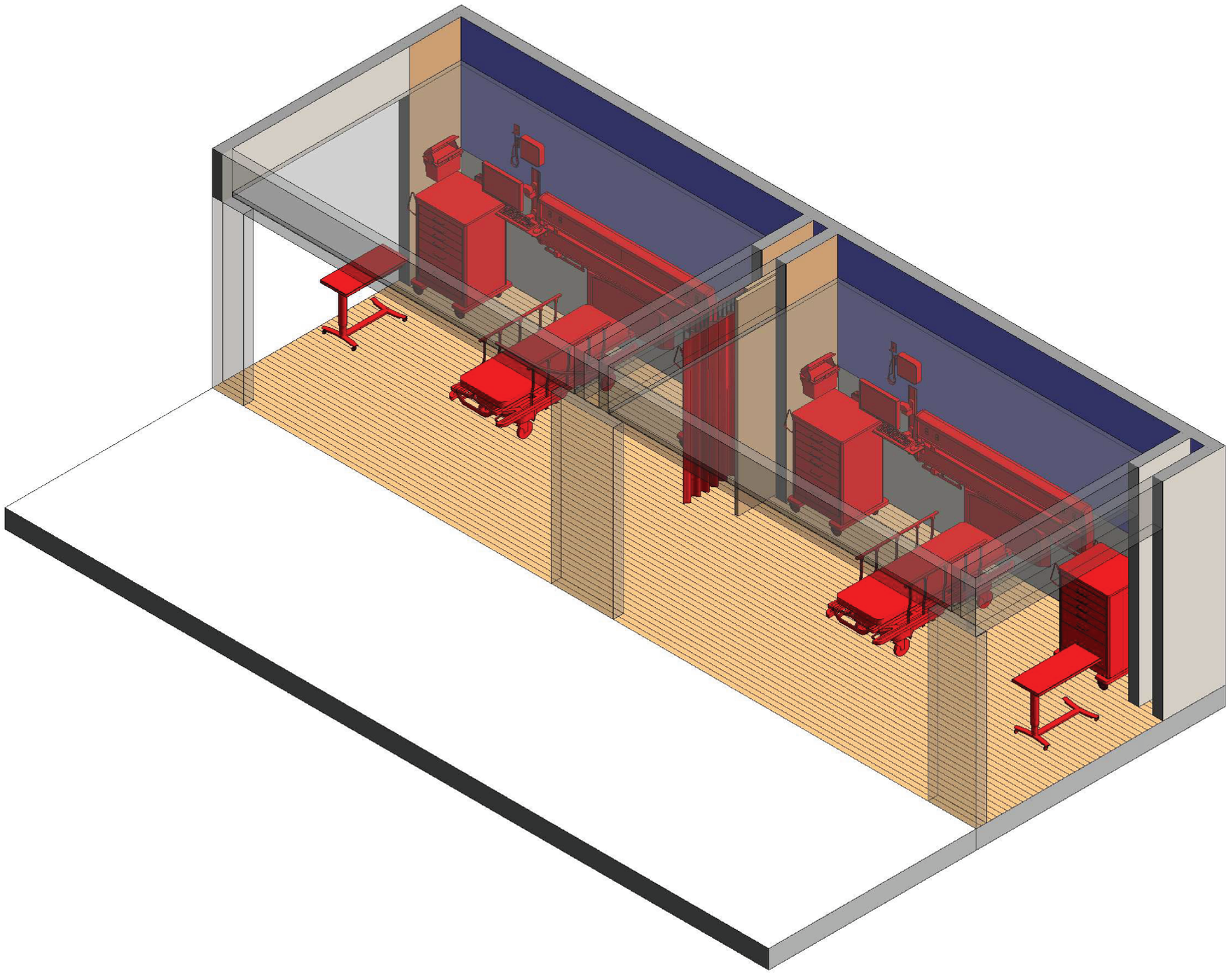
Pattern 6: biomorphic forms & patterns
- Fabrics, carpets and other finishes follow golden section, furniture form, pathway and hallway form

Pattern 7: material connection with nature
- Natural color palette (particularly greens), woodwork, stonework, accent details

	14 PATTERNS	*	STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	**Visual Connection with Nature**	* * *	**Lowered blood pressure and heart rate** (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	**Improved mental engagement/ attentiveness** (Biederman & Vessel, 2006)	**Positively impacted attitude and overall happiness** (Barton & Pretty, 2010)
	Non-Visual Connection with Nature	* *	**Reduced systolic blood pressure and stress hormones** (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991)	**Positively impacted on cognitive performance** (Mehta, Zhu & Cheema, 2012; Ljungberg, Neely, & Lundström, 2004)	**Perceived improvements in mental health and tranquility** (Li, Kobayashi, Inagaki et al., 2012; Jahncke, et al., 2011; Tsunetsugu, Park, & Miyazaki, 2010; Kim, Ren, & Fielding, 2007; Stigsdotter & Grahn, 2003)
	Non-Rhythmic Sensory Stimuli	* *	**Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity** (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)	**Observed and quantified behavioral measures of attention and exploration** (Windhager et al., 2011)	
	Thermal & Airflow Variability	* *	**Positively impacted comfort, well-being and productivity** (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)	**Positively impacted concentration** (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	**Improved perception of temporal and spatial pleasure (alliesthesia)** (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
	Presence of Water	* *	**Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure** (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006)	**Improved concentration and memory restoration** (Alvarsson et al., 2010; Biederman & Vessel, 2006) **Enhanced perception and psychological responsiveness** (Alvarsson et al., 2010; Hunter et al., 2010)	**Observed preferences and positive emotional responses** (Windhager, 2011; Barton & Pretty, 2010; White, Smith, Humphryes et al., 2010; Karmanov & Hamel, 2008; Biederman & Vessel, 2006; Heerwagen & Orians, 1993; Ruso & Atzwanger, 2003; Ulrich, 1983)
	Dynamic & Diffuse Light	* *	**Positively impacted circadian system functioning** (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) **Increased visual comfort** (Elyezadi, 2012; Kim & Kim, 2007)		
	Connection with Natural Systems				**Enhanced positive health responses; Shifted perception of environment** (Kellert et al., 2008)

NATURAL ANALOGUES	**Biomorphic Forms & Patterns**	*			**Observed view preference** (Vessel, 2012; Joye, 2007)
	Material Connection with Nature			**Decreased diastolic blood pressure** (Tsunetsugu, Miyazaki & Sato, 2007) **Improved creative performance** (Lichtenfeld et al., 2012)	**Improved comfort** (Tsunetsugu, Miyazaki & Sato 2007)
	Complexity & Order	* *	**Positively impacted perceptual and physiological stress responses** (Salingaros, 2012; Joye, 2007; Taylor, 2006; S. Kaplan, 1988)		**Observed view preference** (Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
NATURE OF THE SPACE	**Prospect**	* * *	**Reduced stress** (Grahn & Stigsdotter, 2010)	**Reduced boredom, irritation, fatigue** (Clearwater & Coss, 1991)	**Improved comfort and perceived safety** (Herzog & Bryce, 2007; Wang & Taylor, 2006; Petherick, 2000)
	Refuge	* * * *		**Improved concentration, attention and perception of safety** (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
	Mystery	* *			**Induced strong pleasure response** (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)
	Risk/Peril	*			**Resulted in strong dopamine or pleasure responses** (Kohno et al., 2013; Wang & Tsien, 2011; Zald et al., 2008)

Fixed vs Variable



Biophilic Intervention