UNDERSTANDING NICU COMMUNICATION

Investigating Real-Time Interactions of Healthcare Professionals' Care Activities in Huddle Spaces

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| UK Children's Hospital Entrance |

PRESENTATION OBJECTIVES

- Describe why NICU patients and staff have special design needs

- Explore evolution of an open bay to neighborhood NICU design

- Learn about the multi-methodological approach to assess the NICU built environment

- Identify specific design attributes impacting communication in a neighborhood NICU environment

NICU DESIGN NEEDS

For babies

- Extremely fragile patient population
- Crucial period of brain growth & development

For families

- Emotional and psychological challenges
- Defining moment for relationships – with their baby, each other, healthcare system, spiritual

For staff

- Emotional and psychological challenges
- Work experiences largely define who we are and how we feel about ourselves

NICU DESIGN CONSIDERATIONS

- Family Integrated Care

- Couplet Care

- Kangaroo Care – Maternal and Paternal Child Bonding

- Family Transition Rooms

- Daylight / Circadian Rhythms

- Infection Prevention

- Acoustic Control

- Single Family Rooms (SFR)

| UK Children's Hospital SFR Patient Room |

OPEN BAY TO SINGLE FAMILY NICU DESIGNS

| UK Children's Hospital SFR Patient Room |

| UK Children's Hospital Open Bay Patient Room |

Challenges

- Organized as an open space with multiple bassinets

- Lack of space for family members

- High noise levels – impacts communication and job performance; disrupts sleep and heightens anxiety Doede, 2018

- Lack of privacy – interferes with family bonding, exchange of information, and expression of breast milk Beck et al. 2009

- Infection control

| UK Children's Hospital SFR Patient Room |

Influencing Factors

- Positive impact of developmentally-appropriate care on infant outcomes

- Recognized value of breastfeeding and kangaroo care

- Hospital-wide trends toward private rooms and success of innovative prototypes

- The implementation of the Health Insurance Portability and Accountability Act (HIPAA) due to the need to provide patient privacy

Reference: Harris, D. D., Shepley, M. M., White, R. D., Kolberg, K. J. S., & Harrell, J. W. (2006). The impact of single family room design on patients and caregivers: executive summary. *Journal of Perinatology, 26*, S38-S48.

Rationale: Optimal environment for most babies and families

- Improved quality of patient care Bosch et al., 2012, Walsh et al., 2006, Smith et al. 2009, Cone et al., 2010, Stevens et al., 2010 + 2012

- Improved parent satisfaction Stevens et al., 2012

- Improved parent interaction Bosch et al., 2012, Smith et al., 2009, Beck et al., 2009, Watson et al., 2014, Hogan et al., 2016

- Enhanced privacy Domanico et al., 2010, Harris et al., 2006, Shahheidari, M. & Homer, C., 2012, Bosch et al., 2012

- Reduced level of infection Shahheidari, M. & Homer, C., 2012

- Improved lighting levels Domanico et al., 2010, Stevens et al, 2012

- Reduction in noise levels Shahheidari, M. & Homer, C., 2012, Stevens et al., 2012

- Length of stay lessened Shahheidari, M. & Homer, C., 2012, Carter et al., 2008, Ortenstrand et al., 2013

Rationale: SFR beneficial for staff

- Decreased nurse stress/burnout Harris et al., 2006, Shepley et al., 2008, Cone et al., 2010, Bosch et al., 2012 Hogan et al, 2016

- Increased job satisfaction Harris et al., 2006, Shepley et al., 2008, Cone et al., 2010, Bosch et al., 2012 Hogan et al, 2016

- Enhanced interaction with technology Stevens et al., 2012

- Enhanced lighting and noise control Stevens et al., 2012

- Increased staff perceptions of care Stevens et al., 2012

- Increased privacy for staff Bosch et al., 2012

Identified Trade-Offs

Family

- Decreased feelings of family-to-family support Domanico et al., 2010
- Parents feel more assured and secure being able to see all of the activity on the unit Falck, Moorthy, and Hussey-Gardner (2016)

Staff

- Increased number of staff required Stevens et al., 2012
- Footsteps per shift Stevens et al., 2012
- Increased workload Walsh et al., 2006, Smith et al., 2009, Beck et al., 2009, Domanico et al., 2010, Hogan et al., 2016
- Decreased interaction among care team Walsh et al., 2006, Smith et al., 2009, Beck et al., 2009, Stevens et al., 2010, Domanico et al., 2010, Bosch et al., 2012, Stevens et al., 2012, Hogan et al., 2016
- Feelings of isolation Bosch et al., 2012

NICU COMMUNICATION

| UK Children's Hospital SFR Patient Room |

Table 3. Coding Definitions for Care Type and Activity

Care Type	
Direct Care	RN care to patient in patient's room or hallway providing medication, bath, shower, code or responding to alarms and emergencies.
Indirect	Supportive functions such as charting, ordering/recording meds, and completing care analysis such as falls, acuity, pain, care plan. Includes communications needed to complete care.
Meds	Care related to preparing medications in the med room.
Activity	
Report	Reporting to team update on patients. Includes vitals, goals, and care status during the shift. Also includes shift reports and break reports.
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Rounds	Room rounds made at shift change or during the shift not part of medication or patient request.
Admissions/ Discharge	New patient admission or patient discharge activities, including administrative functions and communications.
Patient Care	Patient care in the patient's room or hallway in close proximity to the patient's room, such as transport.
Other	Activities not related to direct or indirect patient care, such as social exchanges or information related to personal topics.

Table 4. Communication Type Definitions

Communication Type Descriptions	
Collaboration	Planning and decision making for patient care involving the interaction and information sharing of at least two team members.
Consult	Asking for patient information or clarification on existing orders, medications, procedures, and diagnostics.
Leadership	Decision-making exchanges that involve identifying options, balancing risks, selecting options, and/or re-evaluating options.
Patient Information	Providing information to another caregiver on patient status and care progress.
Other	Personal experiences and social exchanges.
Coaching	Supporting existing team members' ability to develop care, planning, and coordination skills. Communication related to training of new employees or student nurses.
Coordination	Caregiver team members identifying and preparing for direct care needs such as equipment, scheduling procedures, medication, locating the correct equipment for a particular case.

Fay et al., 2022, Trzpuc & Martin, 2010, Gurascio-Howard, L., & Malloch, K. (2007)

- Complex clinical environments where interprofessional communication is vital to patient care success.

- Effective care relies on seamless communication and collaboration across the healthcare system and demands the establishment of workplace social networks.

THE NEIGHBOORHOOD CONCEPT AND
DNS + HUDDLE PROTOTYPE

| UK Children's Hospital SFR Patient Room |

- Huddle spaces in DNS layout act as the centralized station that can facilitate interdisciplinary communication.

In healthcare, huddles refer to short, regular debriefings that provide staff and bedside caregivers with environments to share problems and identify solutions. [1]

In design, huddle spaces refer to neutral spaces that are not traditionally owned by one primary profession, aimed to facilitate interpersonal teamwork. [2]

Huddle spaces in Decentralized Nurse Stations (DNS) play an important role in communication. An observational study by Fay et al. (2022) showed that the frequency of conversations occurred primarily at DNS, followed by corridors and huddle spaces. When examining the multidisciplinary makeup, huddle spaces hold the largest percentage of conversations [3].

Cai and Zimring (2012), using mixed methods, found that proximity plays a crucial role; the closer the nurses are to other nursing staff, the more likely they are to communicate face-to-face. Their study's interaction ratios indicated that when nurses are spread out, they perceive centralized stations as communication hubs [4].
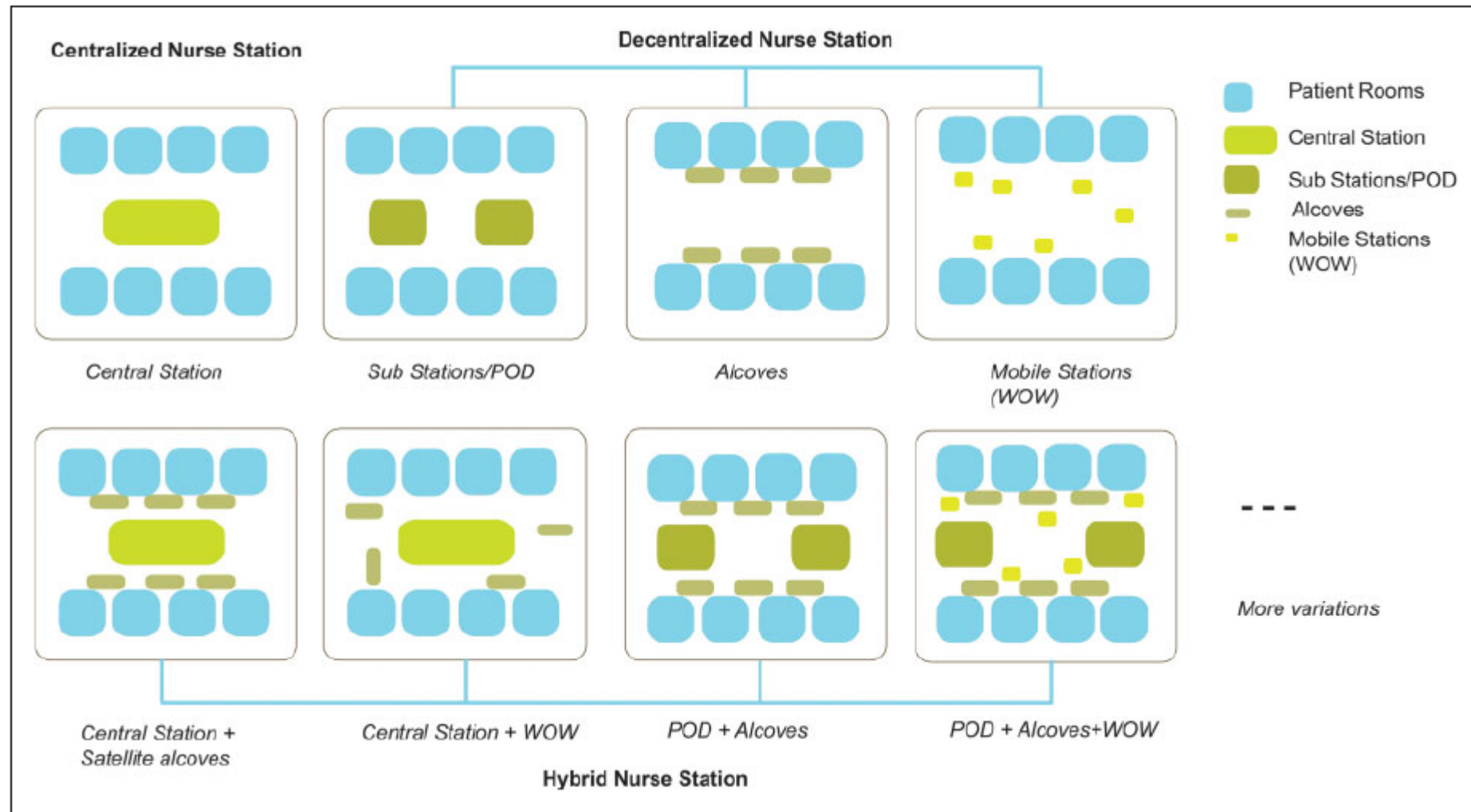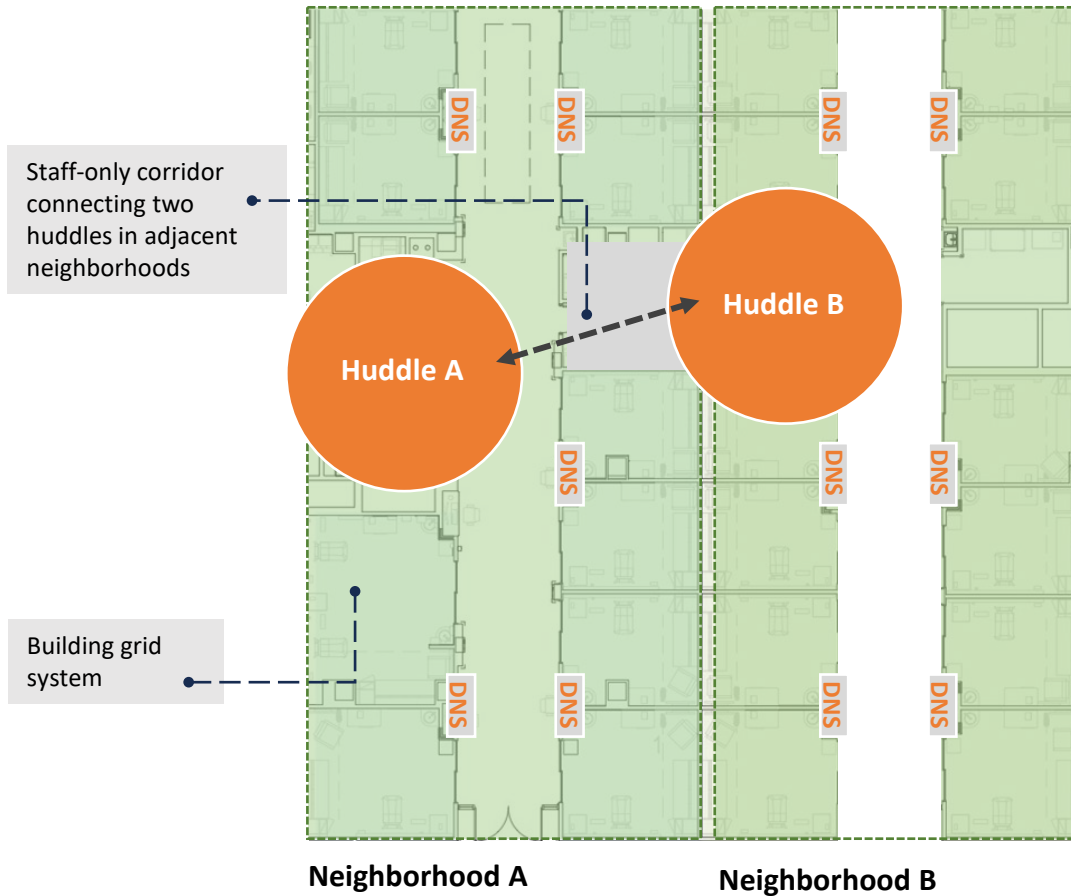
Decentralized nurse station (DNS) typologies (Fay et al., 2018)

Staff-only corridor connecting two huddles in adjacent neighborhoods

Building grid system

Huddle A

Huddle B

DNS

Neighborhood A

Neighborhood B

Huddles in the NICU facilitate teamwork, communication, care coordination, patient safety, team cohesion, and opportunities for reflection and learning, ultimately improving the quality of care delivered to vulnerable neonatal patients.

OVERALL RESEARCH GOALS

Understand how the NICU built environment can influence care practices such as:

- Communication

- Teamwork

- Privacy

- Efficiency

- Satisfaction

- Patient care processes

STUDY BACKGROUND

- Pre/Post-occupancy evaluation of NICU
- 8,000 sq ft. open bay to 36,000 sq. ft. SFR
- Designed by HGA + GBBN
- Examined the impact of decentralized nursing stations, huddle spaces, and increased corridor sizes on staff communication, efficiency, and satisfaction as well as visitor satisfaction.
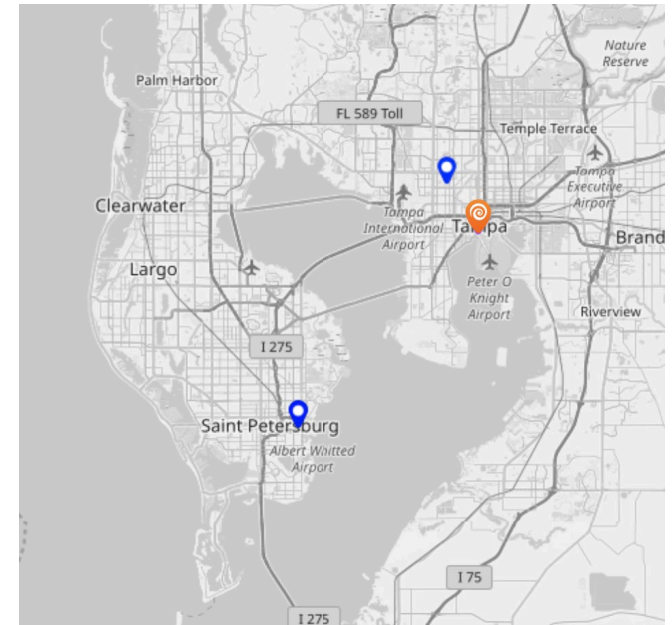
| UK Children's Hospital Entrance |
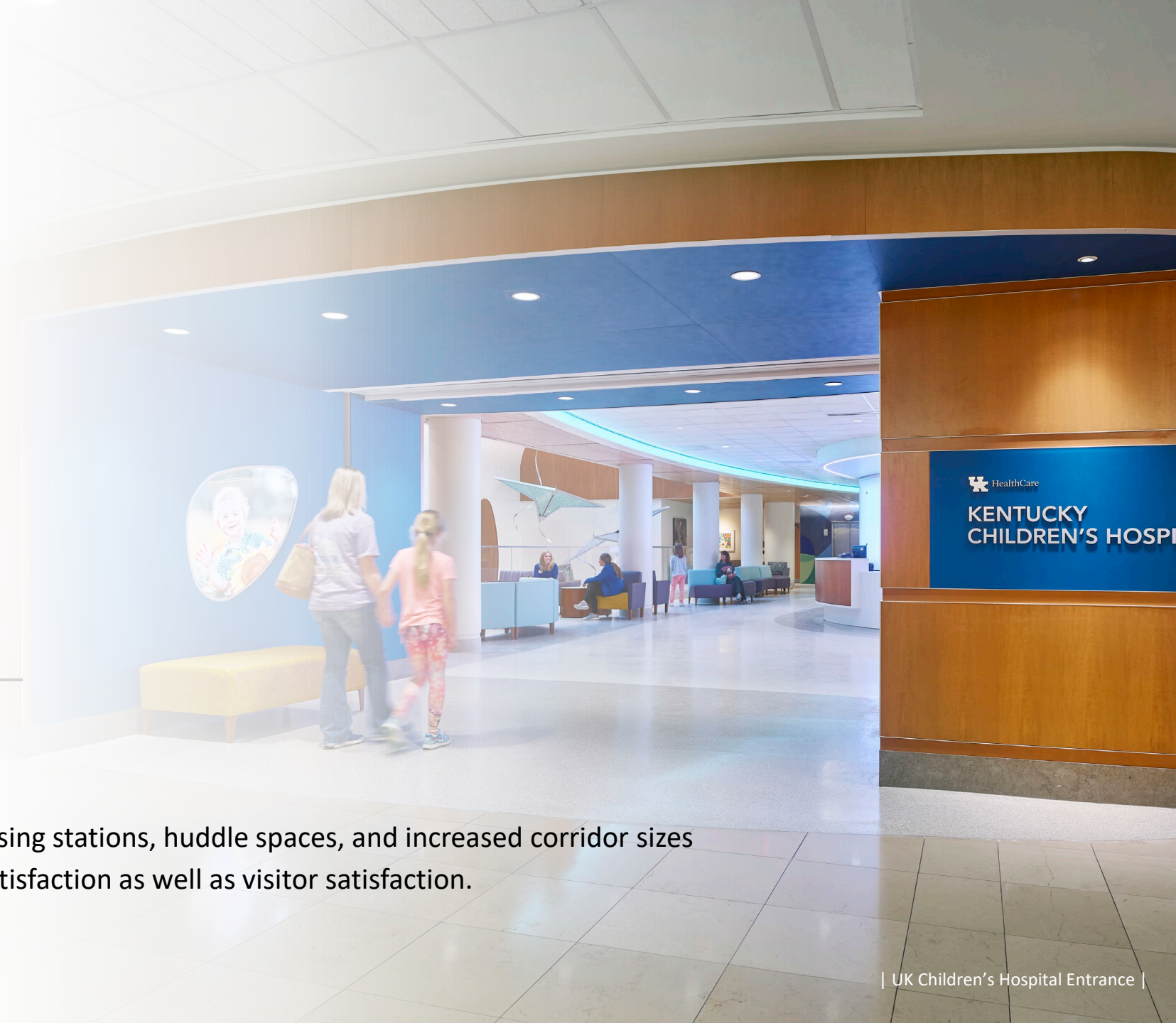
St. Joseph - Tampa

All Children's – St. Petersburg

Tampa General

Lessons Learned:

1. Having a separate admissions room did not work. When the census was high, babies ended up spending multiple days in the admission room.
2. Storage space is a must!
3. There are definite benefits to having a separate milk depot area. Mothers had a place to drop off their milk and staff at the bedside did not spend time preparing milk.
4. There are advantages and disadvantages of private rooms - great for families but the learning needs changed for staff.
5. Communication method important for staff since more spread out.
6. Having a separate procedure room was important---for really sick patients, potential ECMO, bedside procedures such as line placements or drains.
7. Orientation of new staff will be different - more time needed. Less learning opportunities by watching others in open pods.
8. Nursing orientation to the space prior to moving is essential.

SITE CONTEXT

Pavilion H

Pavilion HA
Children's Hospital

Pavilion A
Patient Towers

Ground entrance

Parking with
pedway access

UNIT DEMOGRAPHICS

Description	Pre-Move	Post-Move
Patient Rooms	9 pods NICU, 2 Neo	68 (2 twin, 2 care by parent rooms)
Patient Beds	66 (50 NICU, 16 Neo)	72
Nurse Stations	1 desk (charting completed in patient rooms)	36 DNS
Medication Rooms	2 Pyxis stations	4
Supply Rooms	1	4
Huddle Stations	0	6
RN Locator Technology	None	Portable phone (not personal)
Charting	EMR	EMR
Staffing Ratio (RN: Patient)	1:1, 2:1, 3:1	1:1, 2:1, 3:1
RNs	~200	~250
RNs/Shift	32	40
NCT	12	~24
RT	2	4-6
PT/OT	1.75	2.5
MD	11	11

Open Bay – No equipment

Staff Corridor

Nursery 6

Nursery 7

Nursery 8

TM Desk

Nursery 5

Nursery 3

Nursery 4

Nursery 2

Nursery 1

Nursery 9
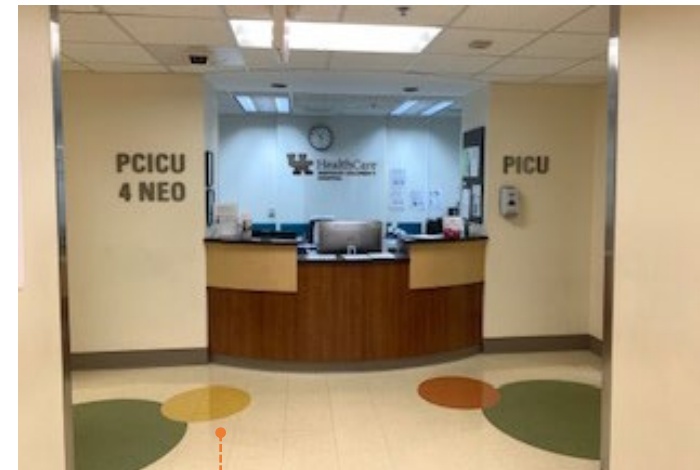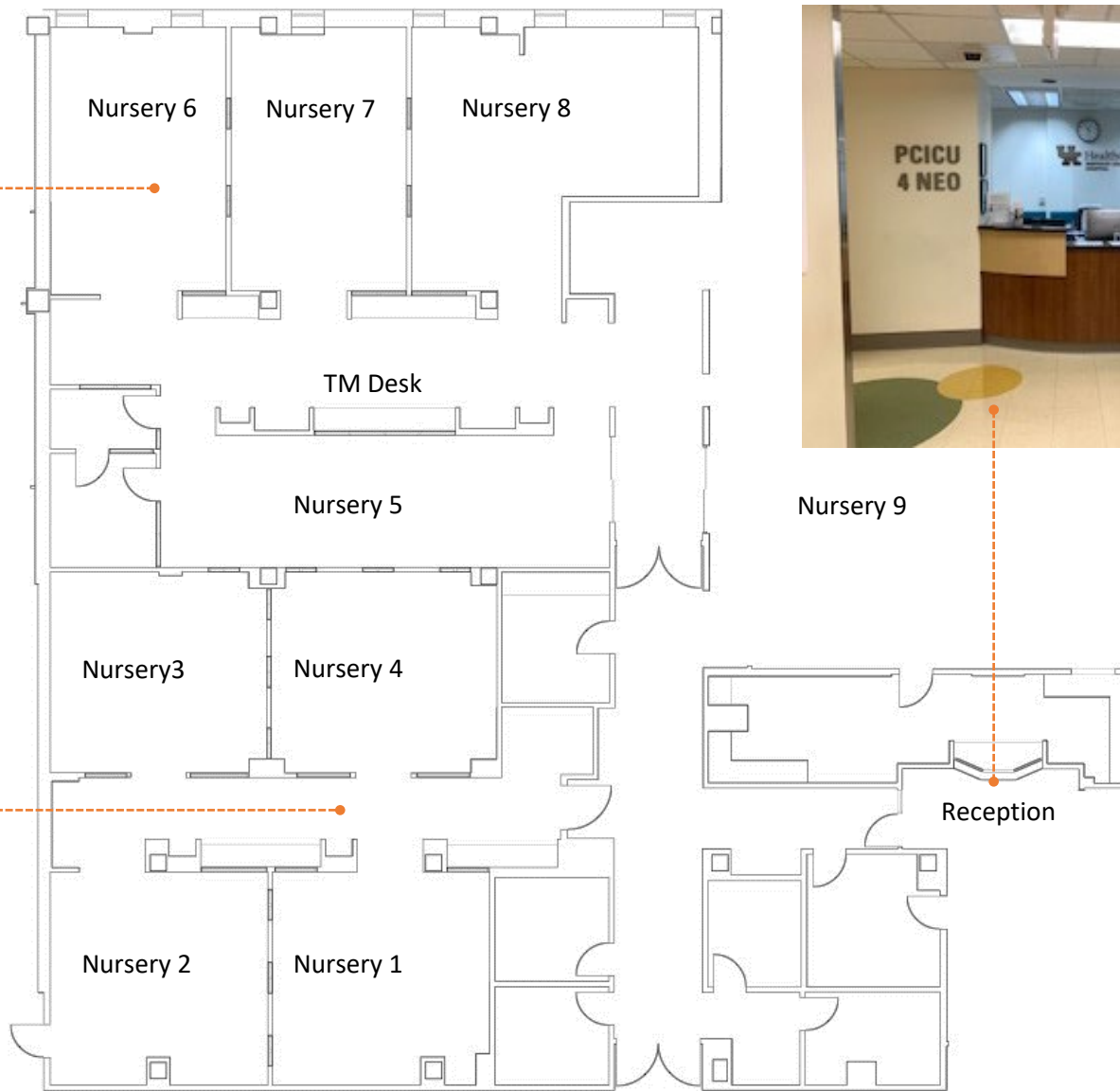
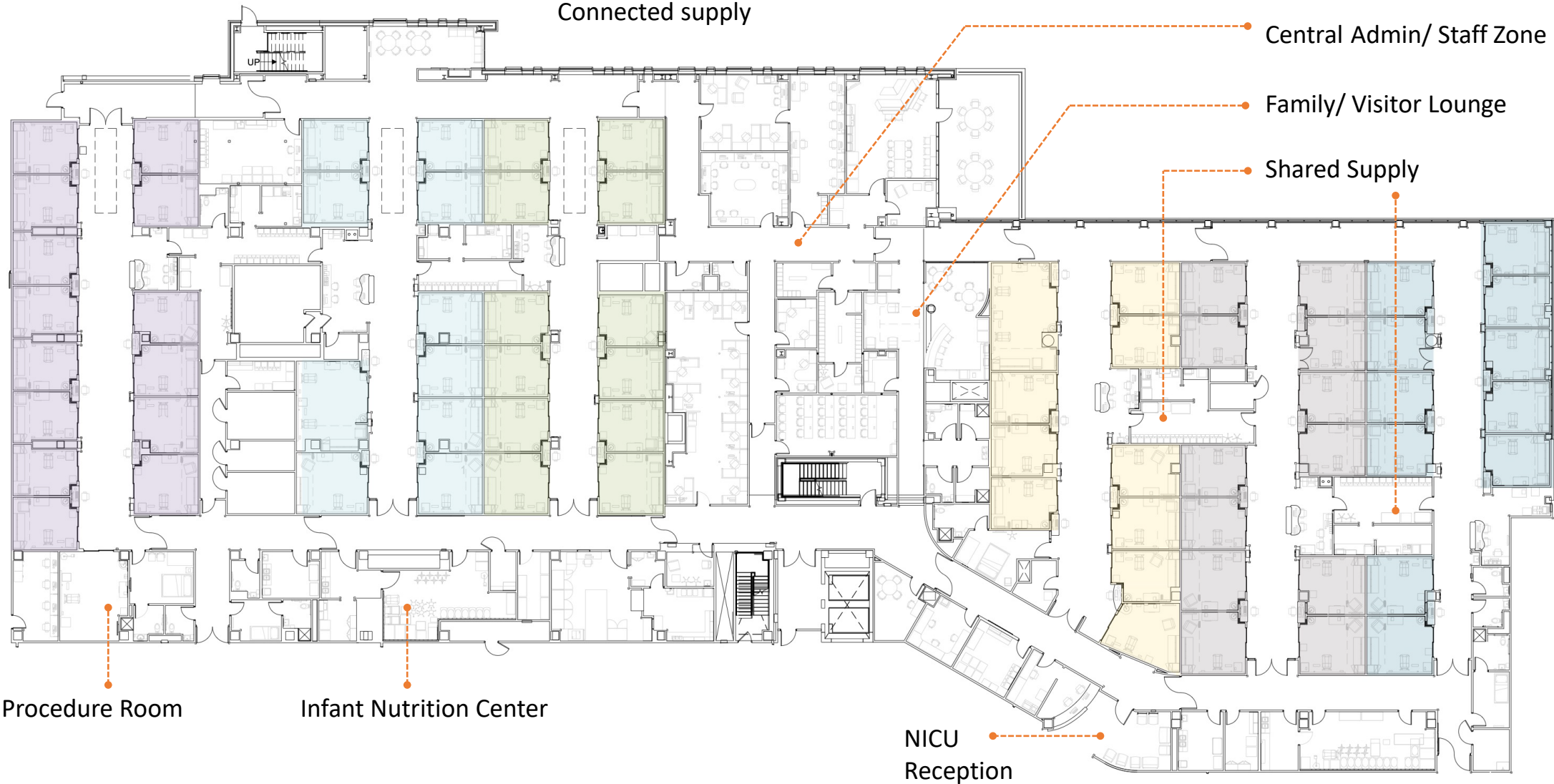Reception

UK Children's Hospital
Entrance Pre-Move

PRE-MOVE NEO POD

POST-MOVE FLOOR PLAN

6 Patient Neighborhoods ● ● ● ● ● ●
68 Patient rooms, 72 beds
Centralized staff zones
Connected supply

Central Admin/ Staff Zone

Family/ Visitor Lounge

Shared Supply

Procedure Room

Infant Nutrition Center

NICU Reception

POST-MOVE FLOOR PLAN

6 Patient Neighborhoods ● ● ● ● ● ●
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Shared Supply

Huddle   **Staff Corridor**

Neighborhood

Procedure Room

Infant Nutrition Center

NICU Reception
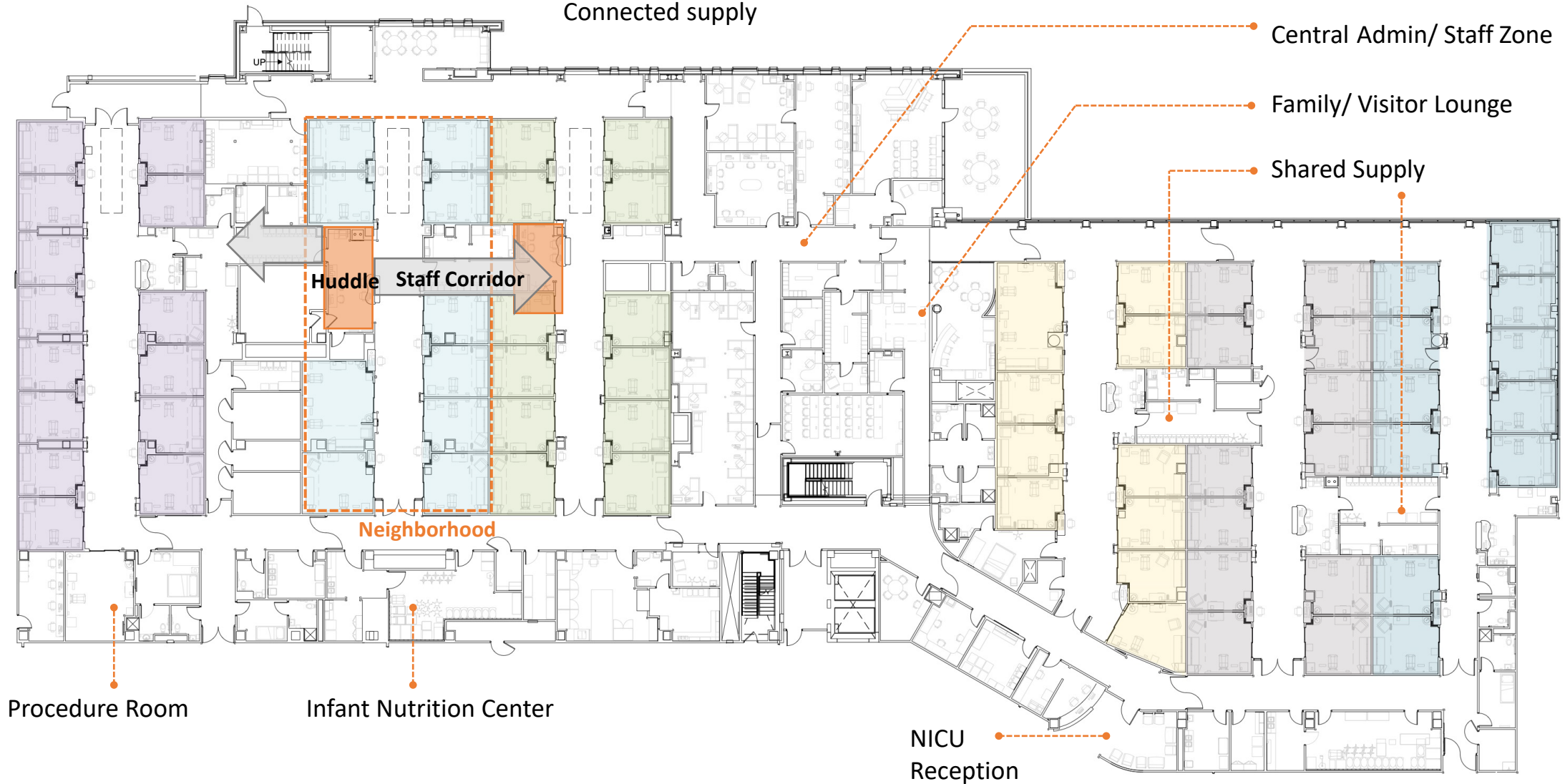
HA1181 -
HA1192

METHODS

Multi-methodological design

- Observational Data
- Space Syntax Analysis

| UK Children's Hospital Corridor Mural |

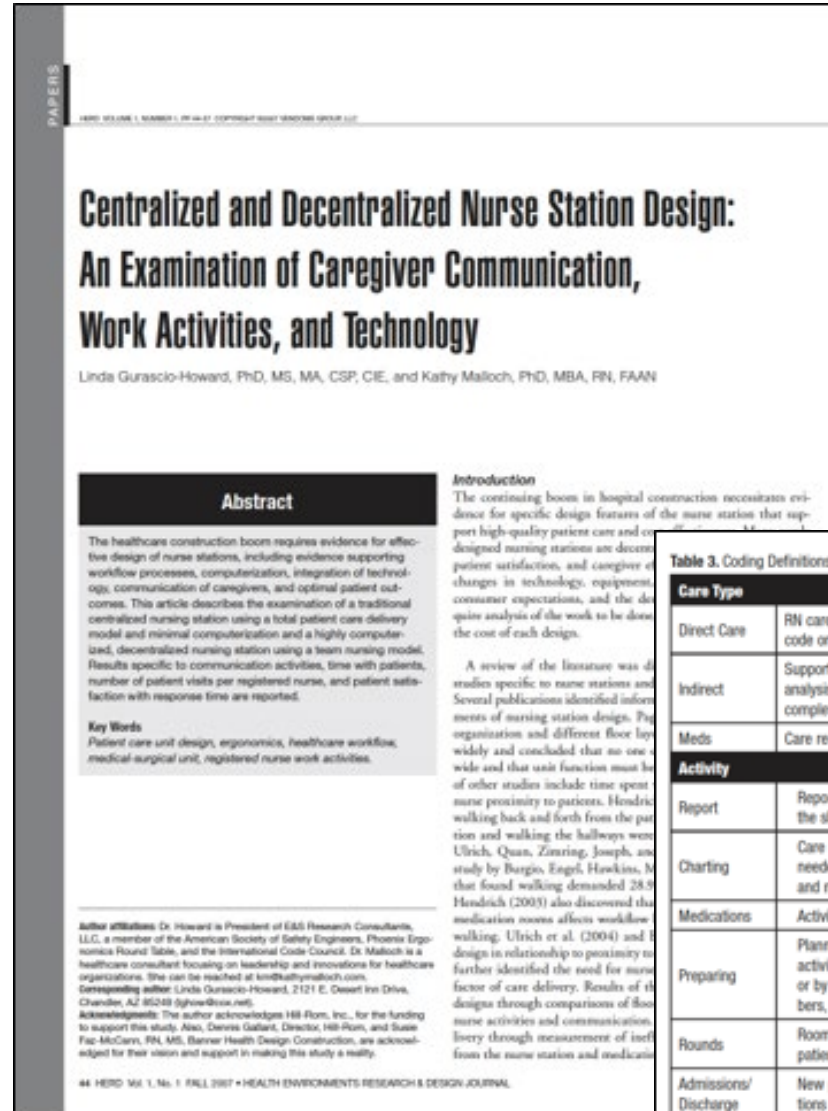**Data Collection Period:** One month

Instrument: WorkStudy+6

Number of Observers: 4, 90-minute observation periods

Total Hours of Observation: 120hrs over 30 days

Observed participants:
- 29 nurses,
- 9 physicians,
- 10 respiratory therapists, and
- 12 technicians

Centralized and Decentralized Nurse Station Design: An Examination of Caregiver Communication, Work Activities, and Technology

Linda Gurascio-Howard, PhD, MS, MA, CSP, CIE, and Kathy Malloch, PhD, MBA, RN, FAAN

Table 3. Coding Definitions for Care Type and Activity

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Level 1: Location
- Huddle Station
- Patient Room
- Decentralized Nursing Station
- Supply Room
- Break room
- Other Location

Level 2: Activity
- Report
- Charting
- Medications
- Preparing
- Rounds
- Admissions/Discharge
- Patient Care
- Other

Level 3: Communication
- Communication
- Non-Communication

Level 4: Mode of Communication
- Texting
- Phone Call
- Face to Face
- Computer
- Other

Level 5: Technology Related Options
- Personal Device
- VOLT Phone
- Desktop
- Cow-Cart
- Tablet
- Other

Level 5: Communication Types
- Collaboration
- Consult
- Leadership
- Patient information
- Coaching
- Coordination
- Other

- Space syntax is a set of techniques for analyzing spatial layouts and human activity patterns in buildings and urban areas. It is also a set of theories linking space and society. Space syntax addresses where people are, how they move, how they adapt, how they develop.
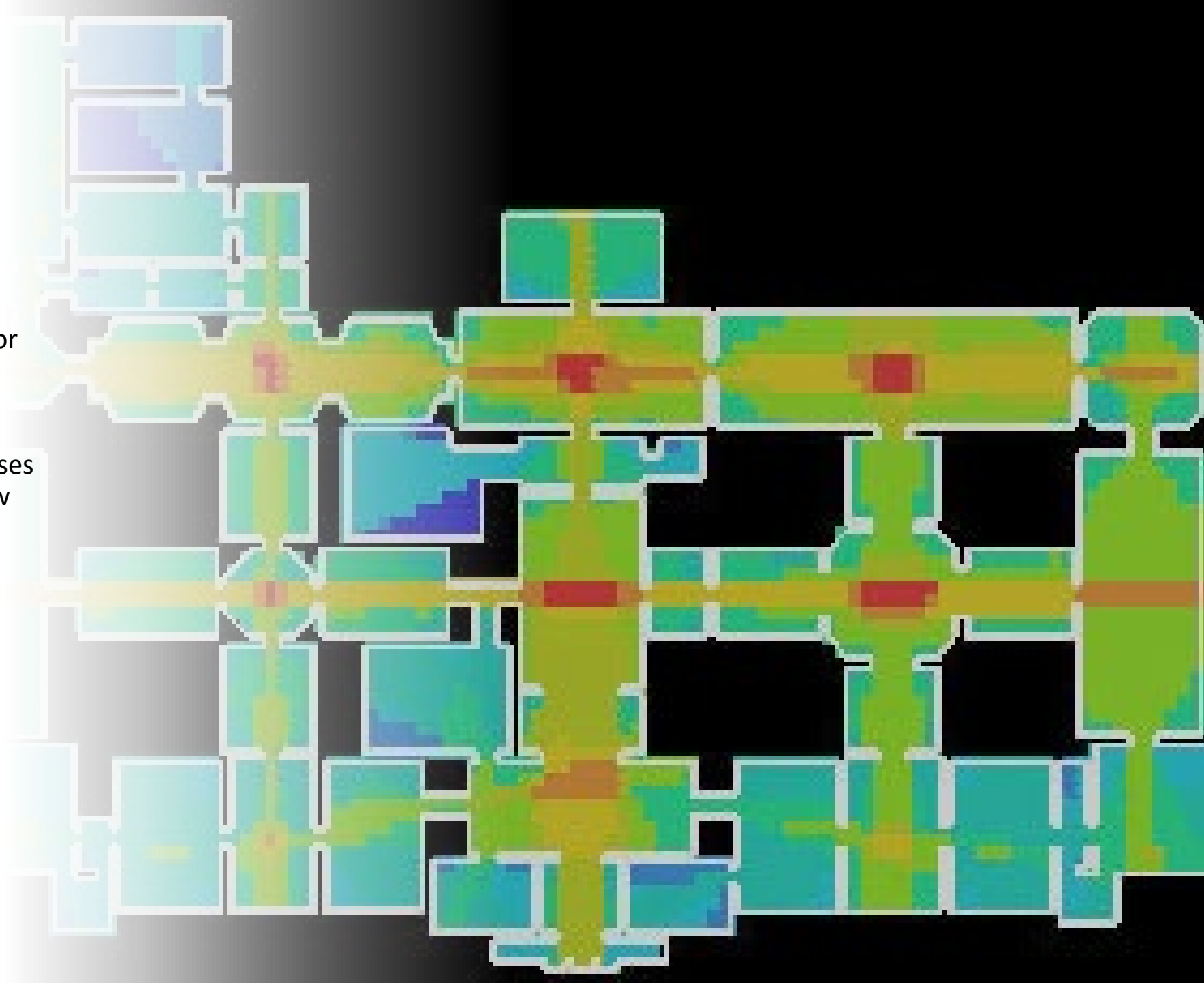
- Advanced analytical approach that employs mathematical algorithms to measure the accessibility and visibility of spatial configurations (Hiller, 1996).

- Produces numerical values that signify the quantity of connected spaces on floor plans without altering direction, serving as an indicator of space visibility (Hiller & Hanson, 1984).

- Space syntax analysis is sensitive to design changes, and these changes can influence the overall performance and user experience of the environment.
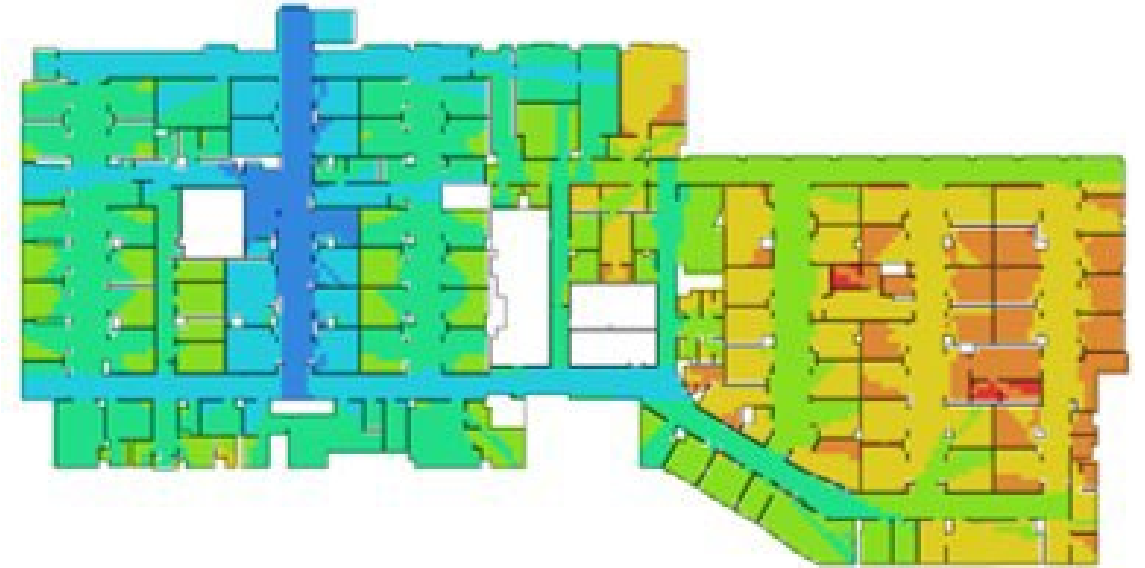
Indicators of Depth Map Software
- Connectivity
- Gate Count
- Visual Integration HH
- Visual Step Depth
- Isovist Area

Connectivity

High ⟶ Low

Indicators of Depth Map Software

- Connectivity: Measures the number of spaces immediately connecting a space of origin.

- Gate Count: Used to establish the flows of people at sampled locations within the city over the course of a day.

- Visual Integration HH: A normalized measure of distance from any a space of origin to all others in a system; calculates how close the origin space is to all other spaces and can be seen as the measure of relative asymmetry (or relative depth).

- Visual Step Depth: Used to determine the number of changes in visual direction from one space to another.

- Isovist Area: A set of all points visible from a given vantage point in space and with respect to an environment. The shape and size of an isovist is liable to change with position.
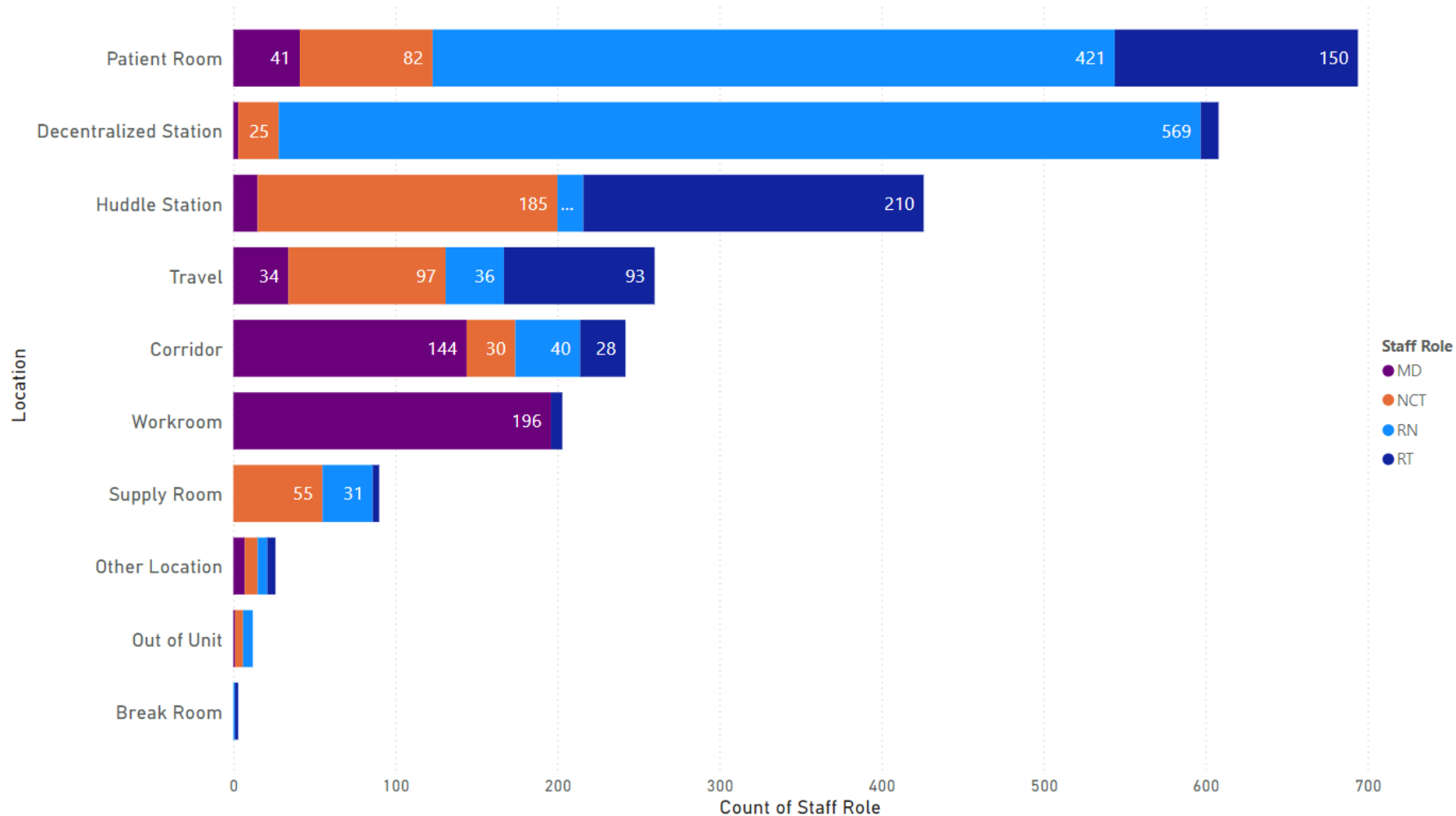
FINDINGS & OUTCOMES

NICU staff members spent varied time at different locations based on their roles. While nurses spend most of their time in patient rooms and DNSs, respiratory therapists (RTs) and nurse care technicians (NCTs) are the staff members who spend more time at the huddle stations.

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The communication mode varied by location; DNS and huddles were the top ranked locations where informal and personal device texting happened.

Face-to-Face Communication X Huddle Station

Role Labels	Count	Average of FTF (unit: second)
MD	9	367.98
NCT	12	1227.11
RN	29	22.13
RT	10	1020.52
Grand Total	**60**	**481.40**

On average, NCT spend the most amount of time communicating face to face at the huddle station, followed by the RT.

Communication via Technology X Huddle Station

Role Labels	Count	Average of Tech
MD	9	0
NCT	12	287.58
RN	29	3.19
RT	10	627.35
Grand Total	**60**	**163.62**

On average, the RT spend the most amount of time communicating via technology at the huddle station, followed by the NCT.

Non-communication X Huddle Station

Role Labels	Count	Average of NC
MD	9	0
NCT	12	1176.37
RN	29	51.73
RT	10	1185.40
Grand Total	**60**	**457.84**

On average, the RT and NCT spent about the same amount of time not communicating at the huddle station.

All time spent X Huddle Station

Role Labels	Count	Average of Raw Time
MD	9	367.98
NCT	12	2691.06
RN	29	77.04
RT	10	2833.28
Grand Total	**60**	**1102.86**

On average, RT spent the most amount of time at the huddle stations, followed by NCTs. MDs spent more time at Huddle Stations than RNs, who used the huddle station the least amount.

OBSERVATION X DNS

Face-to-Face Communication X DNS

Role Labels	Count	Average of FTF (unit: second)
MD	9	18.10
NCT	12	400.98
RN	29	886.37
RT	10	203.55
Grand Total	**60**	**545.25**

On average, RN spend the most amount of time at the DNS communicating FTF, more than double the amount of time than NCTs, and four times the amount of time than NCT.

Communication via Technology X DNS

Role Labels	Count	Average of Tech
MD	9	7.88
NCT	12	2.59
RN	29	356.49
RT	10	2.84
Grand Total	**60**	**174.48**

On average, RN spend the most amount of time communicating via technology.

Non-Communication X DNS

Role Labels	Count	Average of NC
MD	9	6.9
NCT	12	6.2
RN	29	1462.86
RT	10	156.47
Grand Total	**60**	**735.4**

On average, the RNs spent the most amount of time at the DNS not communicating.

All time spent X DNS

| Role Labels	Count	Average of Raw Time
MD	9	32.88
NCT	12	409.78
RN	29	2705.71
RT	10	362.86
Grand Total	**60**	**1455.12**

On average, On average, the RN spend the most amount of time at the DNS. MDs rarely spent their time at DNS.

Communication Mode	Average of Raw Time	# of Times Occurred
Collaboration	23.23	3
Conflict	70.32	5
Consult	56.92	11
Coordination	139.43	11
Desktop Computer	205.96	8
Desktop Phone Call	21.53	1
Informal Talk	231.50	105
Leadership	157.40	3
Patient Information	114.86	27
Personal Device Call	219.00	1
Personal Device Texting	116.77	52
VOLT Phone Texting	49.60	38
Grand Total	162.58	426
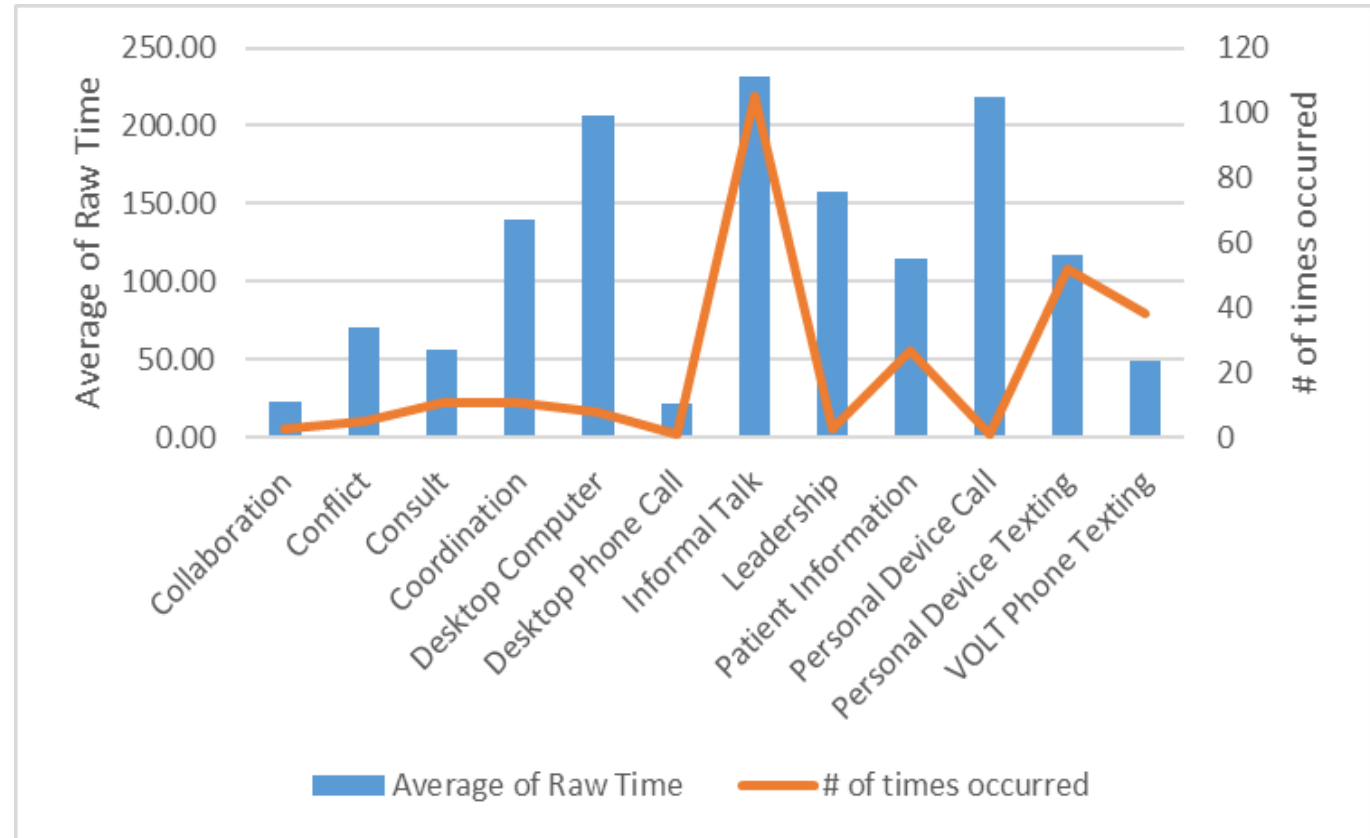
On average, informal talk occurred for the longest amount of time at the huddle stations, it was also the most commonly occurring topic of communication.

| Activity	Average of Raw Time	# of Times Occurred
Break	40.23	1
Face to Face	184.62	165
Faxing	5.82	1
Looking for supplies/forms/equipment	37.69	6
Minor Procedures	95.16	3
Observing	73.65	1
Organizing Supplies	161.28	25
Other Non-Com Other	214.54	3
Other Non-Com Patient Care	24.32	1
Other Non-Com Preparing	27.82	1
Personal Media Use	237.42	25
Scheduling	672.36	3
Technology	98.45	100
Typing/Writing	171.85	91
Grand Total	**162.58**	**426**
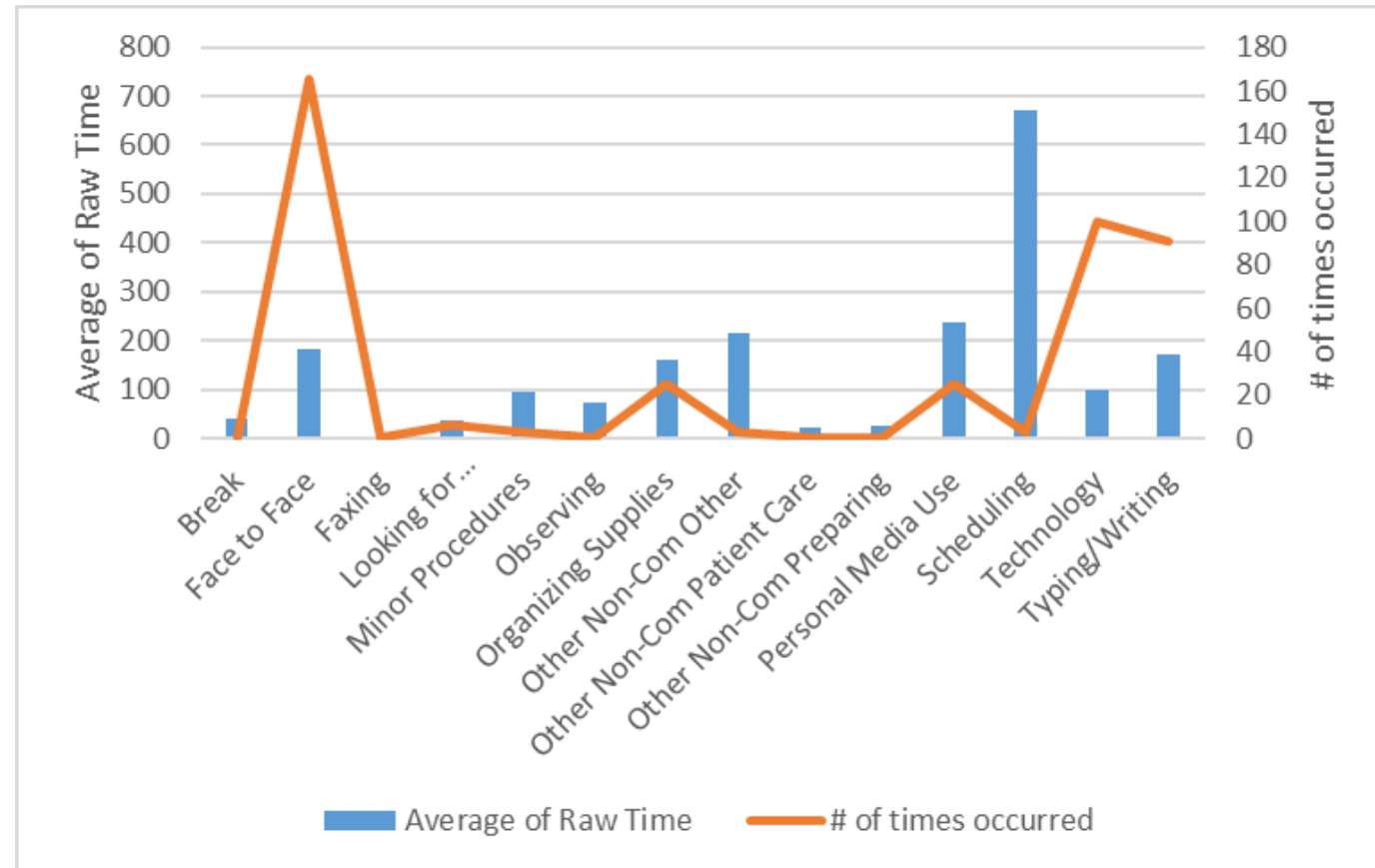
On average, scheduling took up the most amount of time at the huddle station, however, face to face communication was a more commonly occurring activity at the huddle station.

Connectivity

- Results reveal a notable increase in connectivity after implementing changes to the plan.

- Areas in front of the decentralized and huddle stations exhibit strong connectivity, as indicated by the prominent presence of orange and yellow colors.

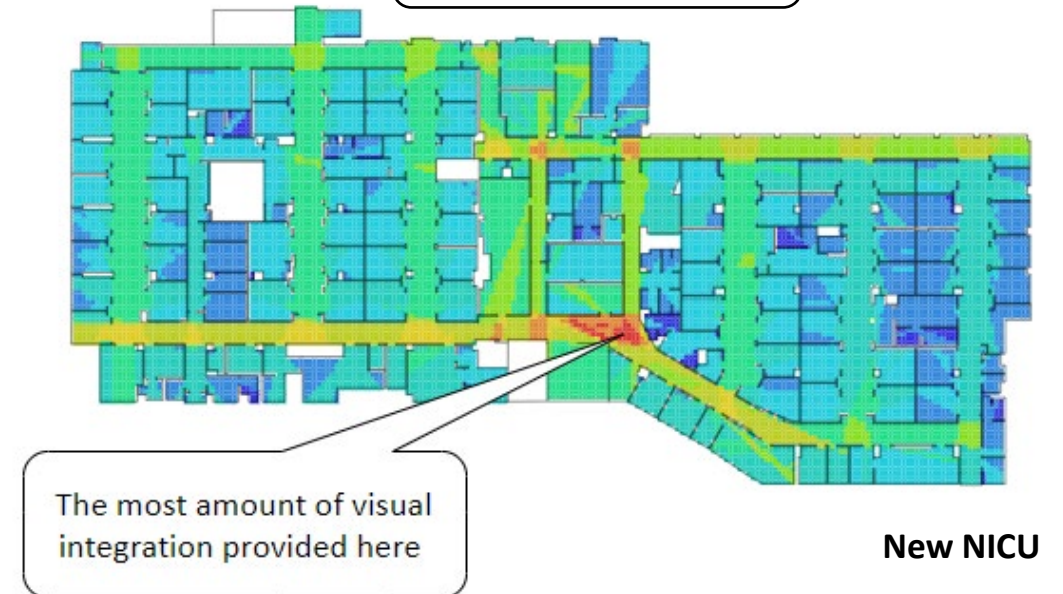- The average connectivity for the old plan was 309.42, and this figure rose to 373.65.

The most amount of connectivity

Old NICU

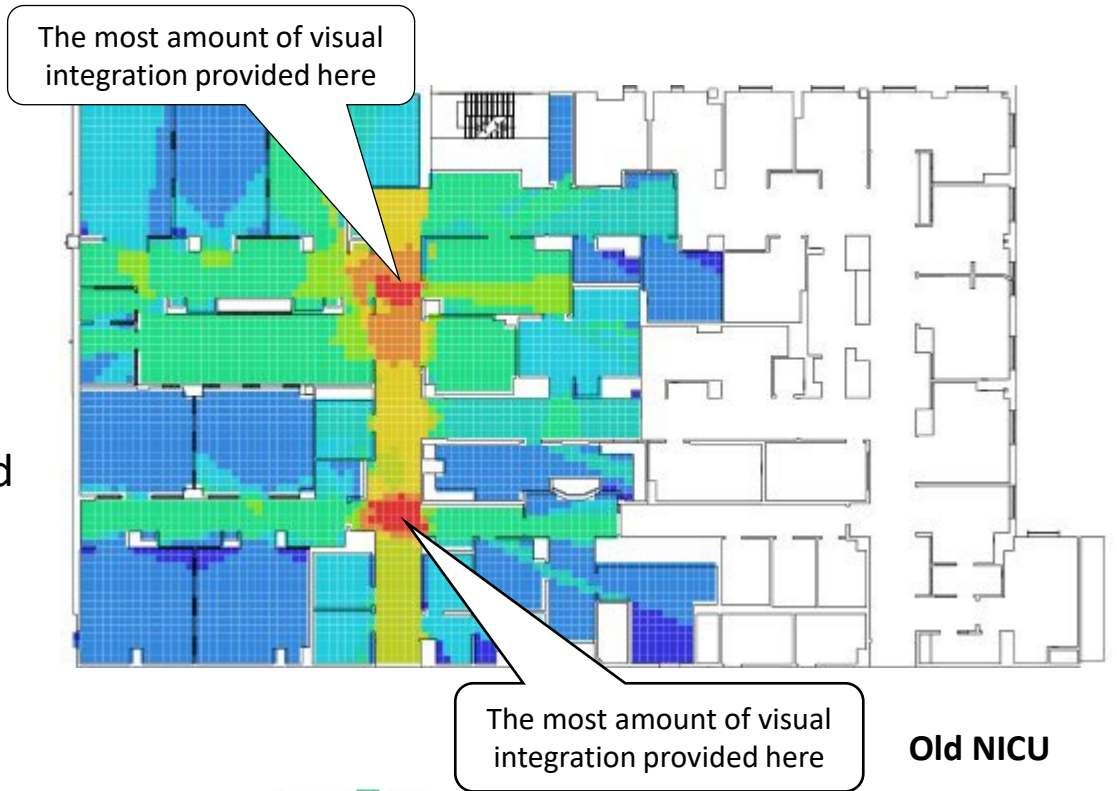The most amount of connectivity

New NICU
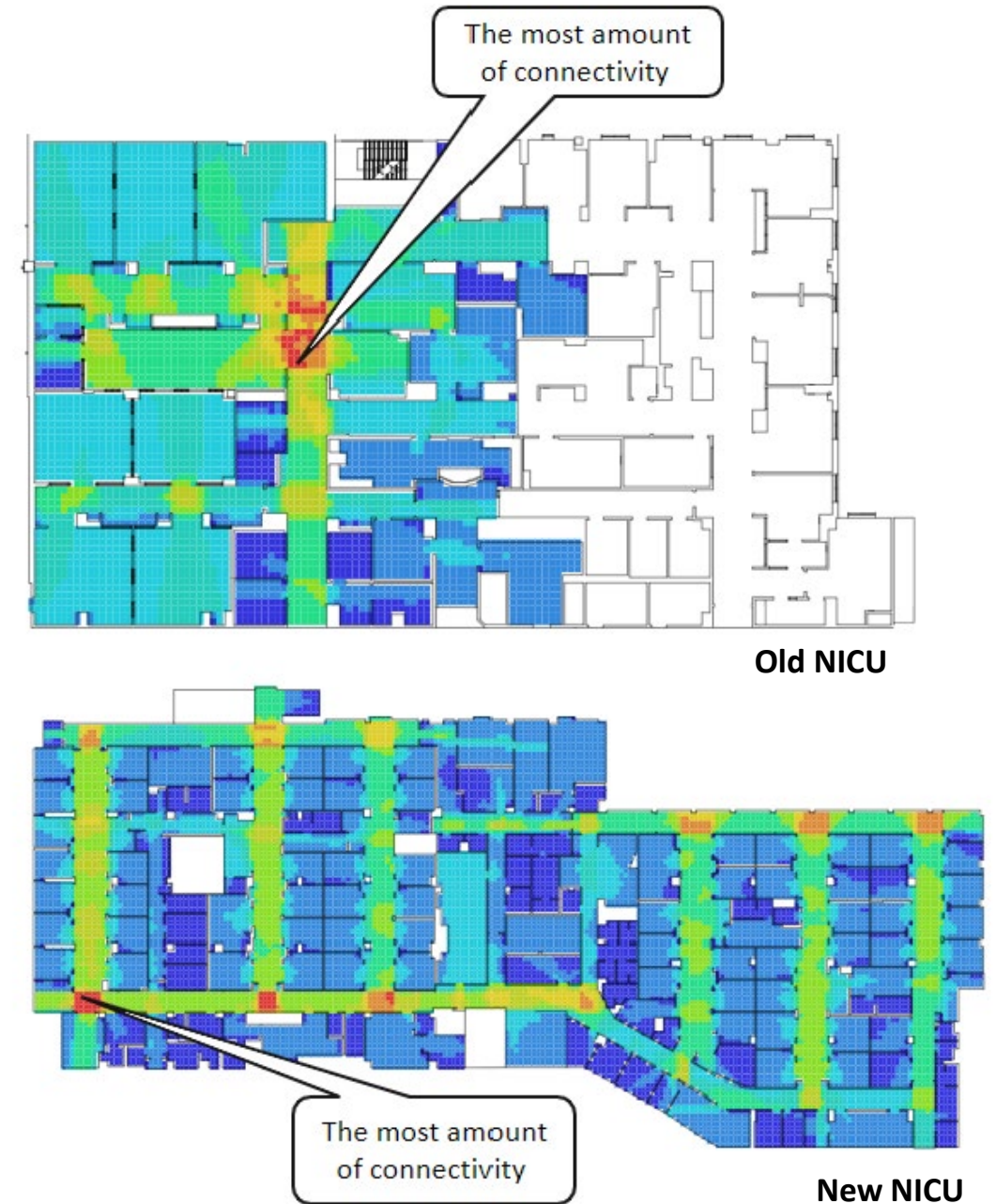
Visual Integration HH

- <mark>Measures how well a space is connected</mark> within a spatial network. The more integrated spaces are more accessible and likely to be used more frequently.
- <mark>High integration values</mark> suggest central and well-connected spaces, while low values indicate more isolated or peripheral spaces.
- <mark>The layouts of the two plan types demonstrated a slight shift in visual integration value.</mark>

Findings

- The old plan exhibits an average visual integration index of **4.7**, showing a graphical depiction of visual integration values for each plan.

- The maximum value of this index for the old plan is **4.7**, while it is **6.96** for the new plan.

The most amount of visual integration provided here

The most amount of visual integration provided here

Old NICU

The most amount of visual integration provided here
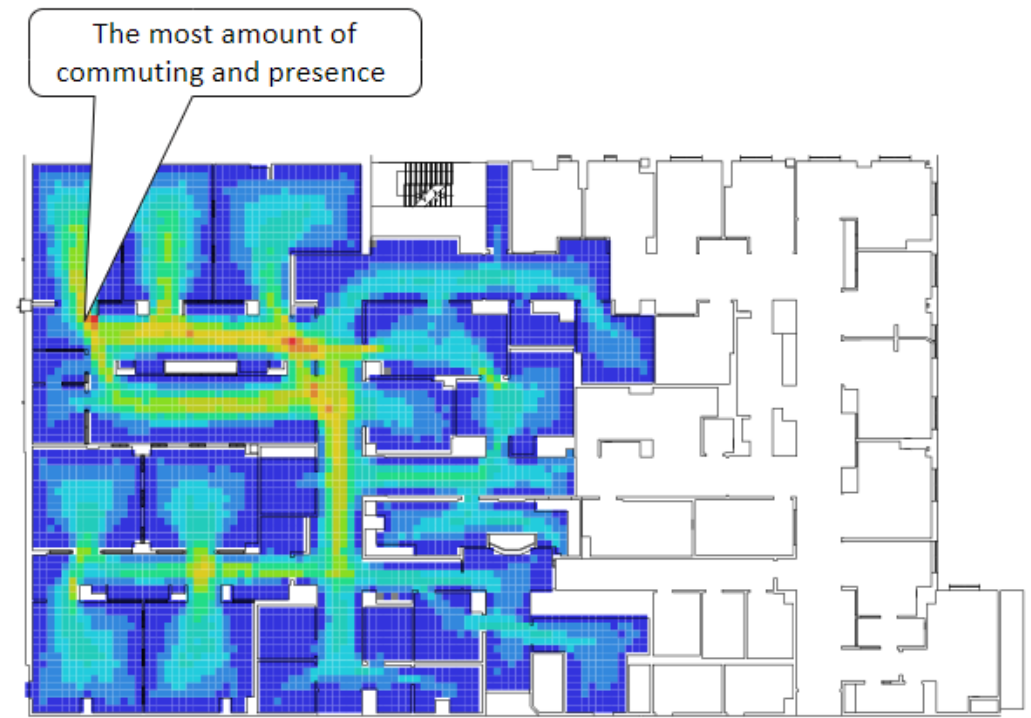
New NICU

Gate Count

- Refers to the number of agents passing through certain points or gates in the simulation.

- Provides insights into the attractiveness, connectivity, and efficiency of different spatial elements within a layout.

Findings

- The analysis revealed a significant decrease in this value compared to the unchanged plan. Specifically, the maximum for the new plan was 95.07, whereas it was 156.07for the old plan.

The most amount of commuting and presence

Old NICU

The most amount of commuting and presence

New NICU

VISUAL STEP DEPTH

- Used to determine the number of changes in visual direction from one space to another.

- Dark blue color represents the first step, enabling staff to have visible areas. Light blue corresponds to the second step, and so forth, with red indicating the final step.

- Where visual direction changes are more frequent, interactions are expected to decrease.

Connectivity

High ⟶ Low

Locating the considered point within the huddle station for analyzing the visual step depth
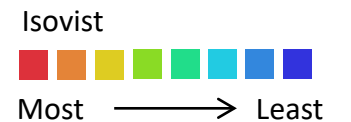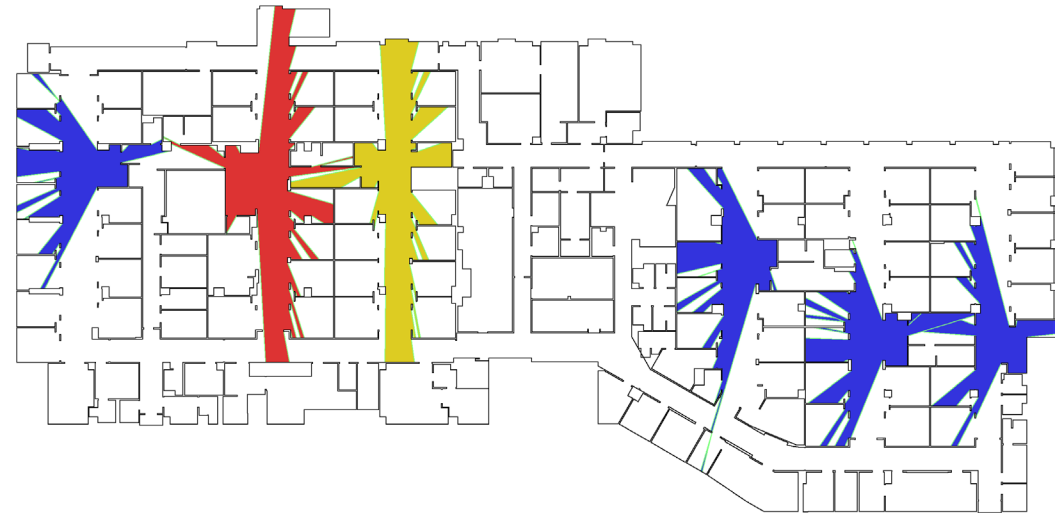
Visual Step Depth:
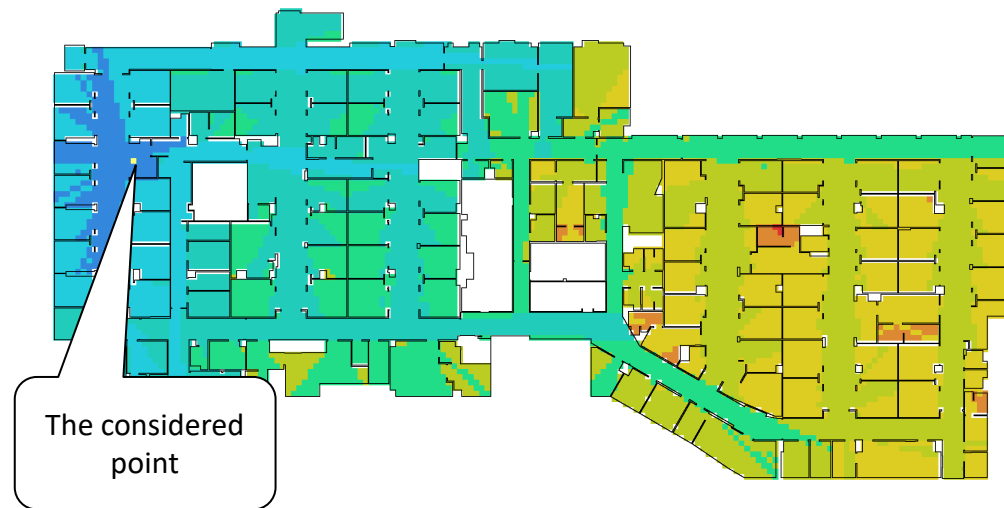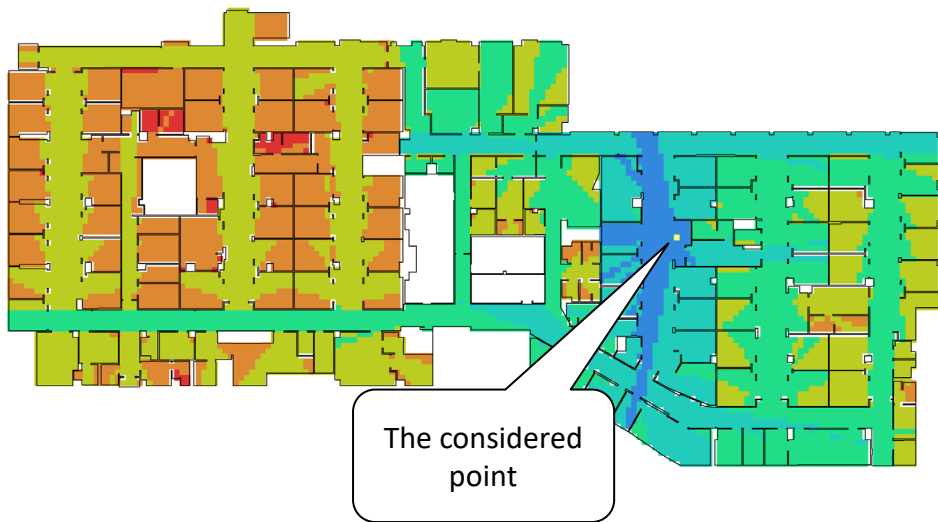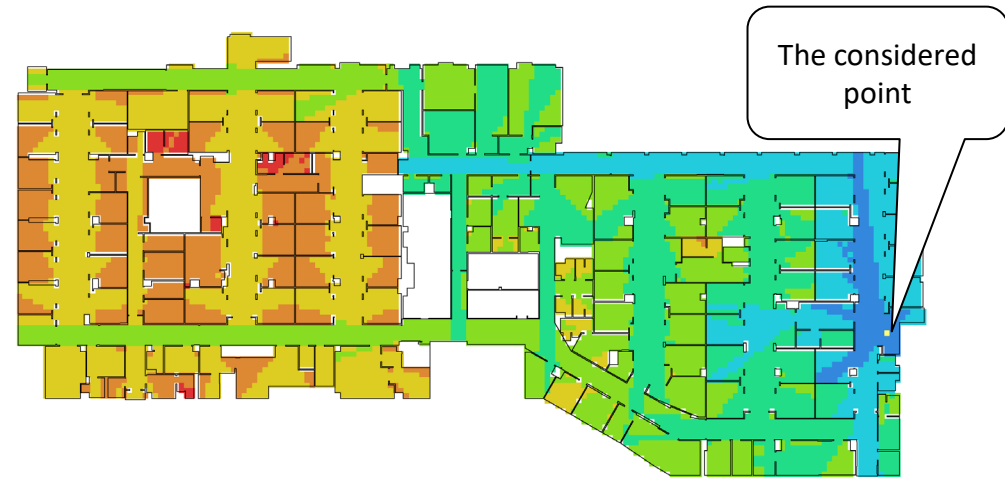
Isovist Area (360 degrees):

This indicator shows the potential of visibility from a point in a specific place.

Result

- The most amount for isovist is shown in the left side of plan, so it is more likely to have interaction in this area.

Isovist

Most ——→ Least

CONCLUSIONS

Observational Conclusions

- Therapist Group spent the most amount of time at the huddle stations, followed by technicians.

- Nurses used the huddle stations the least.

- Technicians spent the most amount of time communicating face-to-face at the huddle station, followed by therapists.

- The most commonly occurring topic of communication was informal talk.

- Space Syntex Conclusions

- Across the unit, huddle spaces serve as a strong indicator for connectivity.

- Areas in front of the decentralized and huddle stations exhibit strong connectivity.

IMPLICATIONS

- NICUs implementing a neighborhood design layout with decentralized nurse stations can contribute to staff's ability to do their job successfully and efficiently.

- Decentralized nurse stations are the most frequented location for staff work in the single-family room NICU.

- Informal communication is an important value for healthcare professionals for staff relationships and well-being.

- Designs that facilitate informal communication support teamwork, relationships, and co-awareness networks.

- Humanizing work environments and supporting frequent communication.

- Healthcare facilities should consider corridors and centralized huddle spaces as strategic locations for collaboration and aim to design less hierarchical environments.

Questions?

UNDERSTANDING NICU COMMUNICATION

Investigating Real-Time Interactions of Healthcare Professionals' Care Activities in Huddle Spaces

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