

Designing an Emergency Department for the Future

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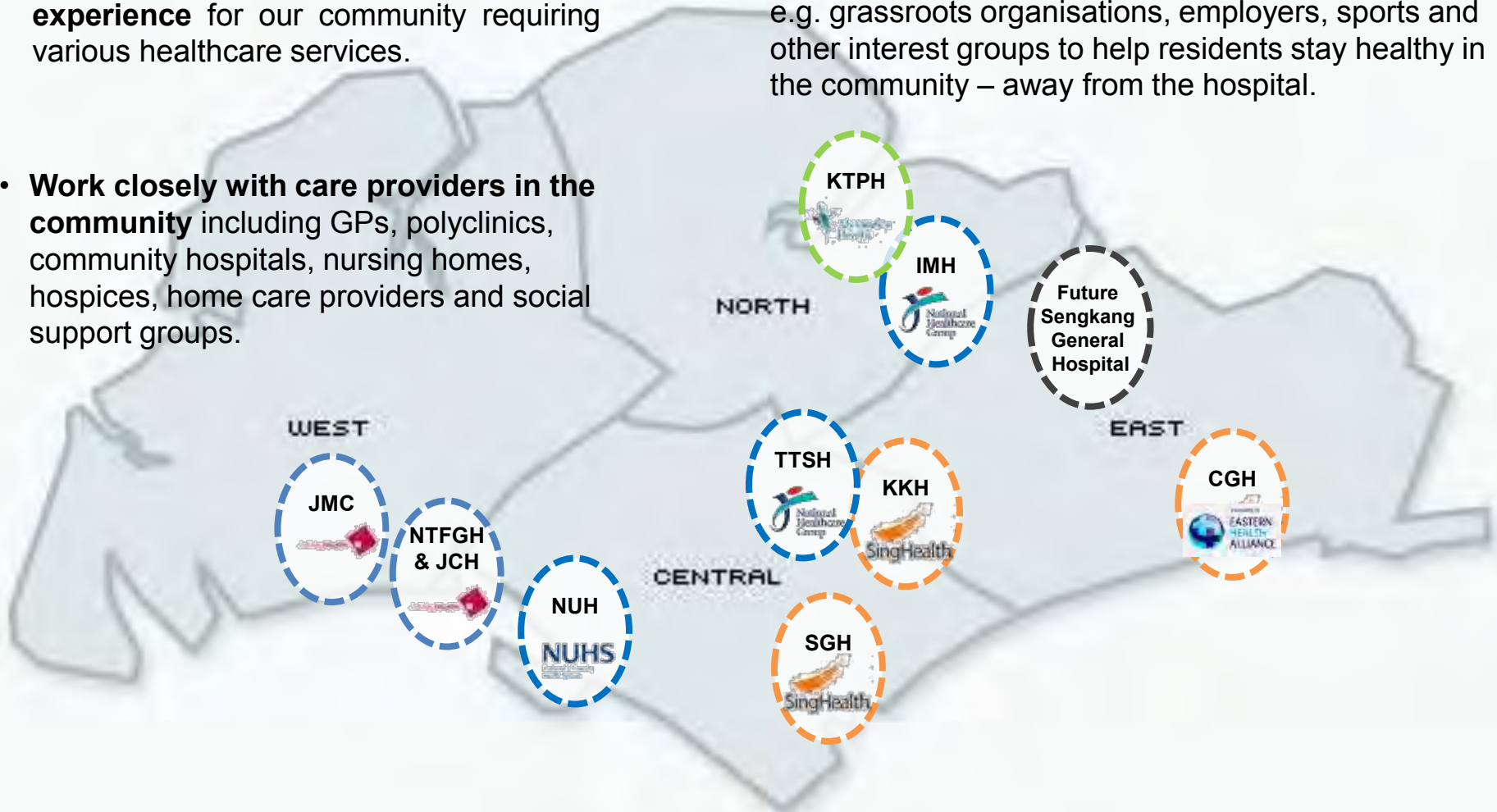
About JurongHealth

- Managed **Alexandra Hospital (AH)** until 29 June 2015.
- The 700-bed **Ng Teng Fong General Hospital (NTFGH)** will be the anchor regional hospital of JurongHealth. It is Singapore's first acute hospital to be twinned with the 400-bed **Jurong Community Hospital (JCH)** to provide integrated and hassle-free acute and rehabilitative care.
- Managing **Jurong Medical Centre (JMC)** to serve the community in the west.
- Partnering GPs in the west at the **Lakeside Family Medicine Clinic (LFMC)** to provide care for patients with chronic conditions.

A regional healthcare cluster for the west

- **Provide integrated and seamless care experience** for our community requiring various healthcare services.
- **Work closely with care providers in the community** including GPs, polyclinics, community hospitals, nursing homes, hospices, home care providers and social support groups.

- **Engage non-healthcare community partners** e.g. grassroots organisations, employers, sports and other interest groups to help residents stay healthy in the community – away from the hospital.





Jurong Community Hospital (JCH)

Total of 12 levels

400 beds (11% Private, 89% Subsidised)

- **Level 1**
Admission & JCH Specialist Outpatient Clinics
- **Mezzanine Level**
Clinical and Administration Space
- **Level 2 and 3**
Private Wards
- **Level 4 to 12**
Subsidised Wards

Ng Teng Fong General Hospital (NTFGH)

Total of 16 levels

700 beds (25% Private, 75% Subsidised)

28 Intensive Care Unit beds and 42 High Dependency beds

15-bed Isolation Ward next to Accident & Emergency Department

18 Operating Theatres

- **Level 1 to 4**
Diagnostics and Treatment
- **Level 5 to 10 (West Wing)**
Private Wards
- **Level 5 to 16 (East Wing)**
Subsidised Wards

Specialist Outpatient Clinics

Total of 8 levels

Training Centre

Auditorium

Diagnostic services

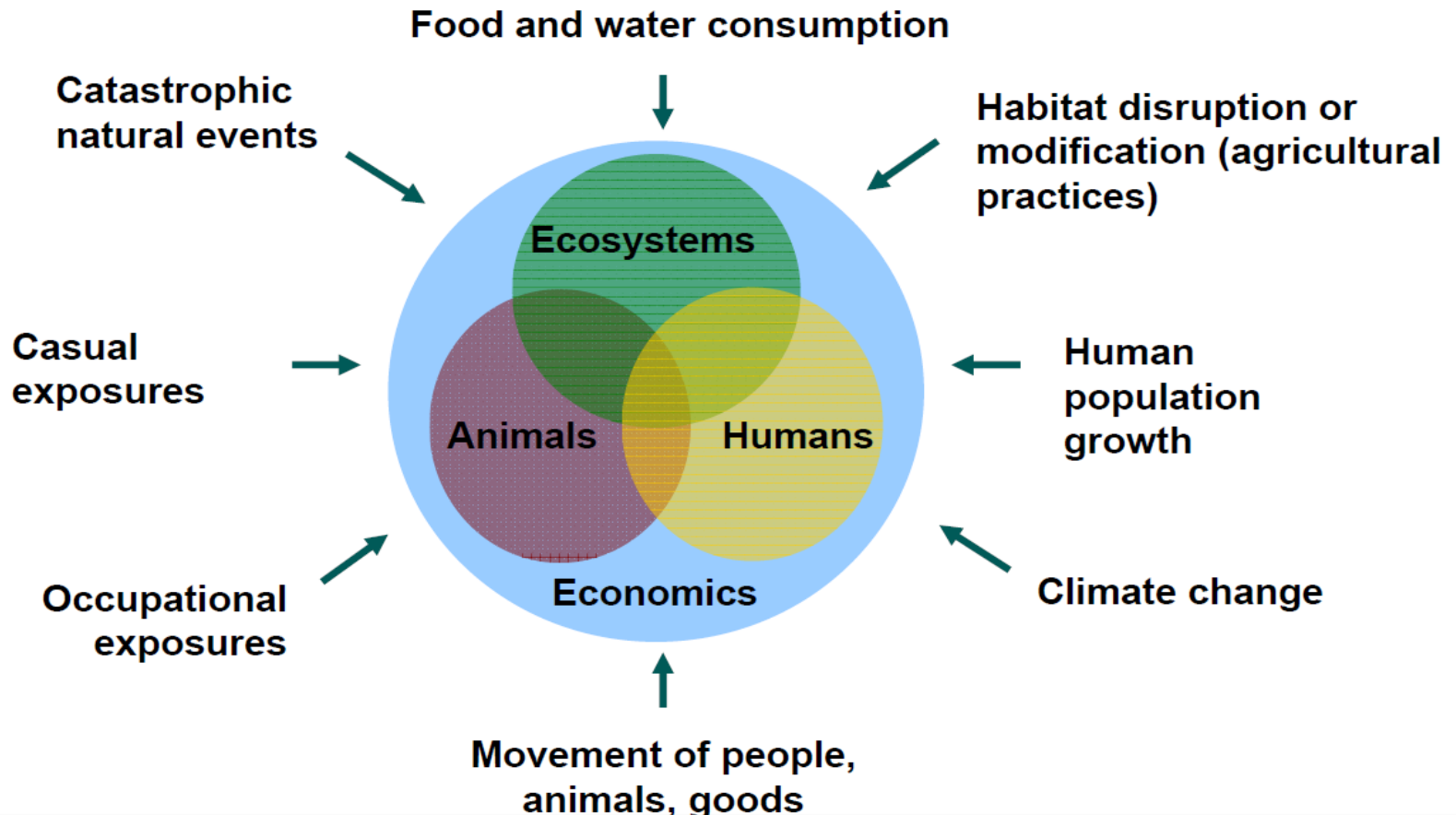
Pharmacy on every clinic floor

- **Level 1**
Training facilities (including an auditorium) and Diagnostic Imaging services
- **Level 2**
Pre-admission testing, Medical Social Services and retail
- **Level 3 to 7**
Specialist Outpatient Clinics (120 consult rooms)
- **Level 8**
Administration



Situational Awareness

Drivers of Emerging Public Health Threats







EBOLA KEY MESSAGES

Call FREE 117

What is Ebola ?

Ebola is a killer disease caused by a virus. It spreads quickly from person to person, kills in a short time, BUT can be prevented.

Signs & Symptoms



FEVER



VOMITING
Sometimes bloody



DIARRHOEA
Sometimes bloody



BLEEDING



MUSCLE OR JOINT PAIN



SKIN RASH

How is Ebola Spread?

blood, saliva, vomitus, stool, urine of an infected person
other person and un-sterilized injections.





ORIGINAL RESEARCH ARTICLE

Open Access

Evidence-based support for the all-hazards approach to emergency preparedness

Bruria Adini^{1,2,3,4*}, Avishay Goldberg^{2,3}, Robert Cohen^{1,2}, Daniel Laor^{1,2} and Yaron Bar-Dayana^{2,3}

Abstract

Background: During the last decade there has been a need to respond and recover from various types of emergencies including mass casualty events (MCEs), mass toxicological/chemical events (MTEs), and biological events (pandemics and bio-terror agents). Effective emergency preparedness is more likely to be achieved if an all-hazards response plan is adopted.

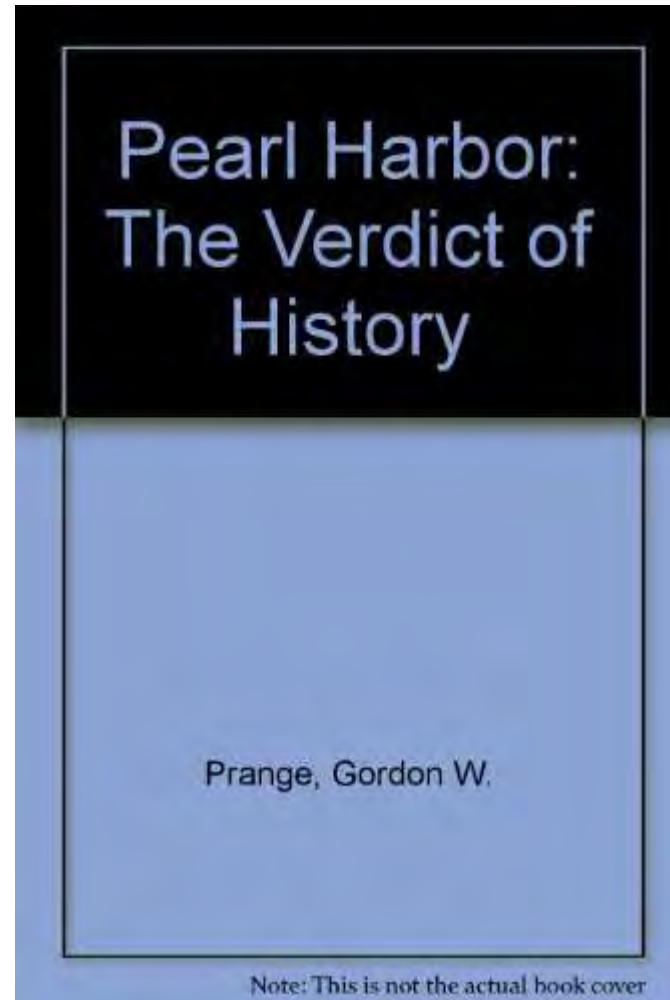
Objectives: To investigate if there is a relationship among hospitals' preparedness for various emergency scenarios, and whether components of one emergency scenario correlate with preparedness for other emergency scenarios.

Methods: Emergency preparedness levels of all acute-care hospitals for MCEs, MTEs, and biological events were evaluated, utilizing a structured evaluation tool based on measurable parameters. Evaluations were made by professional experts in two phases: evaluation of standard operating procedures (SOPs) followed by a site visit. Relationships among total preparedness and different components' scores for various types of emergencies were analyzed.

Results: Significant relationships were found among preparedness for different emergencies. Standard Operating Procedures (SOPs) for biological events correlated with preparedness for all investigated emergency scenarios. Strong correlations were found between training and drills with preparedness for all investigated emergency scenarios.

Conclusions: Fundamental critical building blocks such as SOPs, training, and drill programs improve preparedness for different emergencies including MCEs, MTEs, and biological events, more than other building blocks, such as equipment or knowledge of personnel. SOPs are especially important in unfamiliar emergency scenarios. The findings support the adoption of an all-hazards approach to emergency preparedness.

Keywords: Emergency preparedness, Evidence-based, All-hazards approach, Evaluation, Mass casualty events



”It deals not with action, but with reaction”

Emergency Department

**Epicenter of an Acute Care
Hospital**

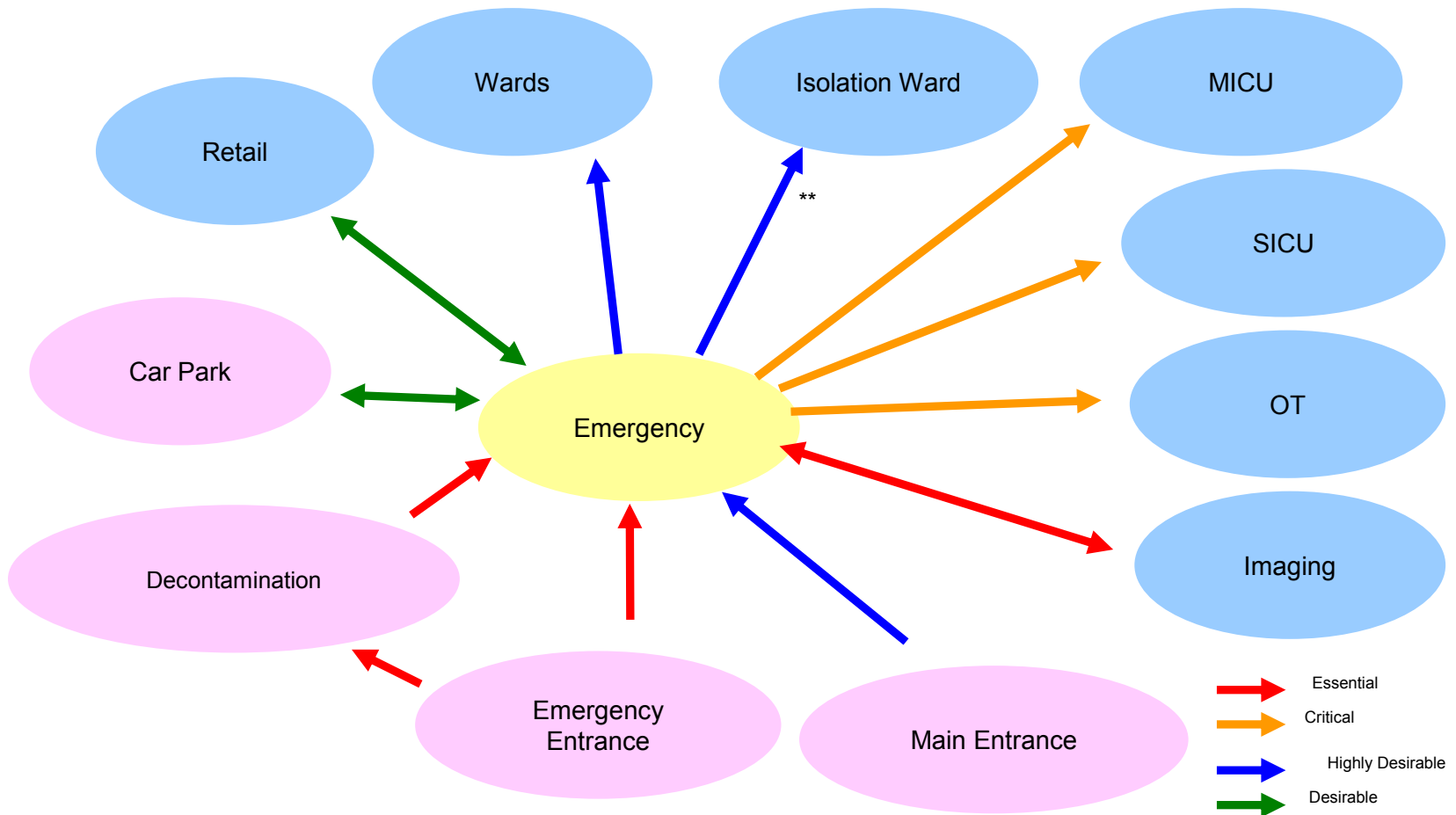
Complex Adaptive Systems (Rouse, 2000)

- An emergency department
 - *nonlinear and dynamic and do not inherently reach fixed-equilibrium points*
 - *independent agents*
 - *goals and behaviors are likely to conflict*
 - *Agents are intelligent - learn and adapt*
 - *emergent behaviors may range from valuable innovations to unfortunate accidents.*
 - *no single point(s) of control*
- must respond effectively to a **wide variety** of circumstances due to the variety of individual and combinations of problems, and **unscheduled** demand, which **fluctuates** significantly over time

“Taming” a complex system

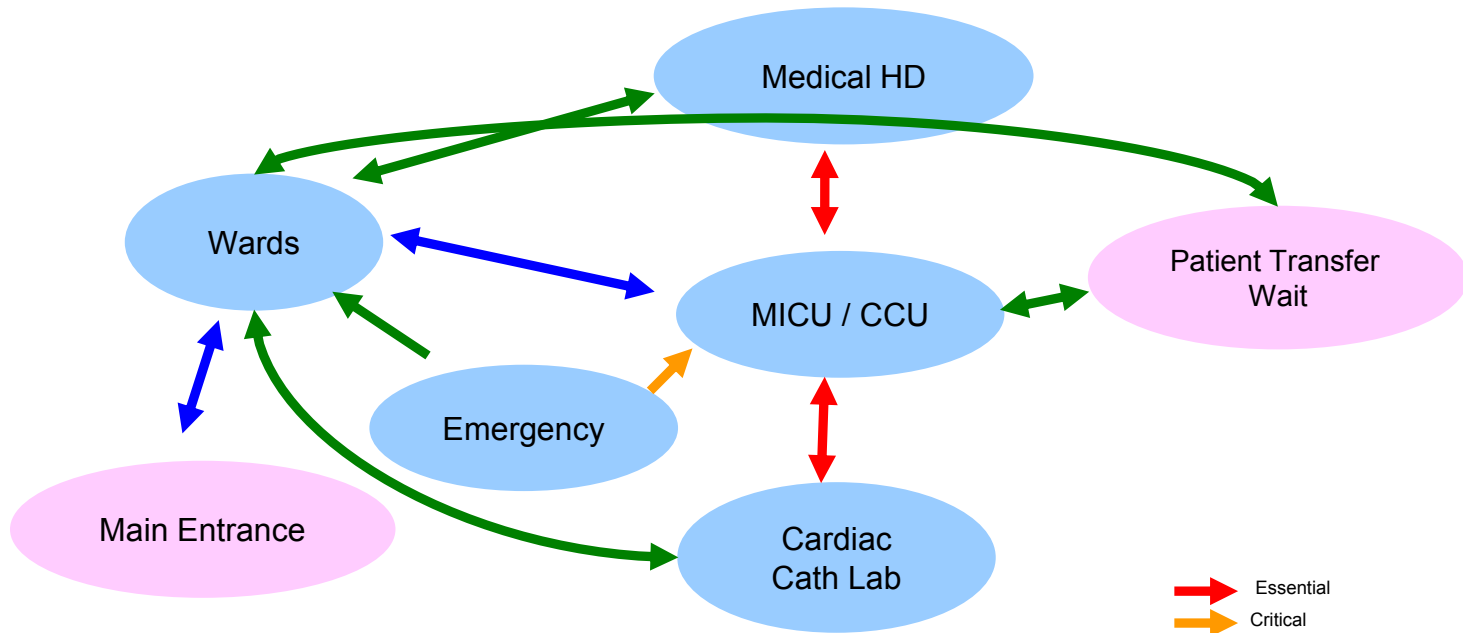
- Shorter distance, fewer steps and people
 - processes are kept short and simple
 - fewer opportunities exist for something to go wrong
 - fewer 'handoffs' of information from one person to another.
 - Less degradation of information occurs
 - Fewer steps mean that fewer feedback loops need to be constructed in order to ensure that errors or faults in the process are detected and corrected.

Functional Relationship



Note: Satellite Pharmacy in Emergency
** dedicated & convenient access to contain spread

Spatial Relationship



Inpatient facilities must have convenient access to Car Park
Assume there will be 2 options for medication dispensing before discharge:
•Discharge pharmacy
•Bedside dispensing



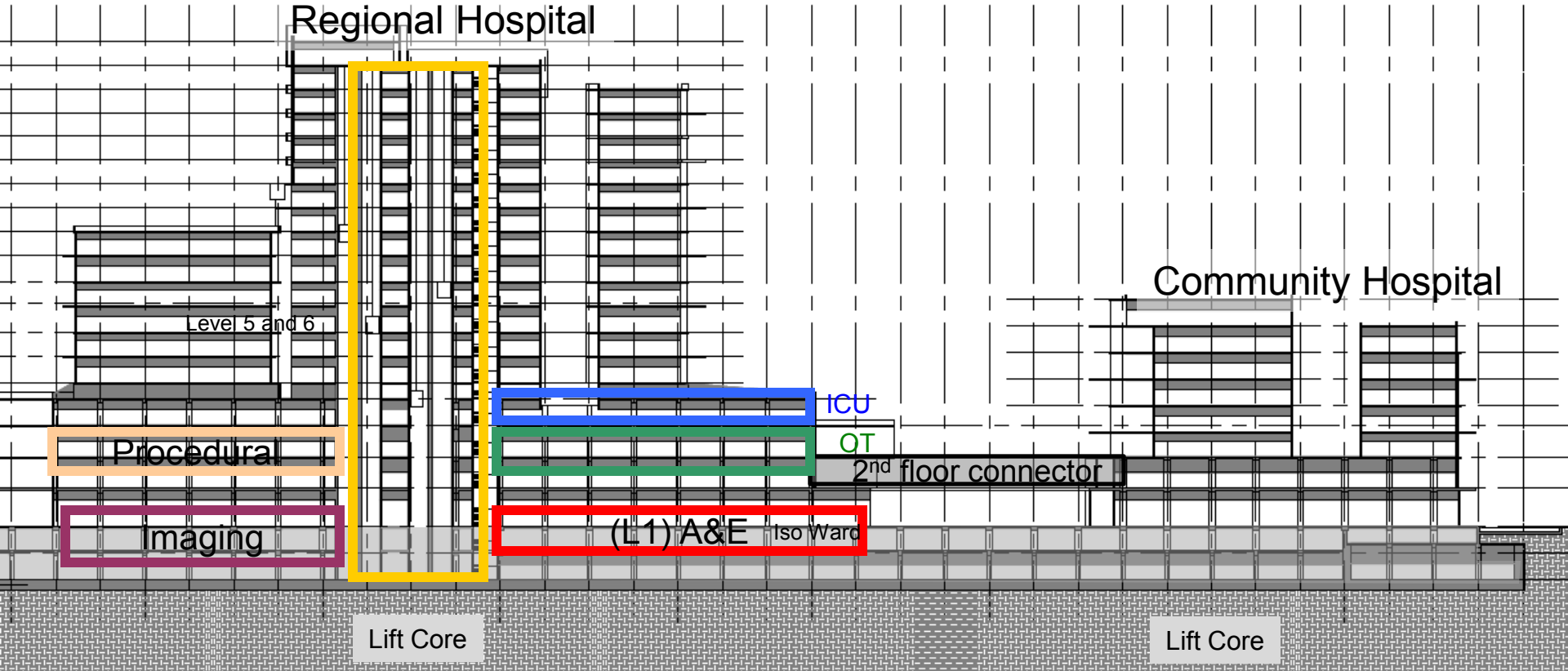
Selecting the Design Team

- Architect
- Medical Planner



- ED charge nurses
 - Shift flow coordinators,
 - ED physicians,
 - staff nurses,
 - registration staff,
 - unit clerks,
 - ED techs
 - Environmental services staff
-
- ED leadership team members who are committed to the meeting schedule and will serve as project ambassadors to other staff members for the life of the project.

Geospatial Relationship



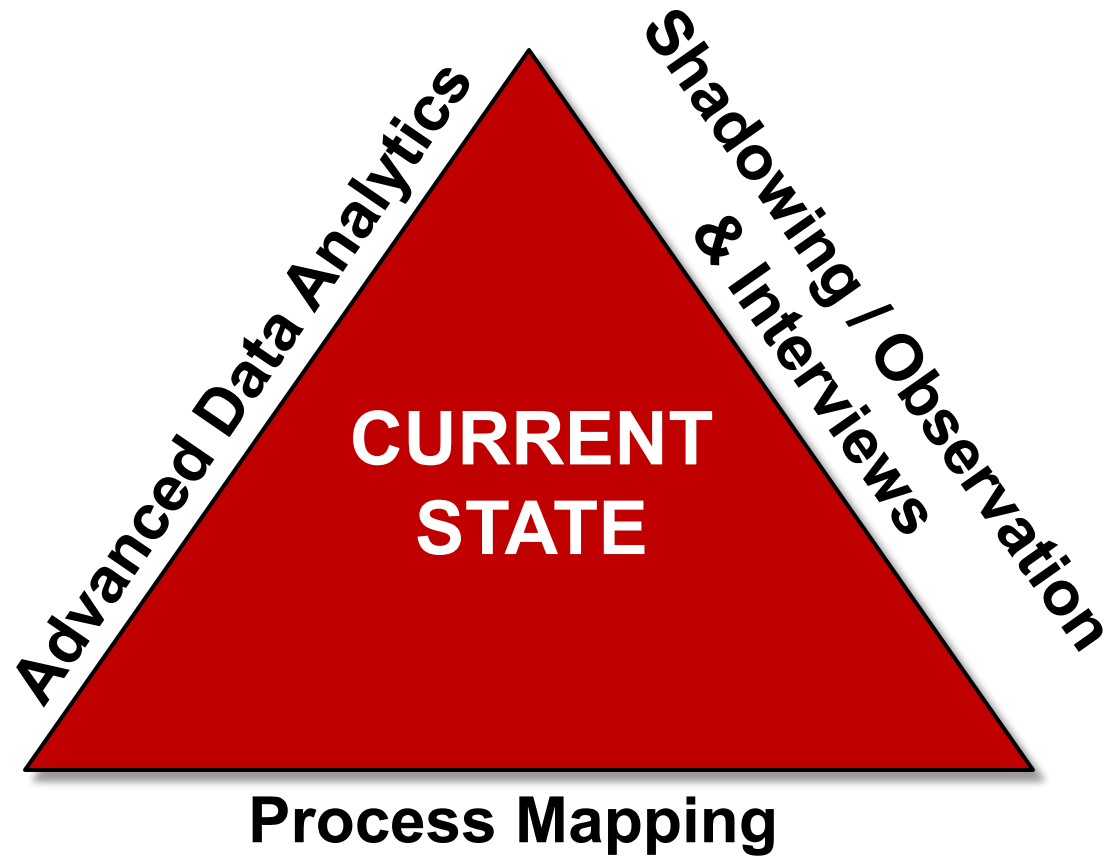
mission

ED Design Concepts

***emergency departments will always
work, no matter how they are
designed***

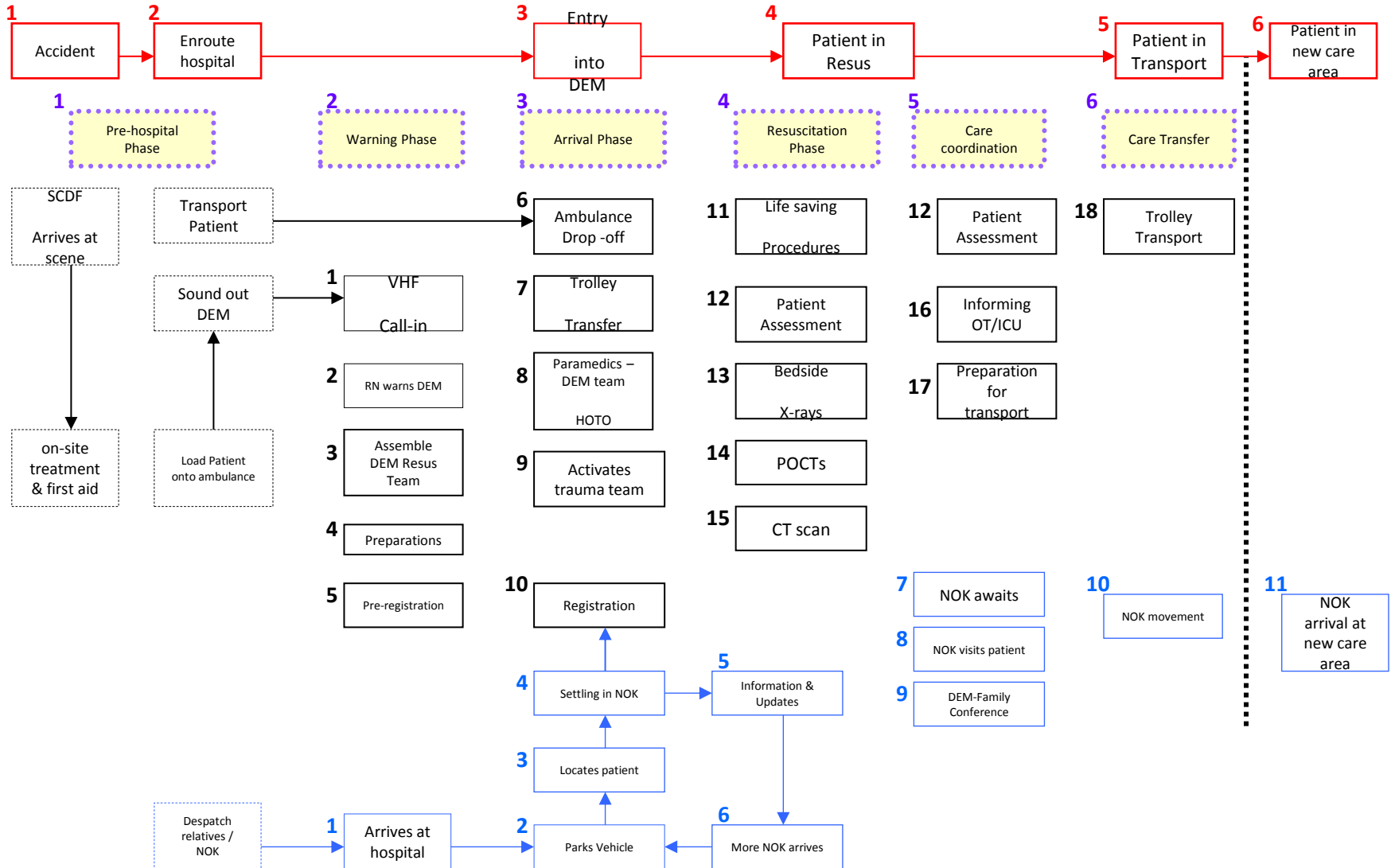
***because the people working in them
make them work!***

Planning a New ED Begins With Understanding How You Operate Today

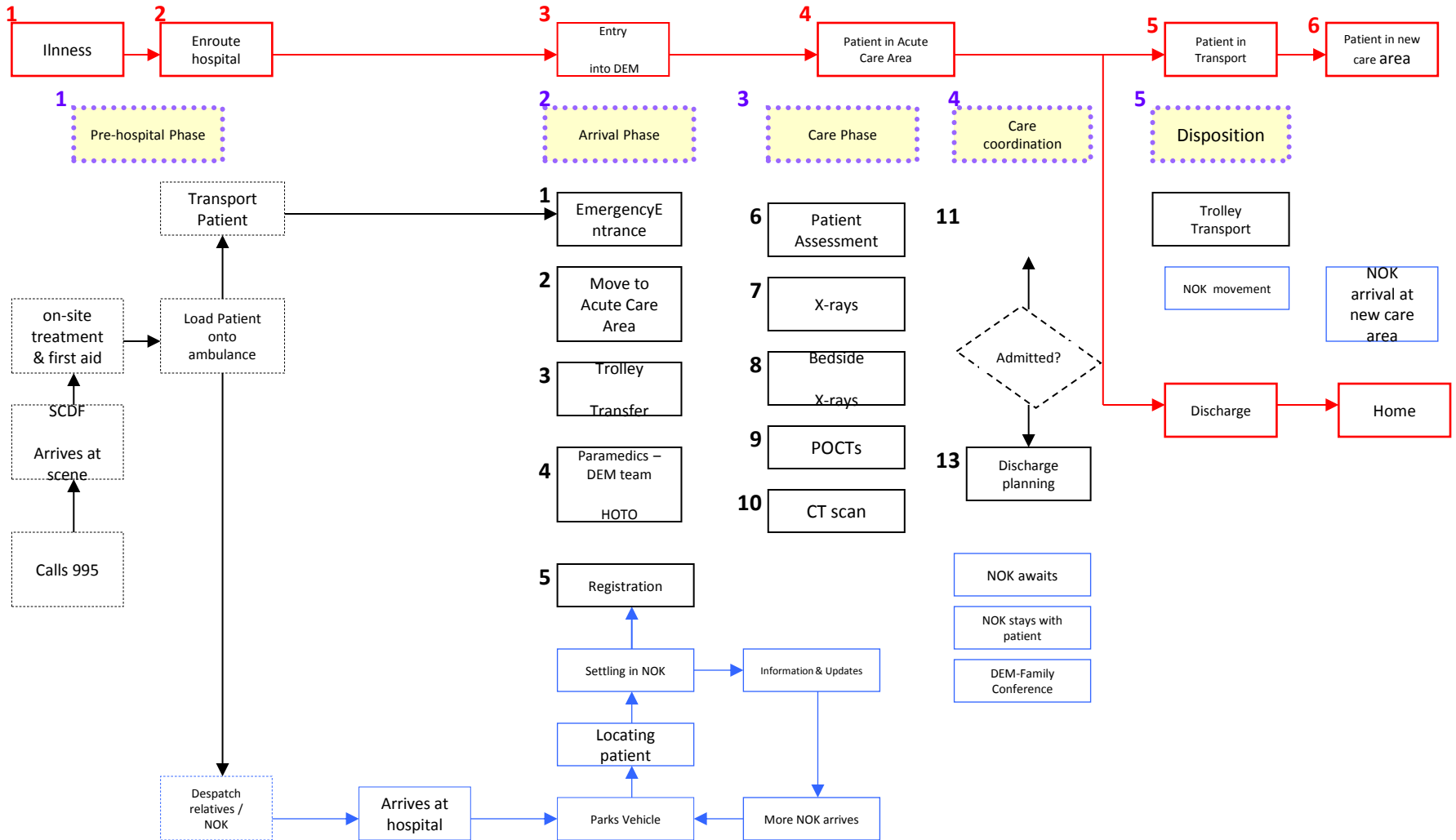




P1 workflow



P2 Flow



Tomorrow's ED Should Be Designed for Patients Not to Wait...

Design for patient turnaround times in minutes...not hours

- ED sized to prevent bottlenecks
- Central registration desk replaced with kiosks and greeters.
- Bedside registration
- Bedside documentation



- **Easy access to ED**
- **Reception close to walk-in entrance**
- **Walk-in entrance away from EMS entrance**

Triage - function, not location



- “Direct bedding” when open treatment stations in ED area
- Focus of patient intake becomes identifying appropriate site of care in ED
- Initiate diagnostics when treatment station not available
- Treat and release low-acuity patients

Space to Support “Self-Service” Activities Such as Kiosk-Based Registration Should Be Planned Into Design

**Case Study: London Health Sciences Centre
London, Ontario, Canada**

Implemented computerized self-registration kiosks in their ED.



Outcomes

- **94% first-time use satisfaction rate (as determined by willingness to use again)**
- **Average intake time: < 5 minutes**

“Treatment Forward” Requires Basic Diagnostics Used By Walk-in Patients Be Positioned at the Front Door

Phlebotomy /
Point-of-Care
Testing

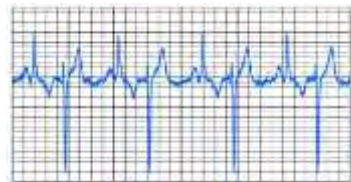


Basic Imaging



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EKG

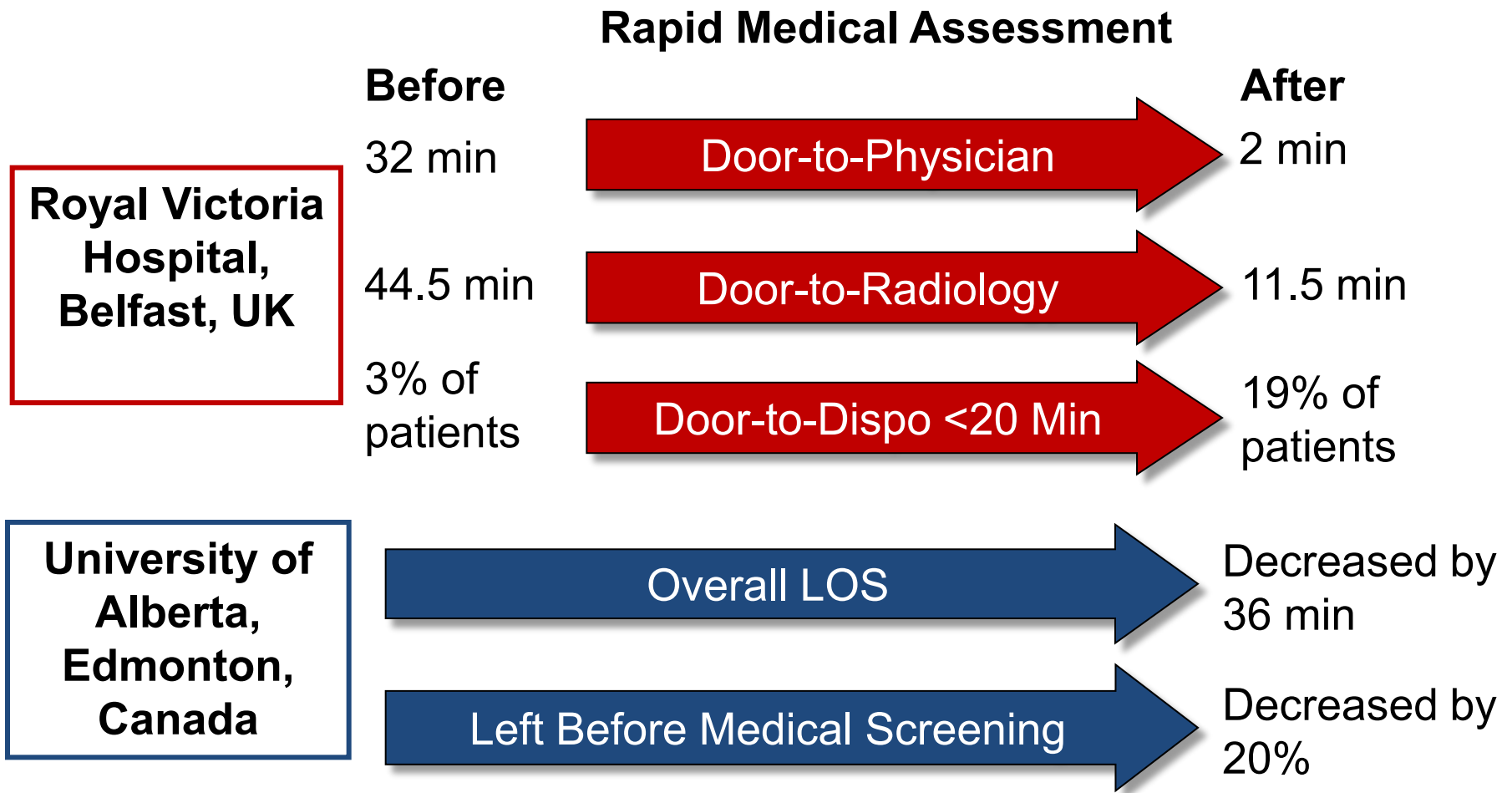


Minor Treatment
Room



The goal of the Treatment Forward model is to reduce arrival-to-physician evaluation time as well as initiating common diagnostics **BEFORE** placing patients in a treatment station.

Early Models of “*Treatment Forward*” have Shown Positive Impact on LOS

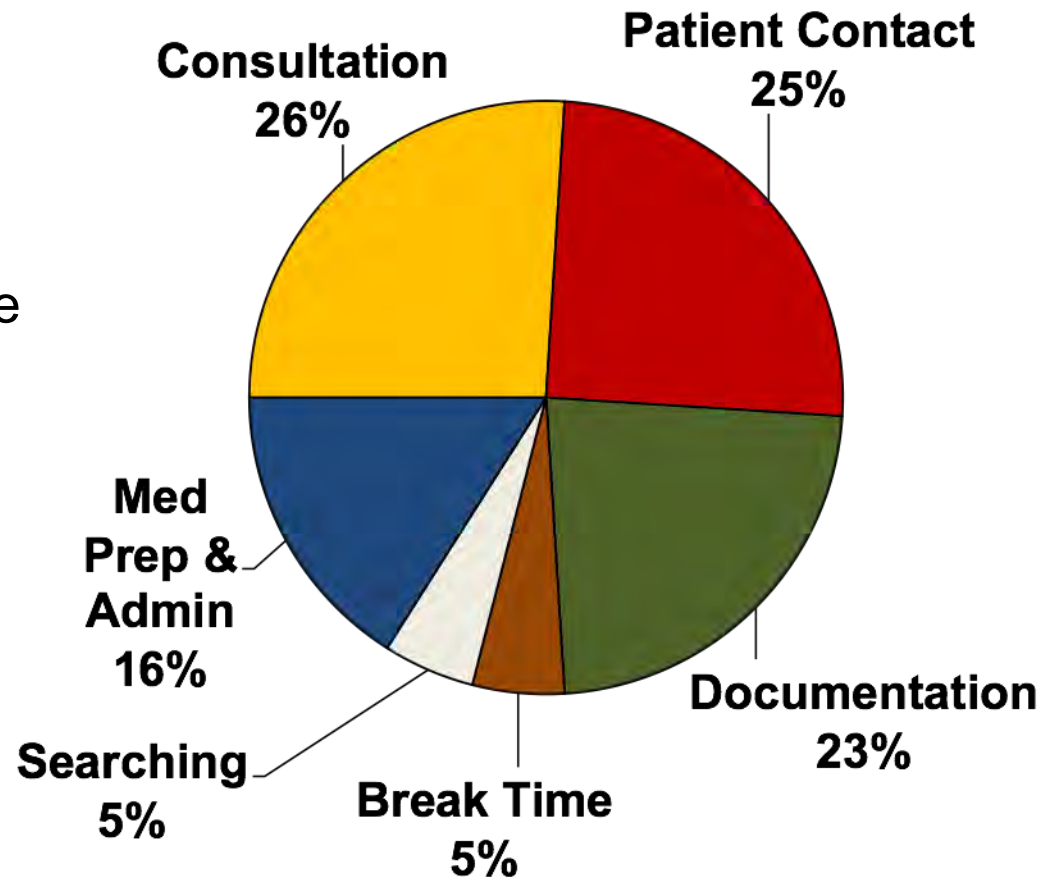


Dispo = disposition; LOS = length of stay.

Nursing Location

Nursing Time Distribution

- 25% of nurses' time is dedicated to direct patient care.
- Nurses experience an average of 5.9 interruptions per hour.
- Hospital design needs to:
 - Reduce walking distance and unnecessary trips
 - Minimize nurses' cognitive breaks and interruptions



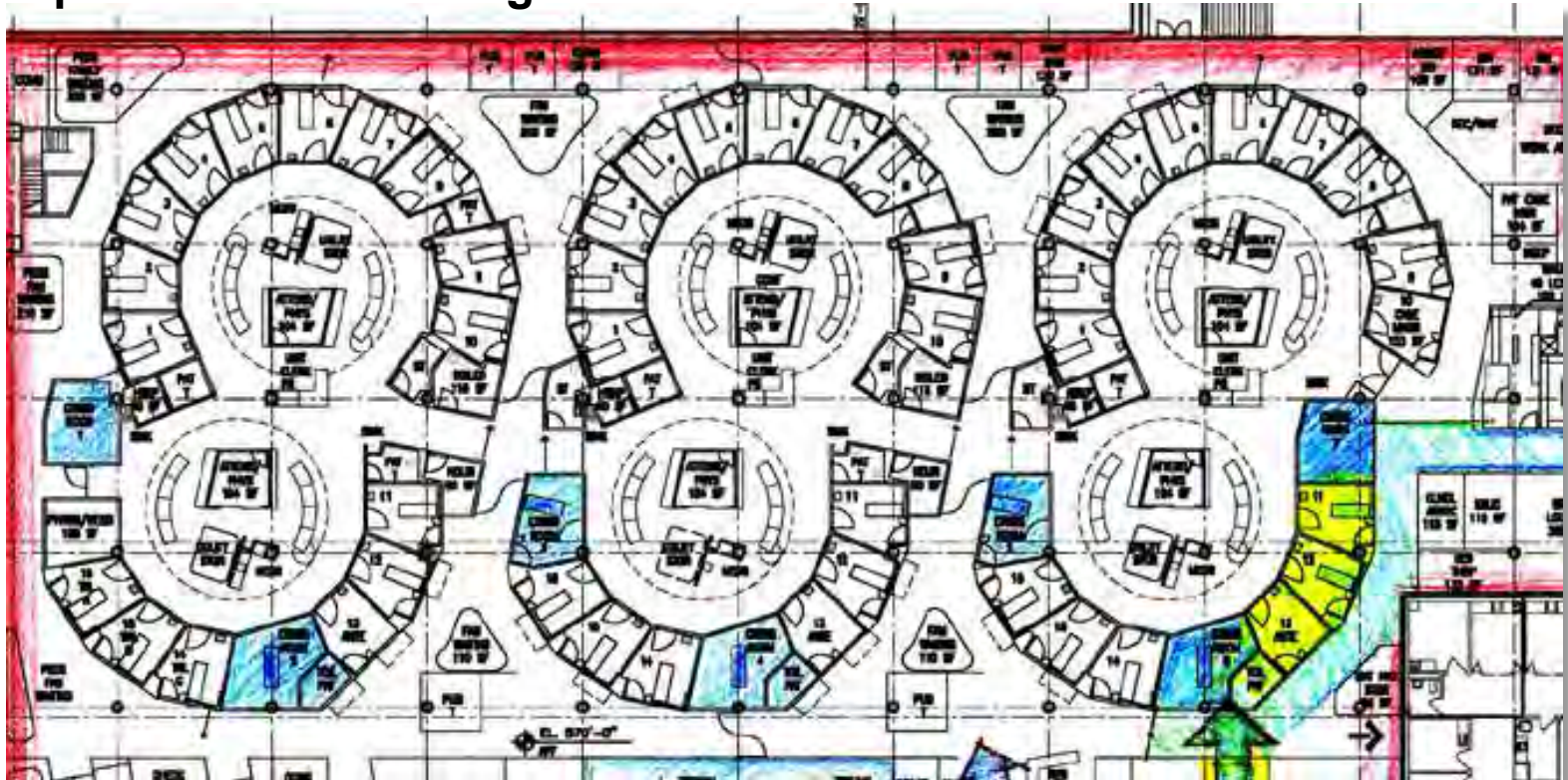
Nurse Station



Decentralized nursing moves clinicians closer to the bedside while maintaining a central station allows ongoing collaboration.

Nursing / Physician Productivity and Patient Safety

Option #1: Pod Configuration



Bringing Care Closer to the Patient Improves Quality, Efficiency



**Point-of-Care
Testing**



Diagnostic Imaging



Equipment / Supplies



**Decentralized
Pharmacy**

Not Every Patient in the ED Requires a Bed for All or Part of Their ED Encounter

Arrival

Triage

Evaluation

Discharge/Transfer

ED Diagnostic Staging Area



- Purpose: Provide alternative holding area for non-emergent patients awaiting lab results.
- Function: Space saved by having patients stay in a chair, not a bed.
- Metrics: Space savings, patient satisfaction
- Facility Implication: Provide dedicated space with comfortable chairs and amenities.
- Staff: Only 1 nurse is necessary to monitor space, depending on size

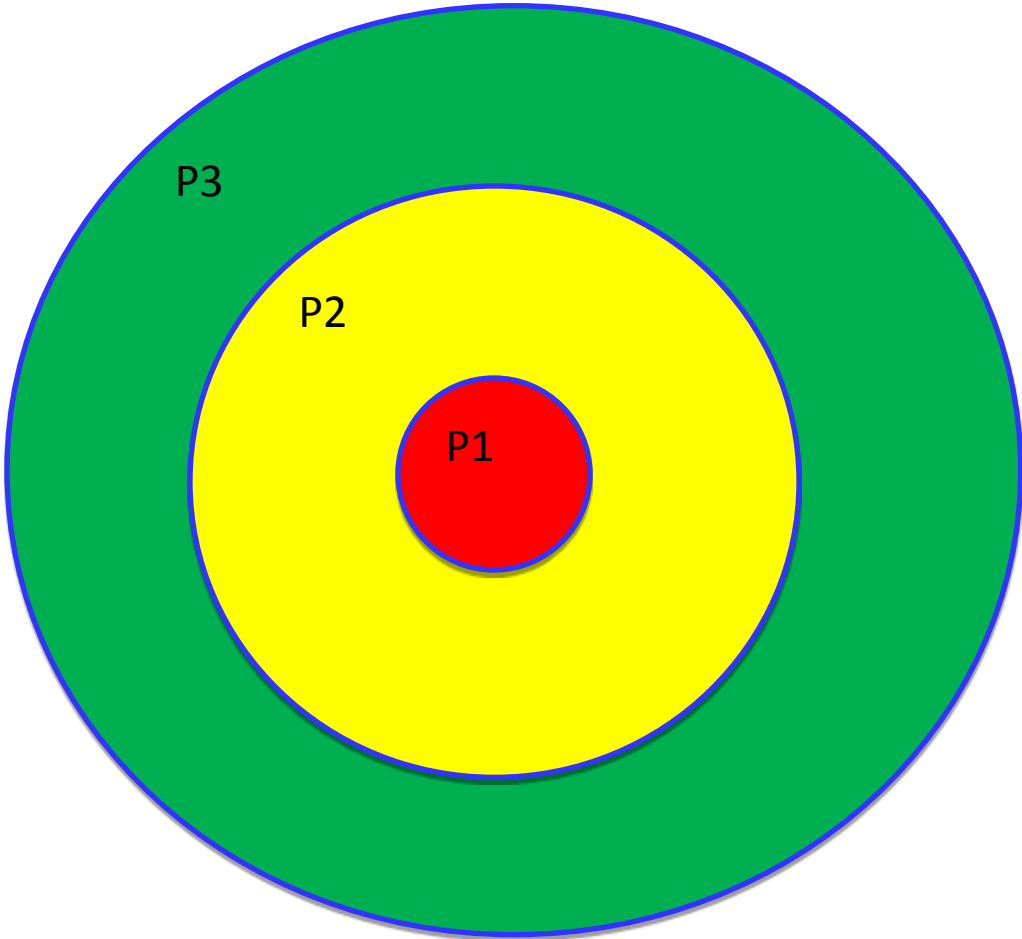
Space for Collaboration Amongst ED Staff, Patients, Other Care Givers Essential and for Teaching

- Private areas for physician or staff consultation with family and patient
- Large single family room replaced with multiple, small consultation stations
- Comfort stations for patient / family access to snacks, blankets, etc.
- Work areas for multidisciplinary clinical teams
- Dedicated space for external consultants
- Staff respite space

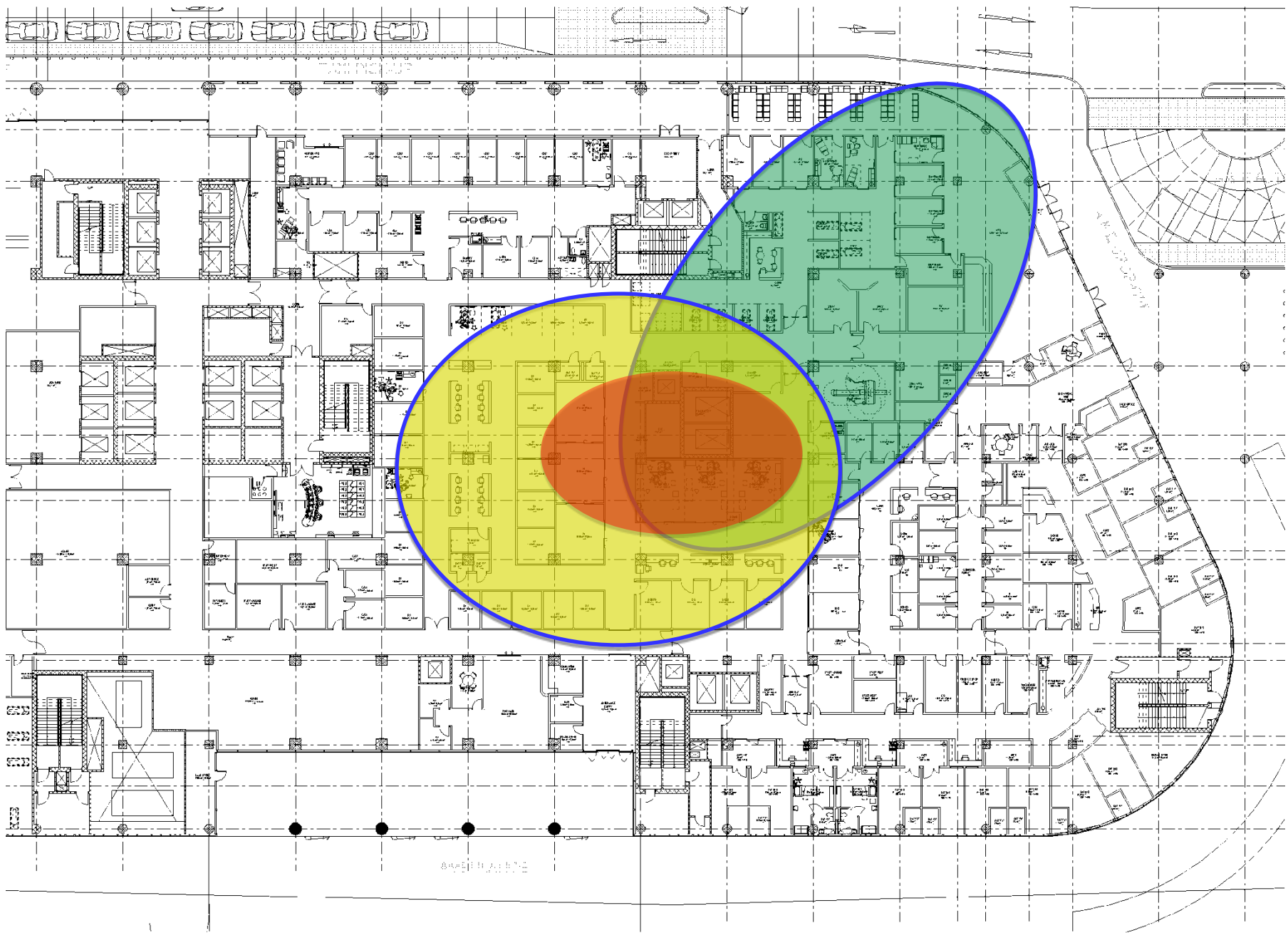


A Healing Environment



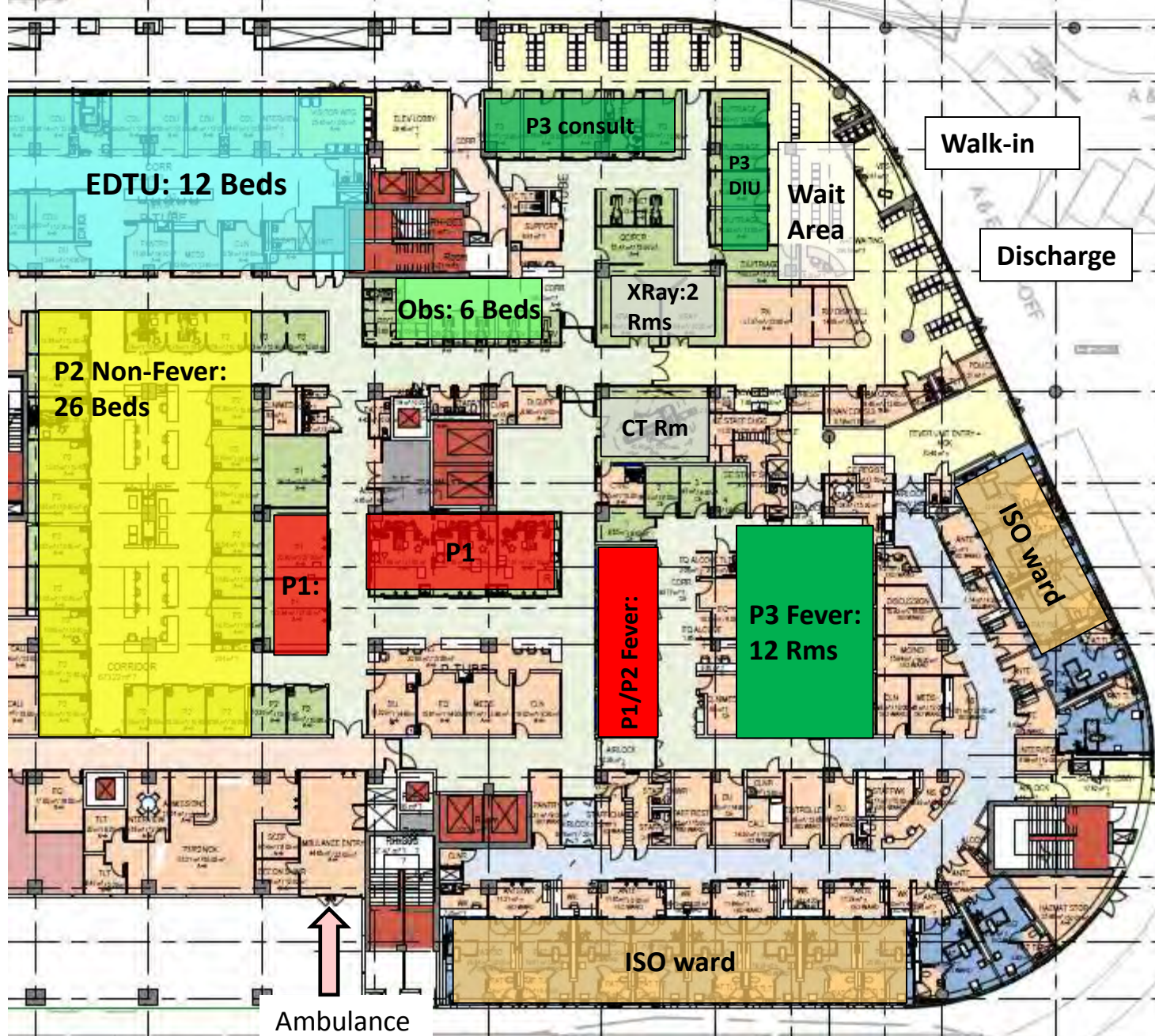


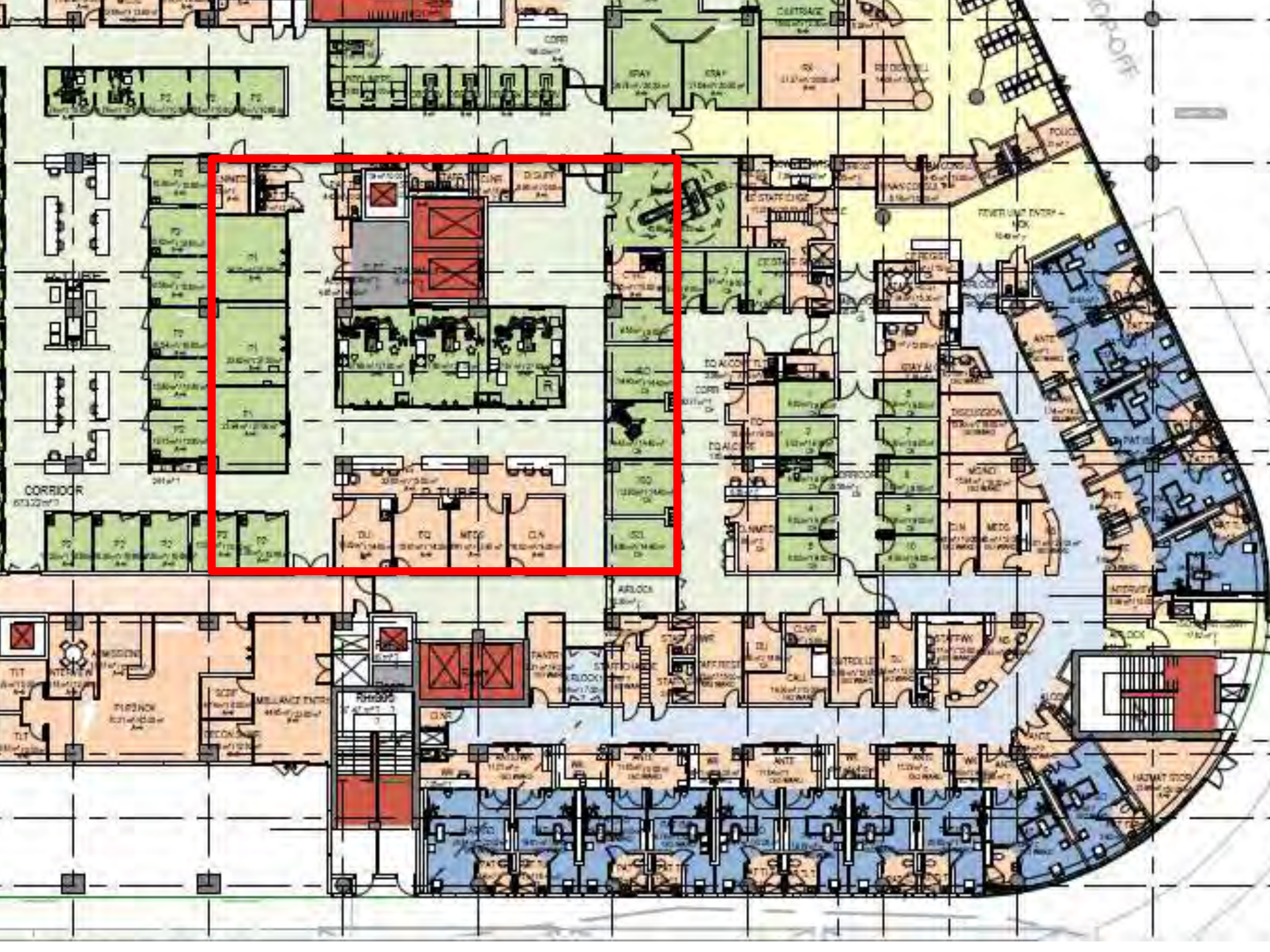




EMD Physical Locations and Layout

1. Triage (Walk-in)
2. Triage (Ambulance)
3. Waiting Area
4. P1 Beds
5. P1/P2 Fever Rooms
6. P2 Beds
7. P1/P2 Flex Trolley Beds
8. P3 Fever Rooms
9. P3 Consultation Rooms
10. P3 Observation Beds
11. P3 DIU Consultation Rooms
12. EDU
13. P1 Mounted XRay
14. ED XRay Room
15. ED Portable XRay
16. ED CT Room





Hospital H2P Event

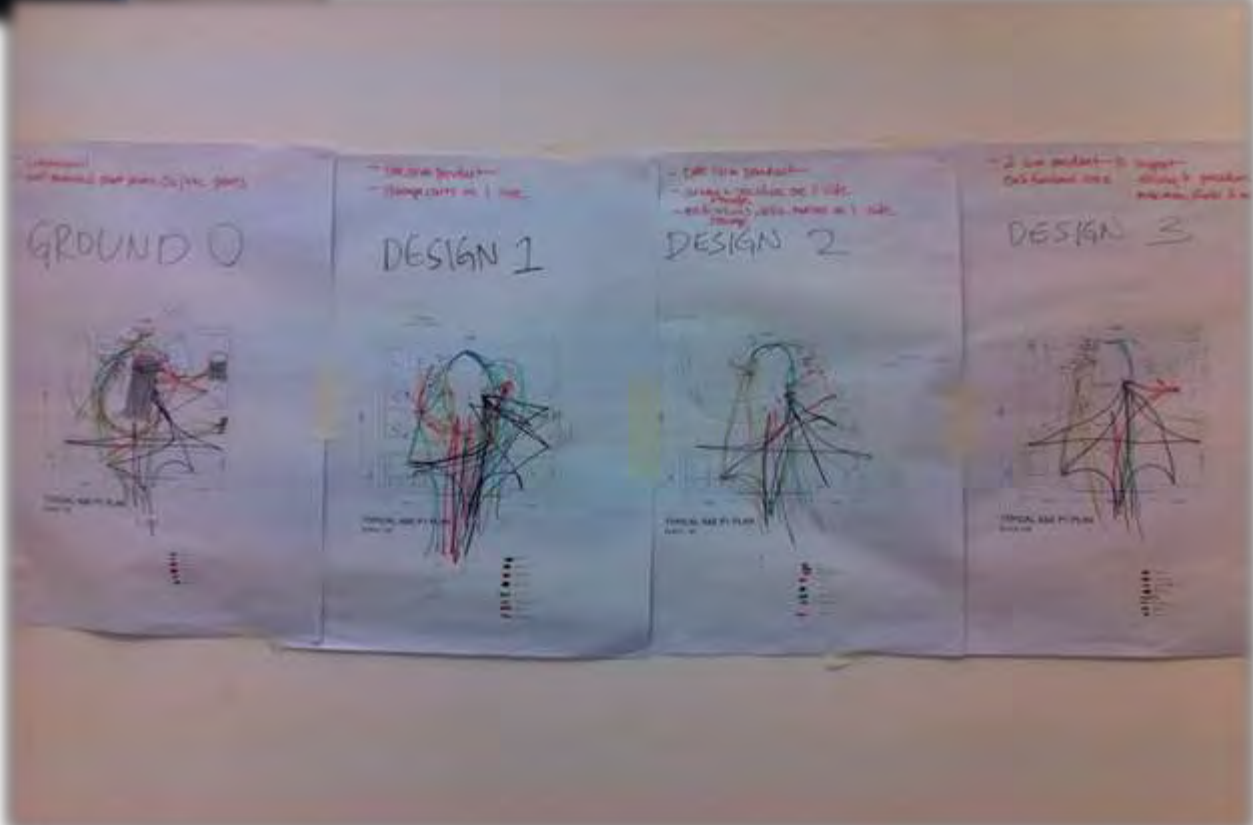


Presentation on Healthcare Preparation Process (H2P) using the Mock-Ups

"Where it all starts, it all is better light into the hospital design, systems and processes"

John Lim and Health Planning Director

Handwritten notes on a sticky note, including a list of items and a date: 11/11/2014





Yellow cabinet with four compartments. The top-left compartment contains a small screen displaying a waveform. The other three compartments have handwritten notes on them.



Medical equipment including a monitor on a stand, a grey cart with drawers, and a white bag with a monitor. A large table with data is pinned to the wall.

| Category | 1 | 2 | 3 | 4 | 5 |
|-------------|---|---|---|---|---|
| Category 1 | 2 | 3 | 4 | 2 | |
| Category 2 | 2 | 2 | 4 | 4 | |
| Category 3 | 3 | 3 | 3 | 4 | |
| Category 4 | 3 | 2 | 6 | 4 | |
| Category 5 | 4 | 3 | 3 | 4 | |
| Category 6 | 4 | 3 | 3 | 4 | |
| Category 7 | 4 | 3 | 3 | 4 | |
| Category 8 | 4 | 3 | 3 | 4 | |
| Category 9 | 4 | 3 | 3 | 4 | |
| Category 10 | 4 | 3 | 3 | 4 | |

SPACE OPTIMIZATION

Before 16.8 m²

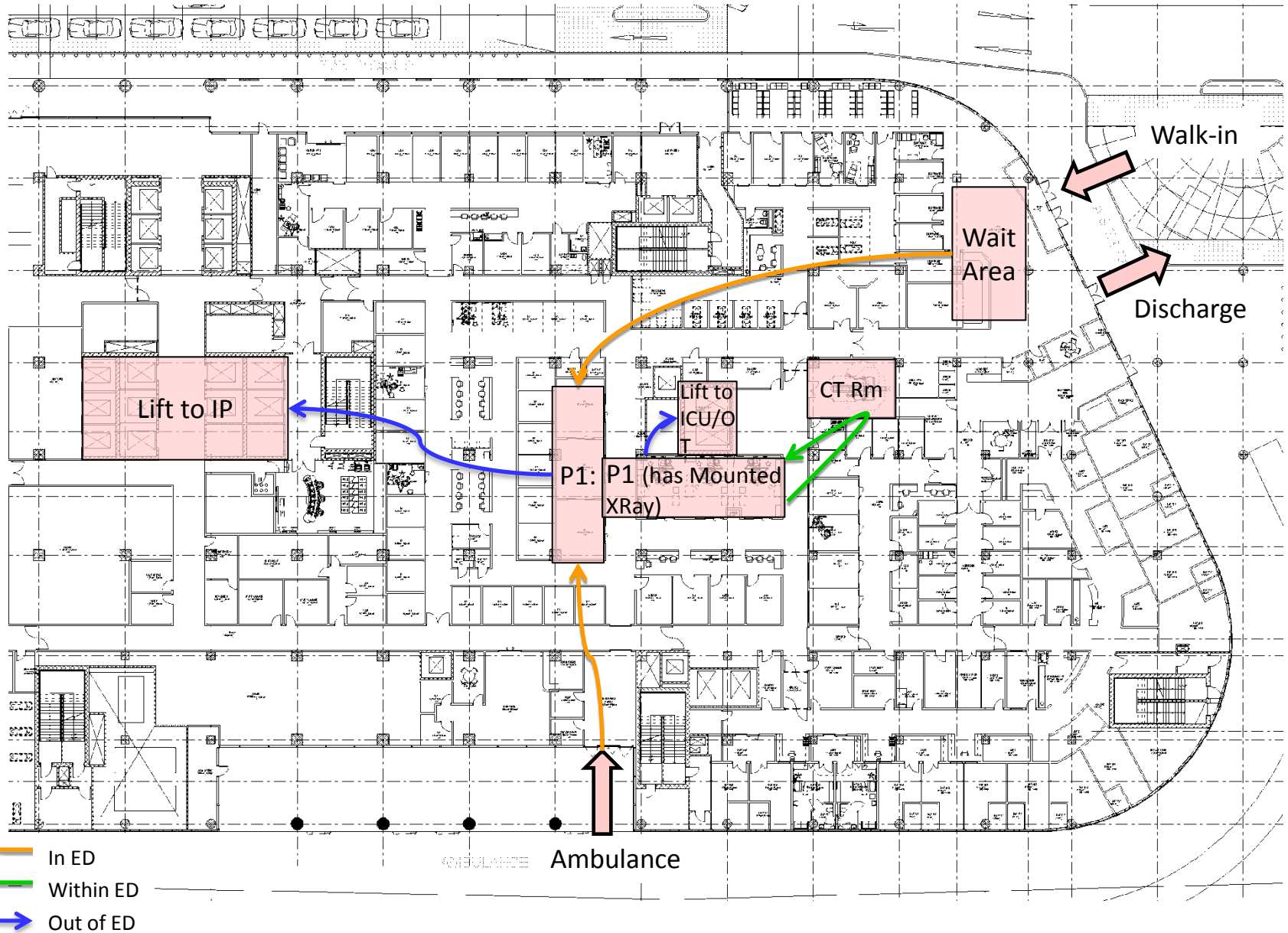
After 19.4 m²

Increased 17%

Red 'X' marking on the floor.



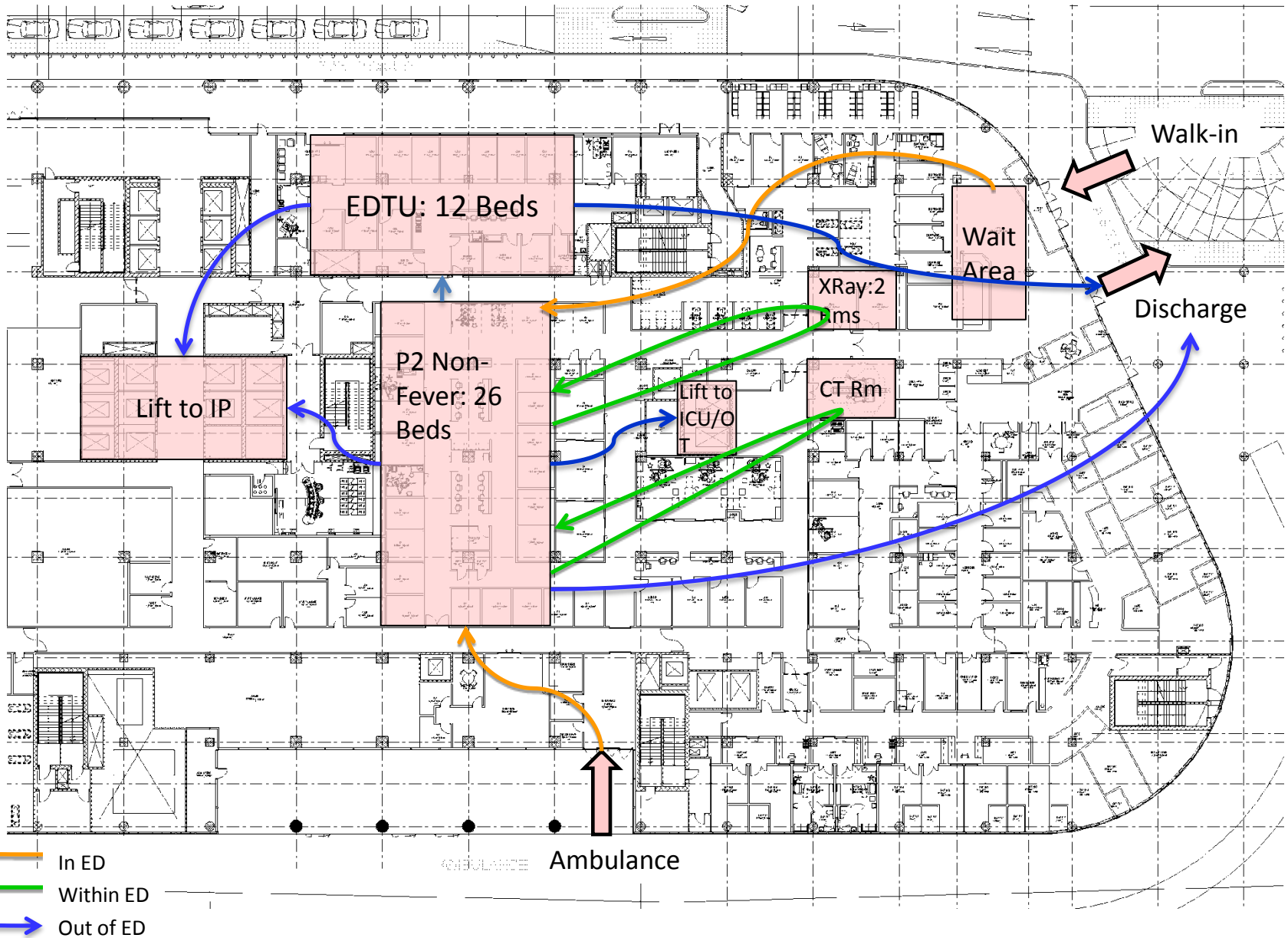
Spaghetti diagram of patient Flow



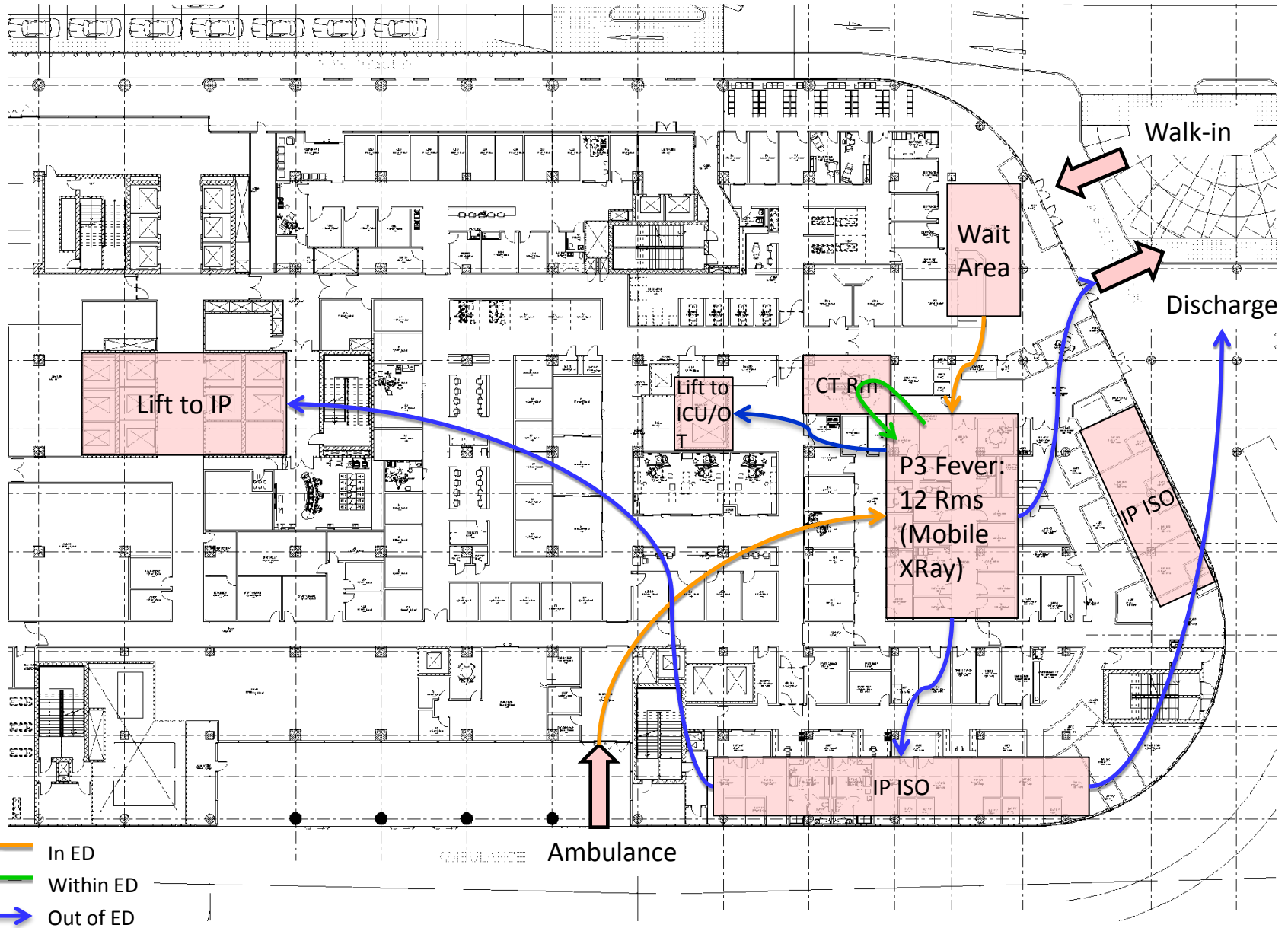




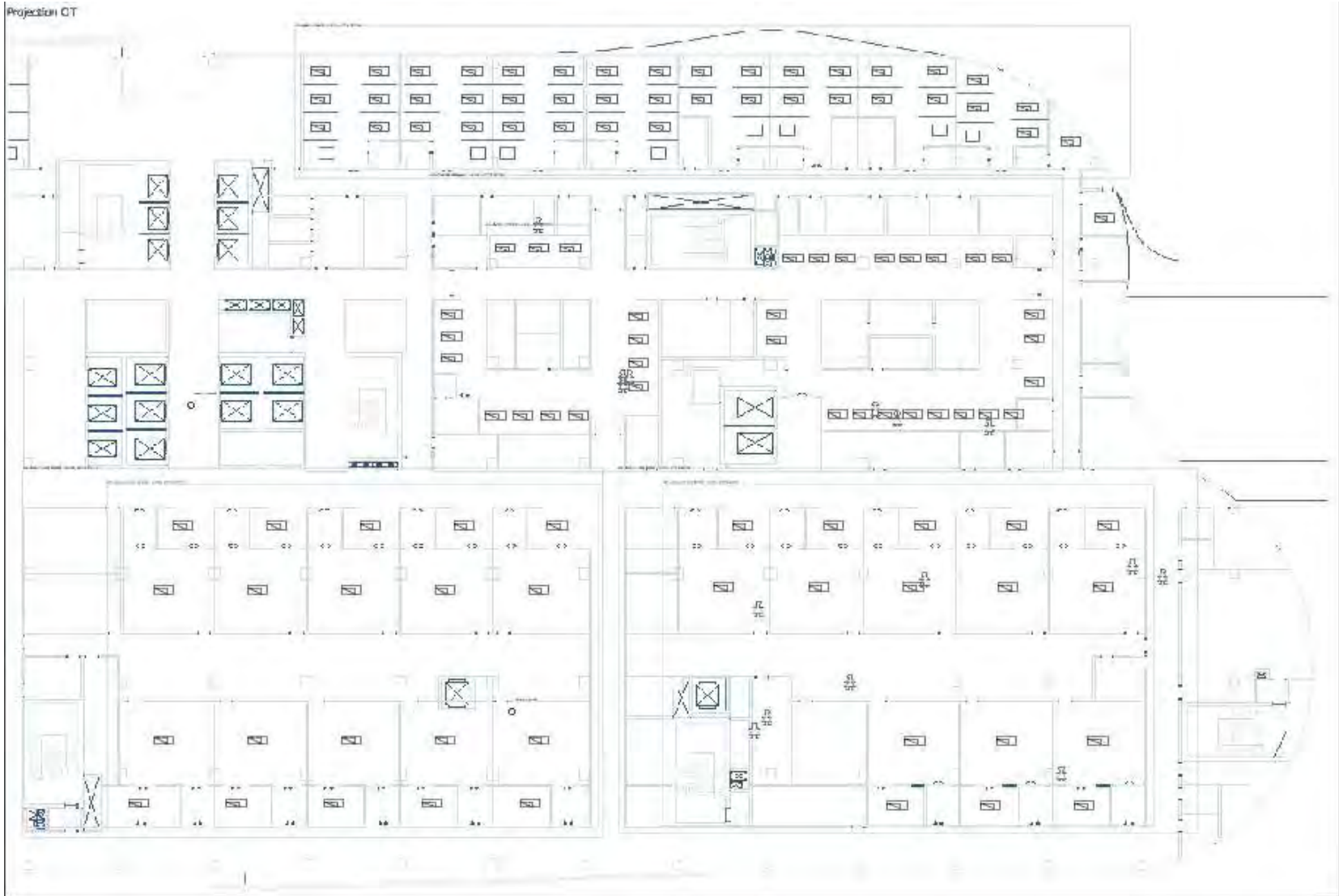
Spaghetti diagram of patient Flow



Spaghetti diagram of patient Flow



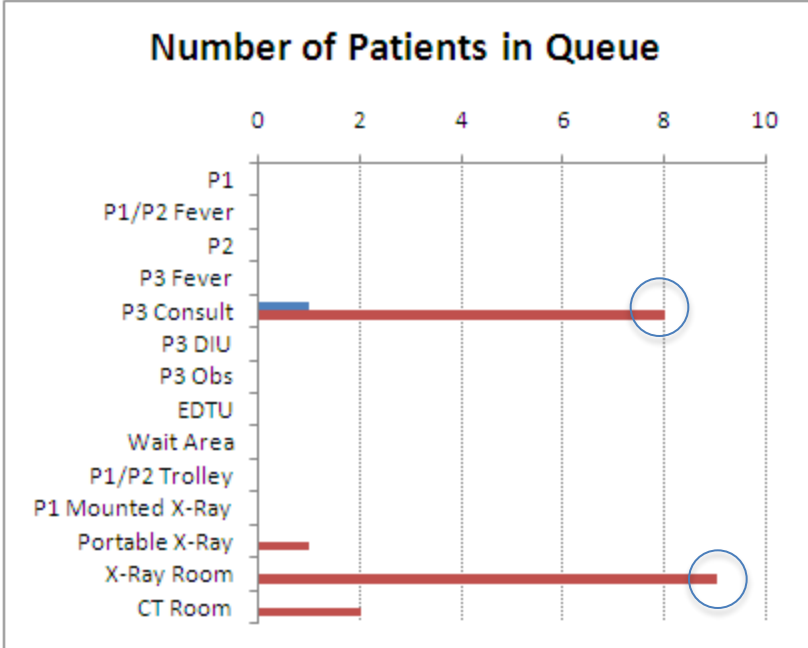
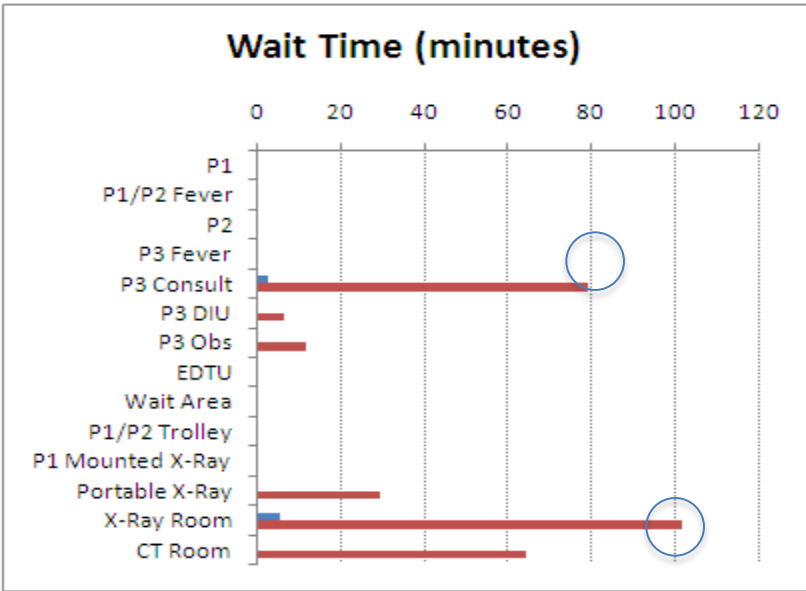
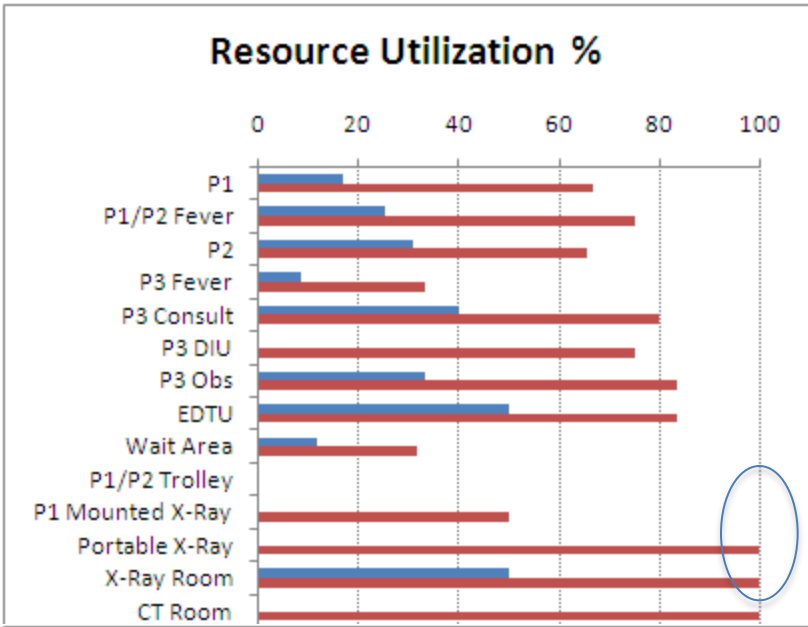
ED Simulation



Objective of ED Simulation Model

- Assess the planned sizing adequacy of various infrastructure facilities within a hospital's ED based on
 - Design plans
 - Local patient arrival patterns by PACS and hour of day
 - Local clinical protocols
 - Local work flow processes
- Model output deliverables
 - Utilization rates
 - Waiting time
 - Queue length
- Model scenarios
 - Annual attendance of 104,000
 - Annual attendance of 122,000
 - Annual attendance of 165,000

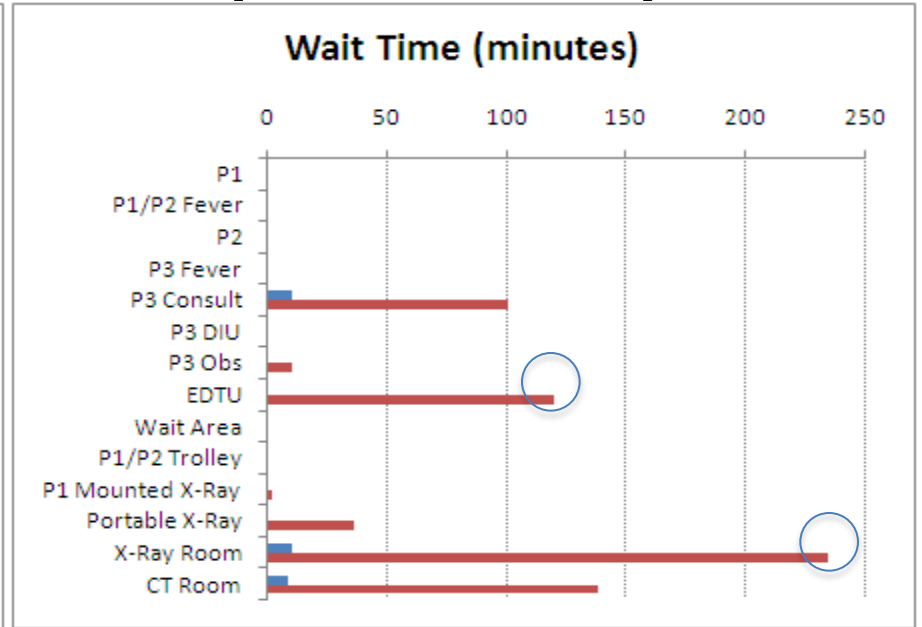
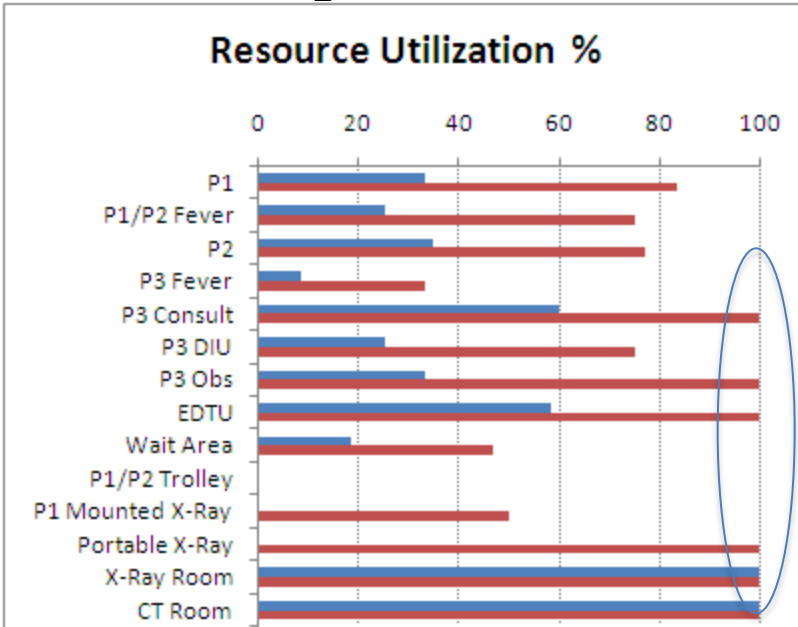
Base Scenario Yr 2009 (100,000)



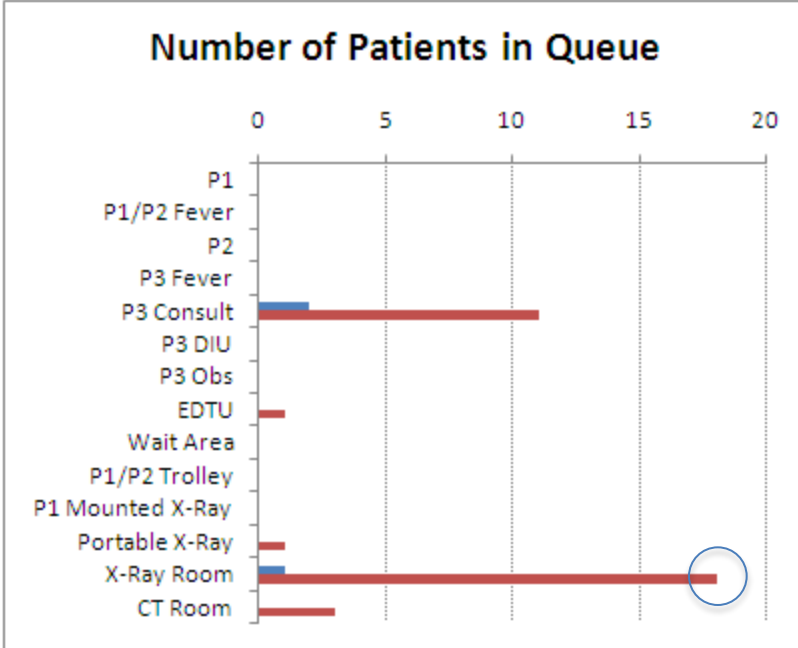
■ Median ■ 95th Percentile

- The highly utilized resources are :
- P3 Consult Rooms
 - P3 DIU Rooms
 - Observation Bay
 - Portable X-Ray at Fever Area
 - X-Ray Rooms
 - CT Rooms

Projected Yr 2015 (120,000)



■ Median ■ 95th Percentile

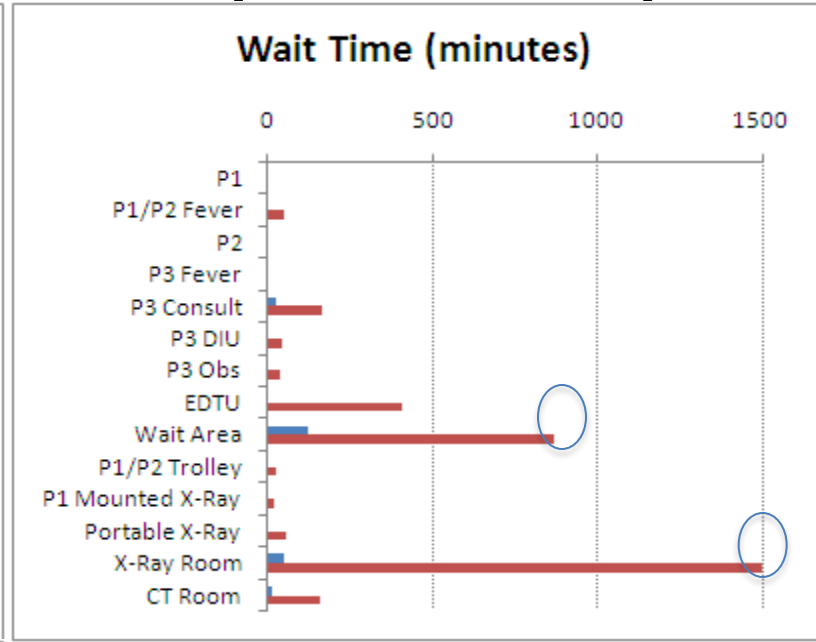
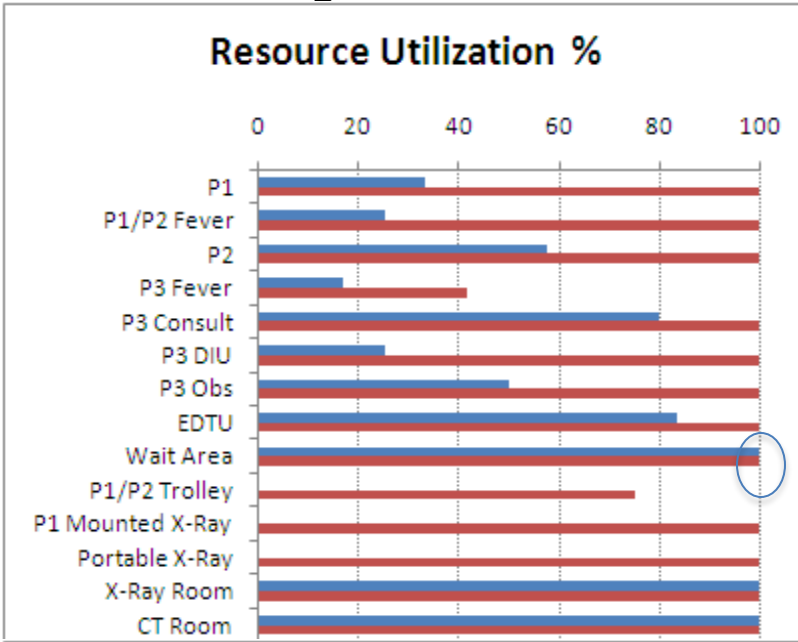


Locations that experience high utilization levels in 2009 are even more congested in 2015, especially:

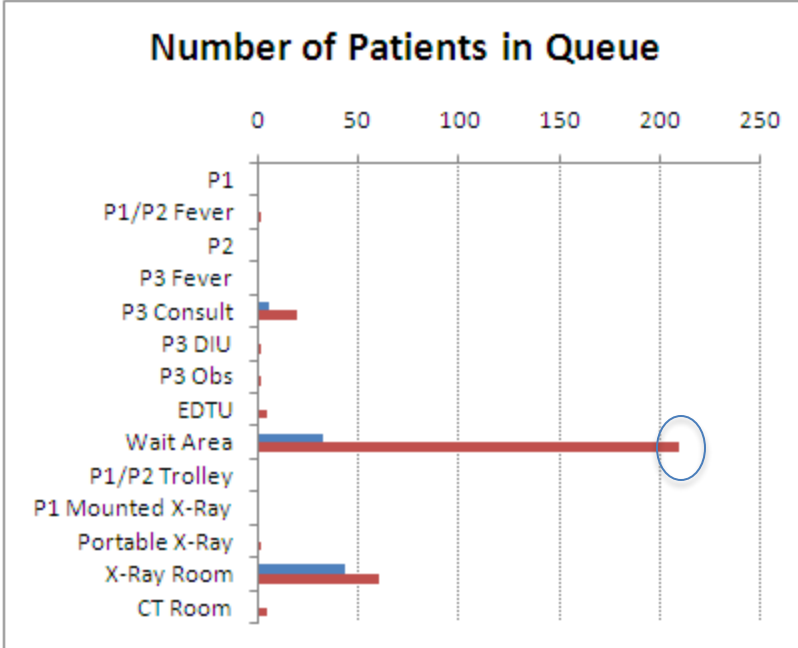
- P3 Consult Rooms
- P3 DIU Rooms
- Observation Bay
- Portable X-Ray at Fever Area
- X-Ray Rooms
- CT Rooms

In addition, **EDTU** capacity will also be stretched.

Projected Yr 2020 (160,000)



■ Median ■ 95th Percentile



Almost all resources are highly utilized.

P1 and P2 beds are so highly utilized that there is a need to double park (using P1/P2 trolley beds) 75% of the time.

The reason for high utilization of Wait Area is caused by P3 waiting for X-Ray Room and CT Room.

Patients can wait up to 25 hours for X-Ray Room!

Planning the Future





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Age-related decline in color perception and difficulties with daily activities—measurement, questionnaire, optical and computer-graphics simulation studies

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Received 19 March 1999; revised 8 November 1999; accepted 21 June 2000 Available online 21 August 2001.

Abstract

In aging societies, the age-related decline in visual ability is a particularly important problem. To identify problems in daily living caused by this decline in visual ability, we simulated vision in the elderly using yellowed lenses. A questionnaire study was then conducted to investigate the population and age group that has visual deficits about issues identified in the optical study. Subjective responses related to people over 75 years old. A color judgment experiment was carried out using subjects aged 80 or older. Confused colors were yellow/white, blue/green, dark blue/black and purple/dark red. Based on this color confusion data, we used computer graphics to simulate the vision of the elderly. Simulated views of public signs are shown.

Relevance to industry

This study shows what colors tend to be confused by the elderly and provides essential data for developing products. Color combinations on interfaces such as switches, indicators and displays have to be considered carefully. Optical simulation of the yellowed vision of the elderly based on color tests are powerful tools for improvement through experience.

Author Keywords: Vision in the elderly; Decline in vision; Simulation; Improvements for the elderly; Older adults



Scientists Design 24-Hour Lighting Scheme for the Elderly

Working with the American Institute of Architects, the LRC proposed a 24-hour lighting scheme for older adults that can positively impact the aging visual, circadian, and perceptual systems. The proposed lighting scheme was designed to provide:

- high circadian stimulation (CS) during the day and low stimulation at night
- good visual conditions during waking hours, and
- night lights that provide perceptual cues to increase postural control and stability.

High CS by light can be achieved by providing at least 400 lx at the cornea of a circadian-effective white light source (i.e., more short-wavelength energy) during the daytime. Light levels recommended in the study were high enough and long enough to assure an effect on the circadian system of older adults, based on a model of human circadian phototransduction by Rea and colleagues (2005).

The recommended dose also considers the normal changes to the aging eye and was based on estimated melatonin suppression as a function of CS after one hour exposure.

No more than 100 lx at the cornea of a less circadian-effective white light source (i.e., less short wavelength energy), such as a 2700 K lamp, is recommended for evening hours.

A proposed 24 h lighting scheme for older adults

MG Figueira

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Abstract

Alzheimer's disease (AD) patients exhibit random patterns of rest and activity rather than the consolidated sleep/wake cycle found in normal, older people. Light treatment has been shown to improve rest and activity rhythms and sleep efficiency of AD patients, presumably through consolidation of their circadian rhythms. The circadian system is maximally sensitive to short-wavelength radiation. Two independent studies summarized here show that 30 lux at the cornea of blue light ($\lambda_{max} = 470 \text{ nm}$) from light emitting diodes (LEDs) for 2 h in the early evening improved sleep efficiency of older adults, including those with AD compared to exposure to the same dose of red light. Because compliance to blue light treatment may be difficult for adults with AD, we conceived of a lighting scheme that might be more practical and as effective. White light dosages of different spectra and amounts for night and for day, based on a computational model for human circadian phototransduction, might be more readily accepted by seniors and by their caregivers. Implications for an improved visual environment and for better sleep efficiency of older adults are discussed.



Places of Wellbeing : Light & Health Q&A: Rosalyn Cama

POSTED BY URBAN CHOREOGRAPHY · 19/05/2011 · LEAVE A COMMENT

FILED UNDER : CAMA, HEALTHCARE, INTERIOR DESIGN, LIGHTFAIR, LIGHTING, ROSALYN CAMA, SAFETY

By Susan S. Szenasy in METROPOLIS MAG.COM



When I heard that Rosalyn Cama, principal of the New Haven firm, CAMA, Inc., was about to speak at Lightfair (Philadelphia, May 17-19) I jumped at the chance to engage her in conversation about the relationship of light and health. My motivation was strictly personal. I've spent enough time in hospitals, both as a patient and frequent visitor, to know the dismal conditions in these sealed, dank, germ-ridden buildings where you go to get cured of what ails you, and can come away with some bug or another. And as someone who spends too much time staring at computer screens in darkened rooms and whose every cell is screaming for sunlight and fresh air, I, personally wanted to take advantage of Ros' special learning as an interior designer, researcher, and consultant in the healthcare field (she is the author of *Evidence-Based Healthcare*

Design, John Wiley & Sons, 2009). Hospitals, as I see them, are the extreme environments of our times. If we solve some of our health, safety, and welfare problems in these places we can begin to understand what it takes to design all kinds of healthy interiors. Here Ros talks about why lighting design is key to human health.





Issue Paper #4
January 2007

Sound Control for Improved Outcomes in Healthcare Settings

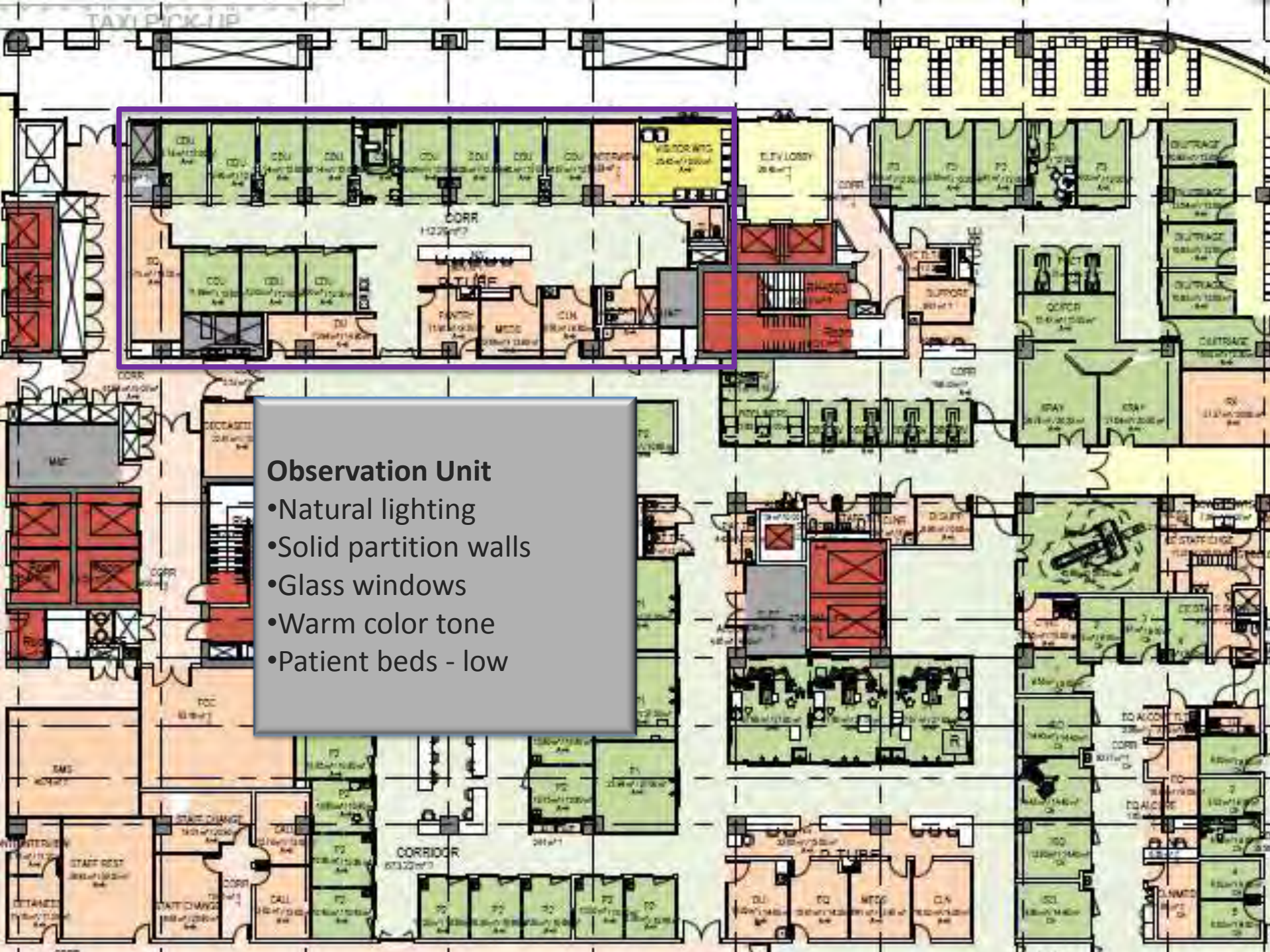
**Anjali Joseph, Ph.D., Director of Research,
The Center for Health Design**

**Roger Ulrich, Ph.D., Professor, Center for Health
Systems and Design, Texas A&M University**

**This paper was funded by a grant from the
Robert Wood Johnson Foundation.**

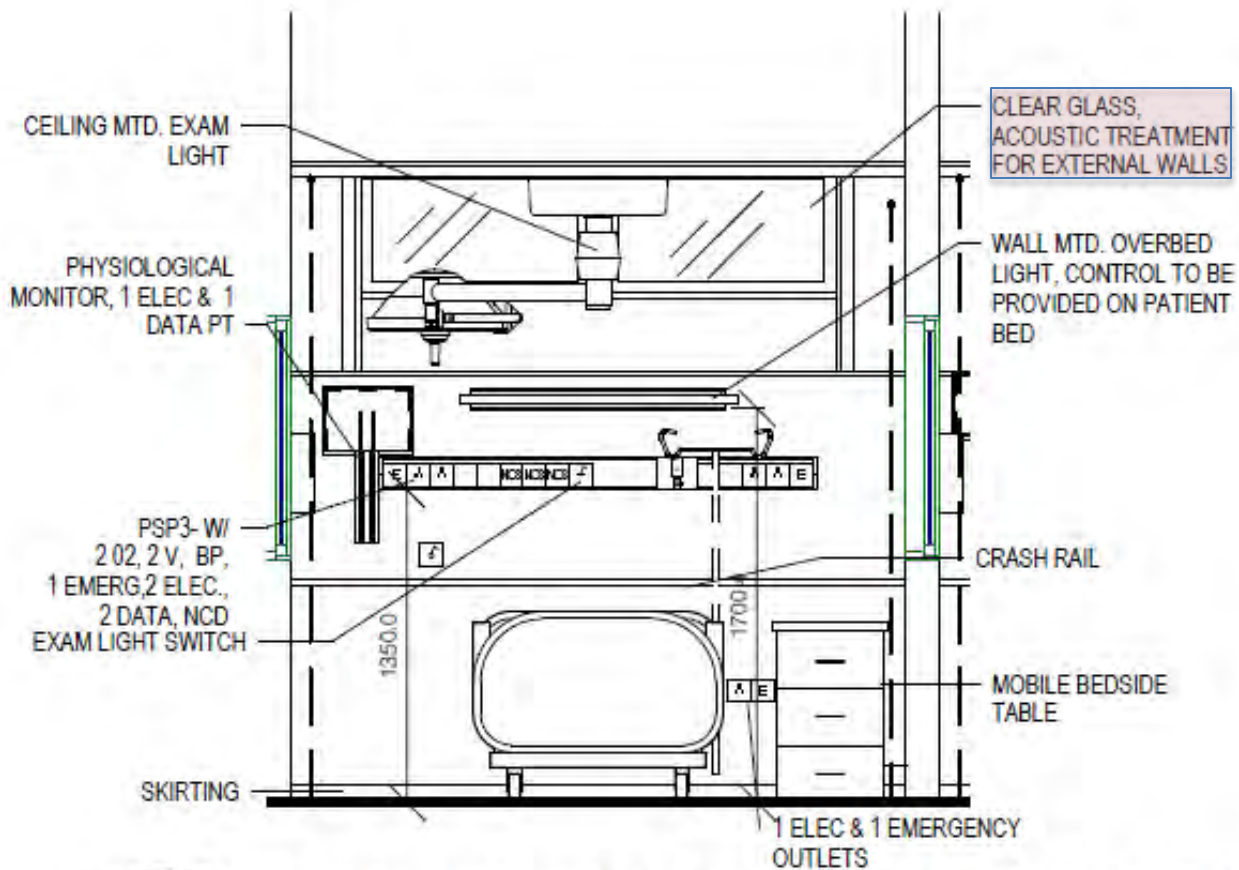
Features of Geriatric Friendly ED

| Structural modification | Goal |
|---|--|
| Sky or ceiling lights or diurnal lighting changes | Reduce risk of delirium by use of natural lighting |
| Sound proof curtain | Reduce risk of delirium by decreasing extraneous noise, improve privacy |
| Rubber mats, non skid floor surfaces Grab bars and ramps (for wheelchair) Stable furniture Clear walkway Good lighting Bedside commode and urinal | Reduce risks of falling |
| Comfortable ambient temperature | Improve patient comfort |
| Reclining chair, Comfortable chairs with armrest Padded or lined trolleys, pressure reducing mattress | Improve patient comfort Reduce pressure ulcers |
| Large faced clocks, boards with names of hospital and clinical staff Simple and easily readable signage | Reminder to improve patient orientation Reduce risk of delirium |
| Examination room that has big enough door and space to accommodate wheelchair and walking devices Available stool for elderly patient to step on to get onto the examination trolley | For ease of transfer and examination of elderly |
| Hearing assistance or amplifying devices | Improve communication for those with hearing impairment |
| Visual aids (eg magnifying glasses, fluorescent tapes on call bells , telephones with large keyboard) | Visual support for visually impaired patients Reduced risk for delirium |



Observation Unit

- Natural lighting
- Solid partition walls
- Glass windows
- Warm color tone
- Patient beds - low



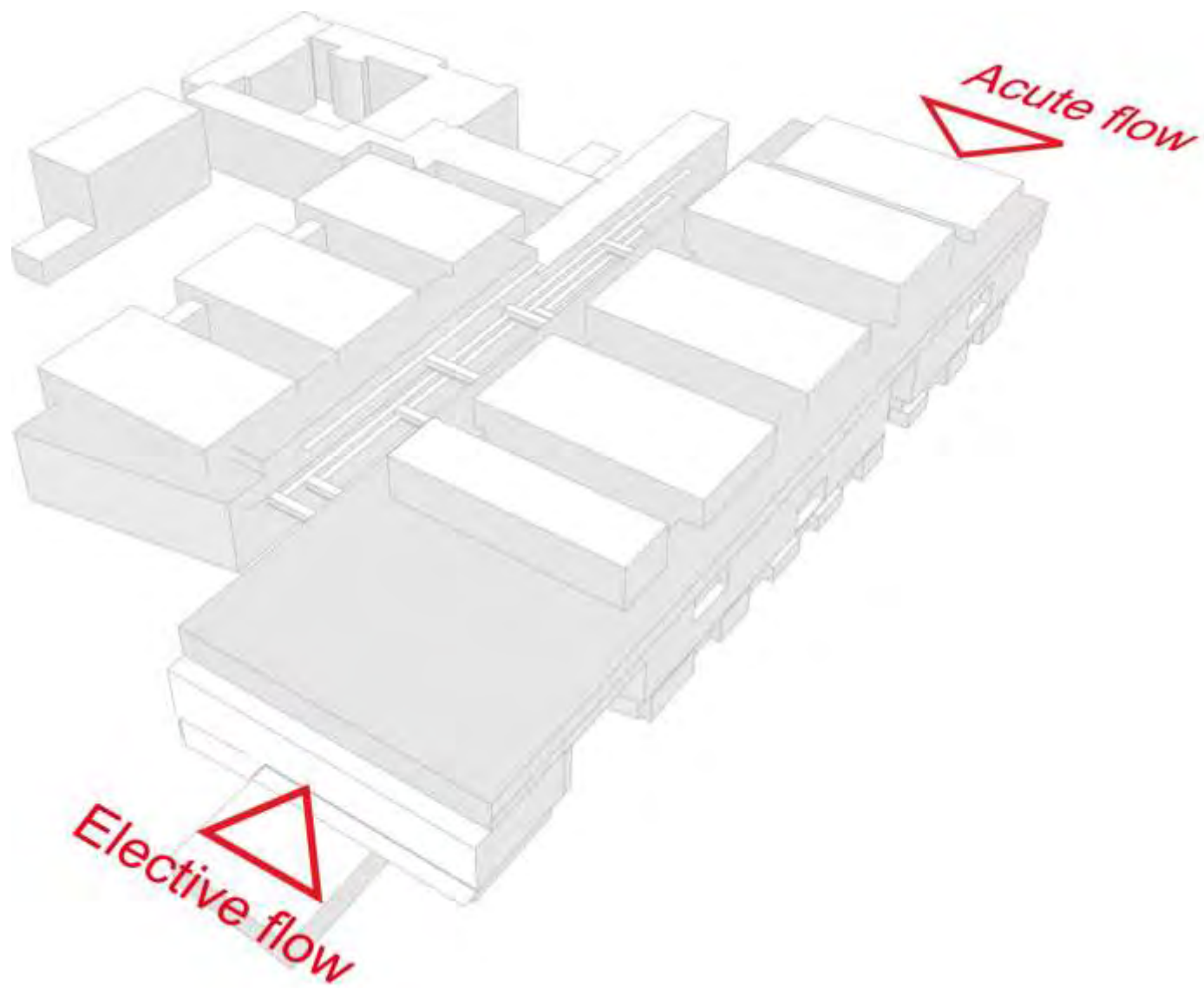
2

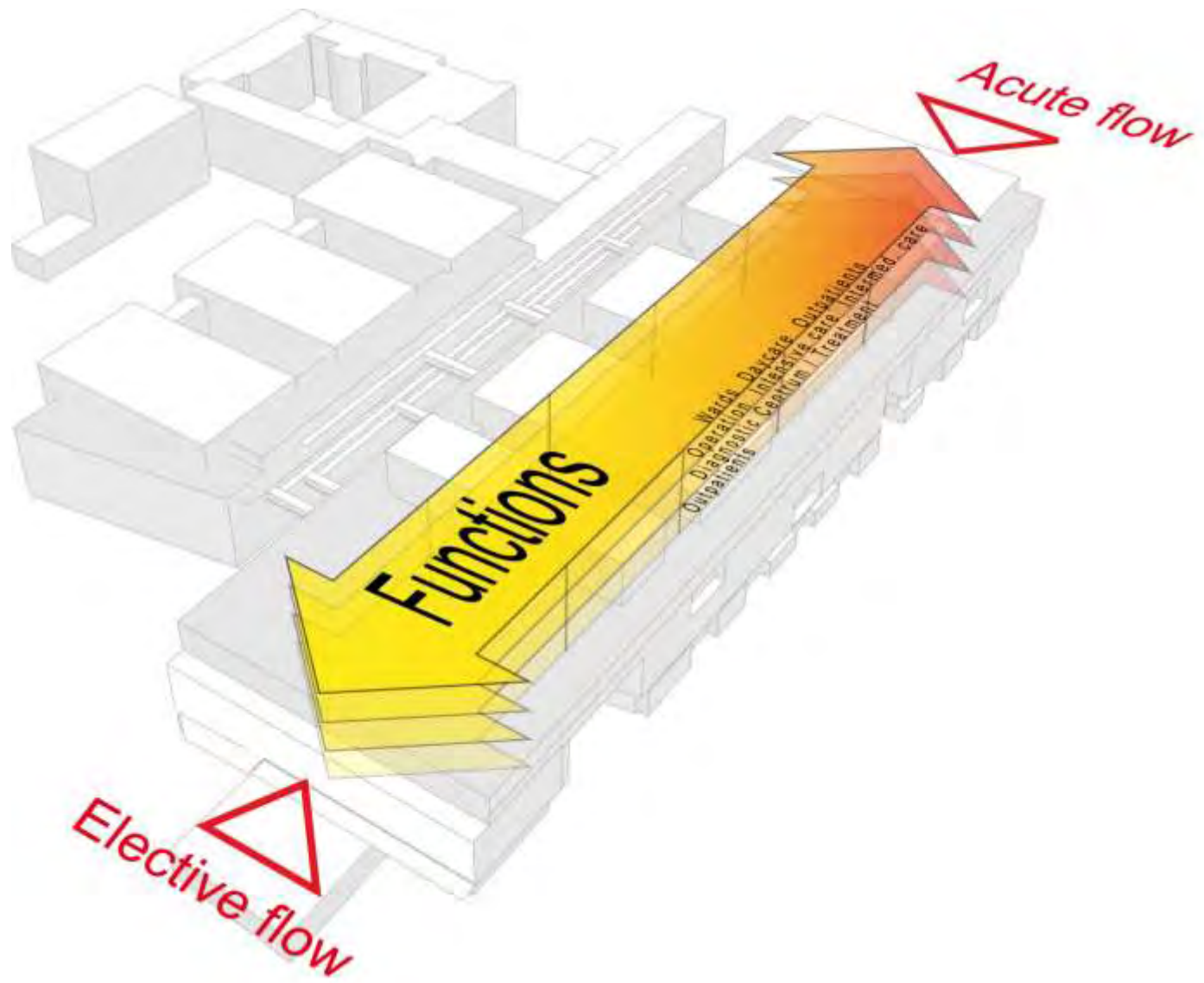
RH L1_A&E_CDU_N ELEVATION

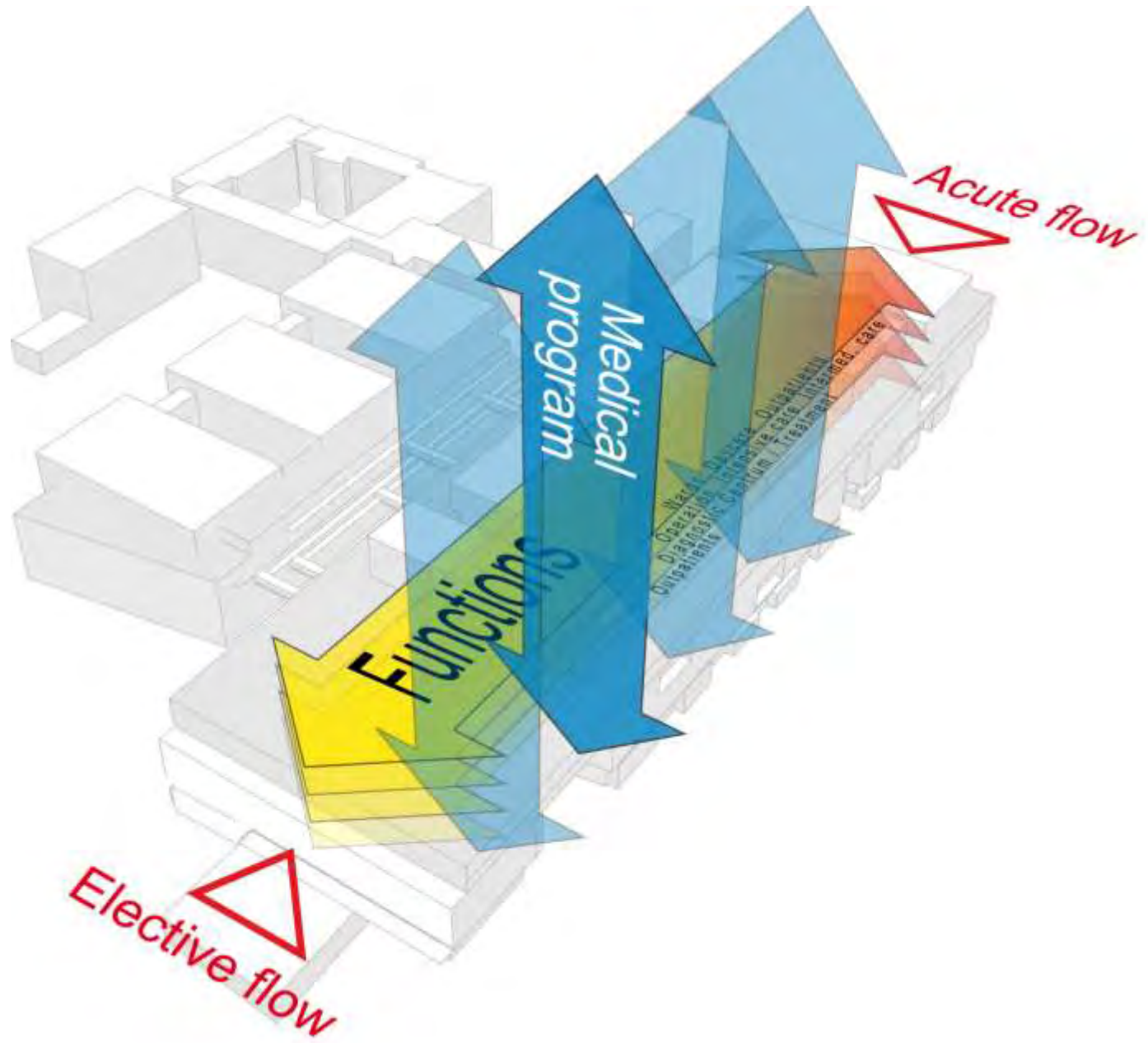
1 : 50

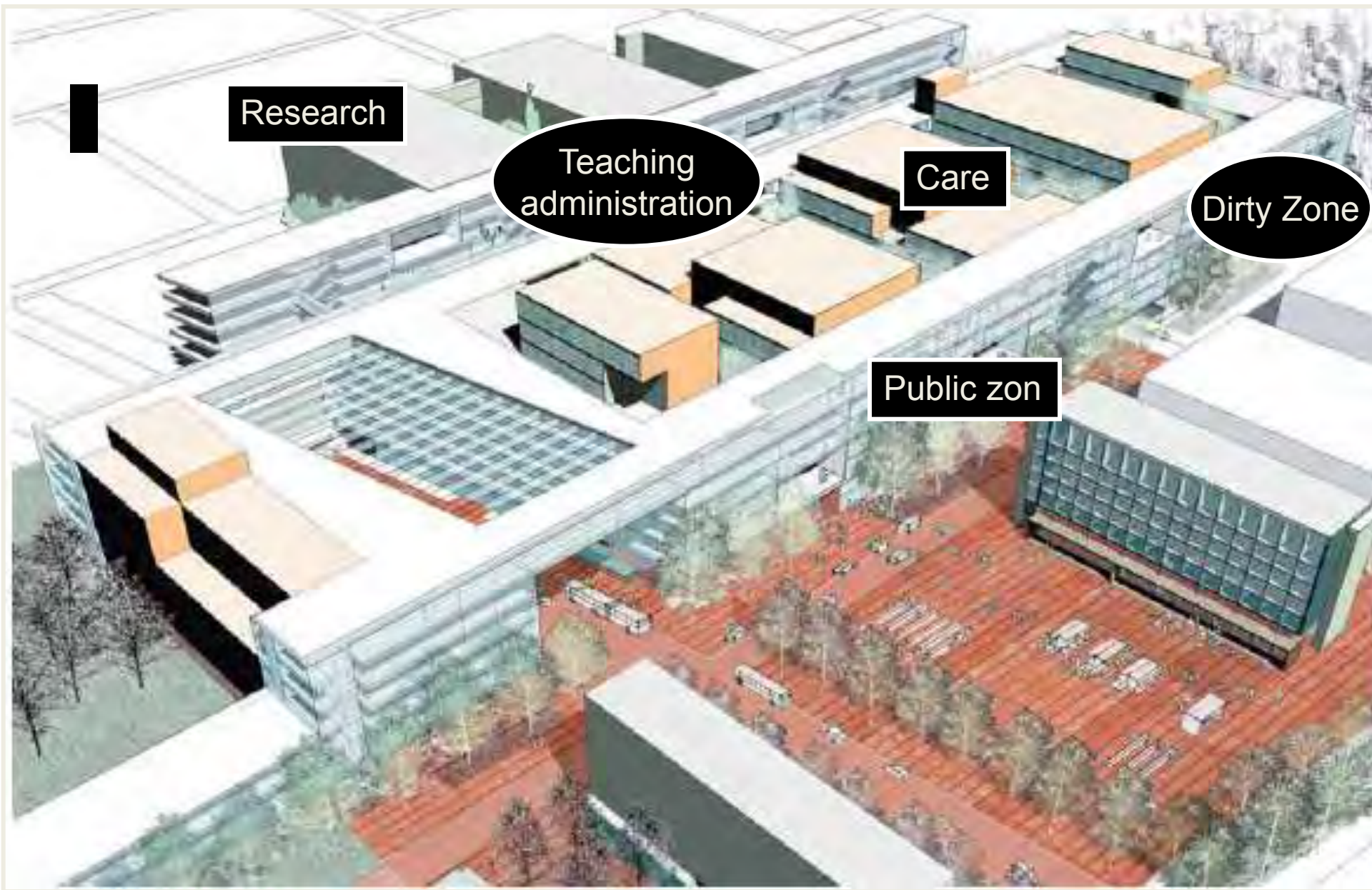
“Bang” vs Cough











Research

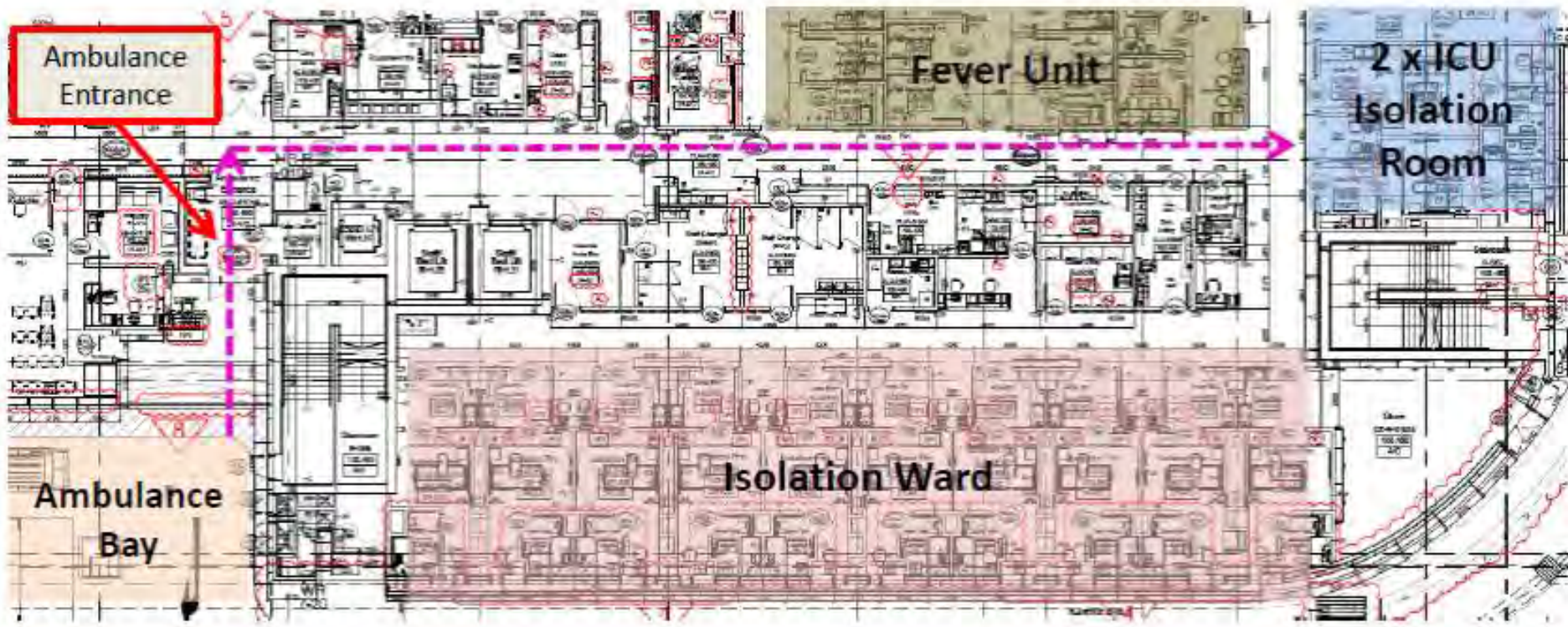
Teaching
administration

Care

Dirty Zone

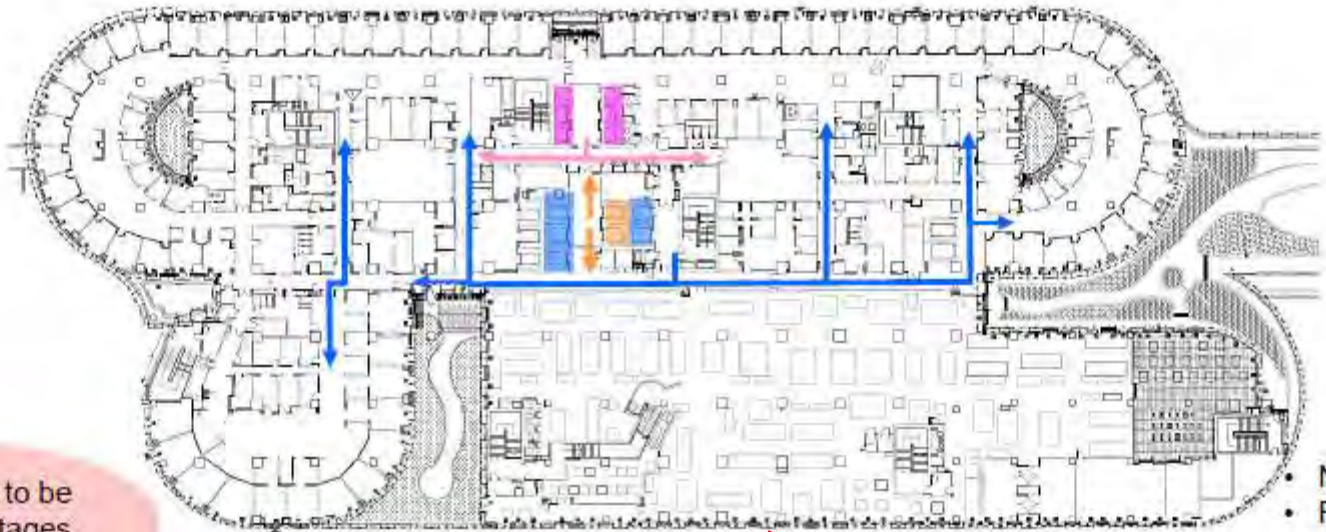
Public zon

Containment of Highly Infectious Patient



3.5 PATIENT MOVEMENT IN ICU/HD FLOOR

NORMAL



Isolation beds to be increased in stages

- No Visitors
- Roller shutter will separate Isolation Patient Lift from other lifts
- AGV lobby to be also separated by roller shutter

PANDEMIC

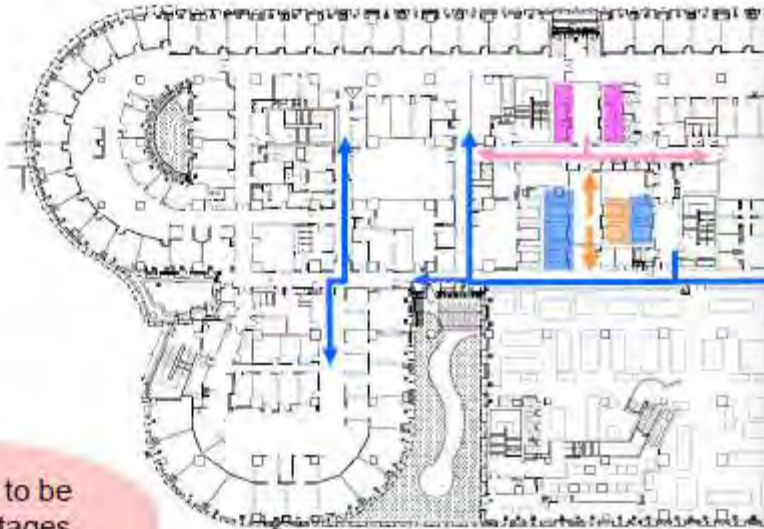
- Visitors
- Isolation patients
- Normal patients
- Food & clean supplies



Anterooms too small for bed - is it ok?

3.5 PATIENT MOVEMENT IN ICU/HD FLOOR

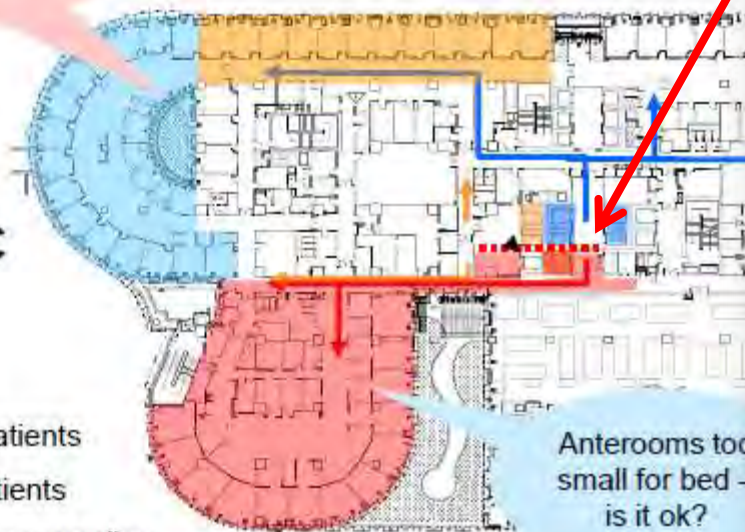
NORMAL



Isolation beds to be increased in stages

PANDEMIC

- Visitors
- Isolation patients
- Normal patients
- Food & clean supplies



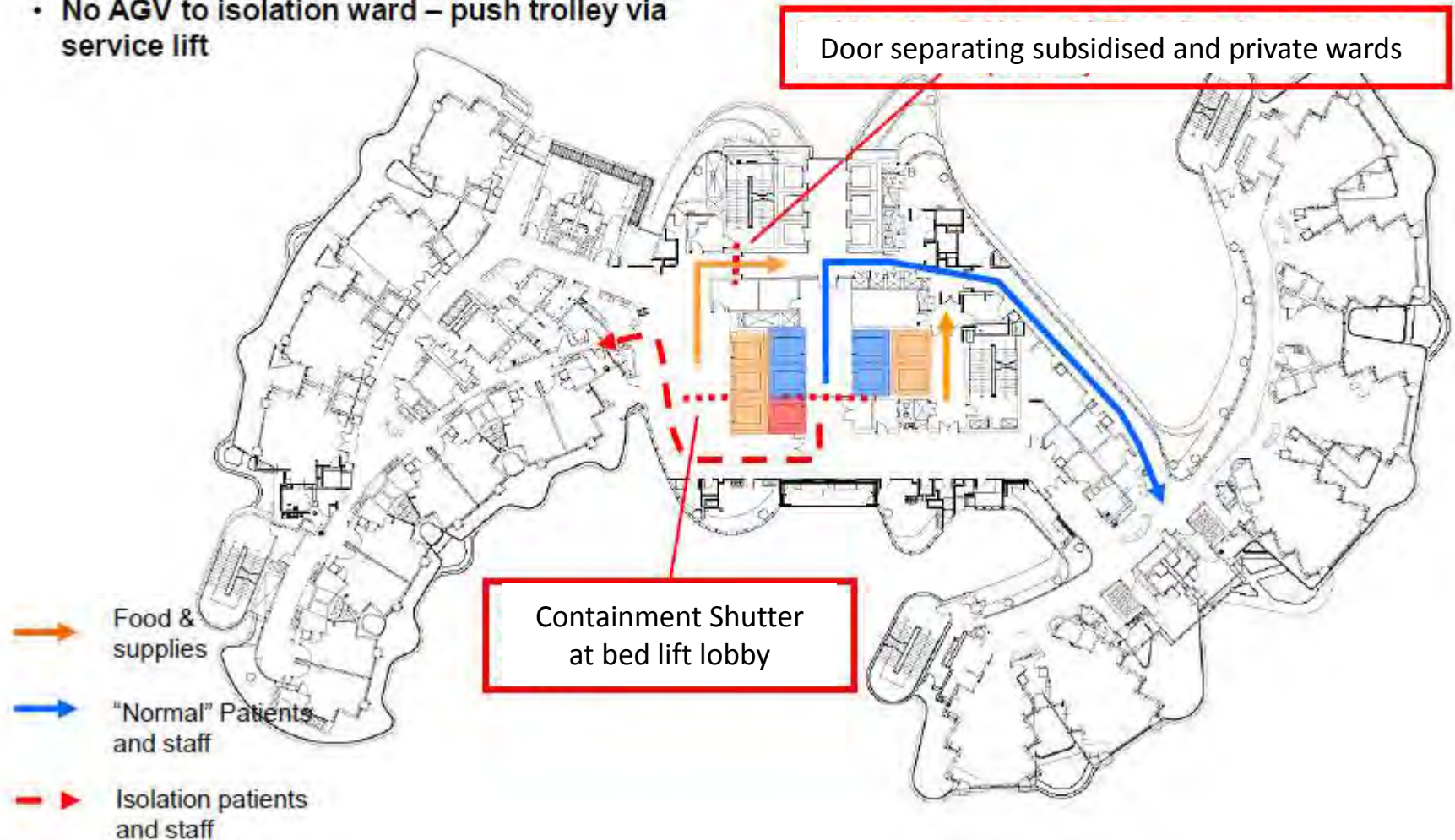
Anterooms too small for bed – is it ok?



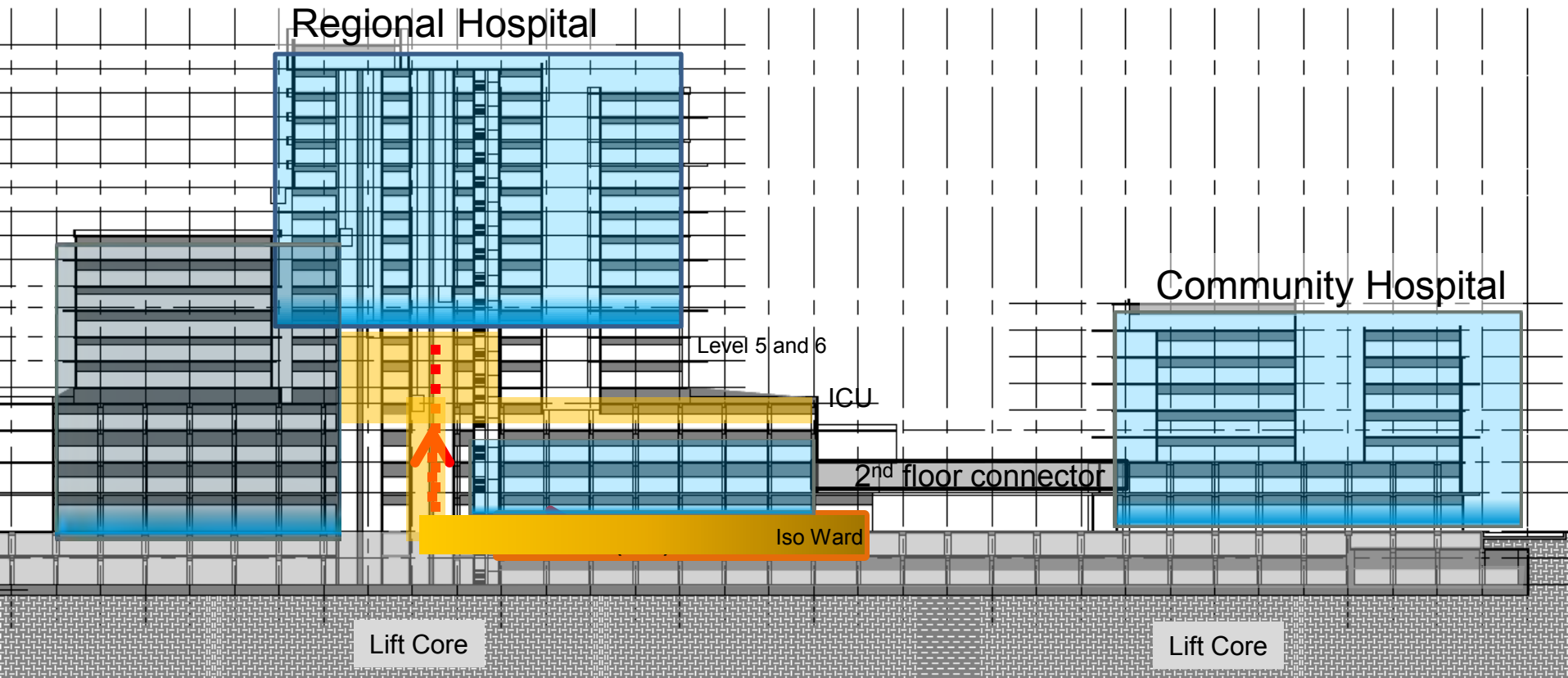
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3.5 PATIENT MOVEMENT IN L5 (isolation)

- No Visitors
- Roller shutter will separate Isolation Patient Lift from other lifts
- AGV lobby to be also separated by roller shutter
- **No AGV to isolation ward – push trolley via service lift**



“Isolation” Zone of the Hospital



Queue Mgt Sys

- 1 Queue 1 Bill

OneQueue chit with patient journey for the day



Room display panel showing Dr's and PSA's name outside every consult room



Queue kiosk for self-registration

Visitor Mgt System

- Regulate visitors going to wards
- Aids in contact tracing

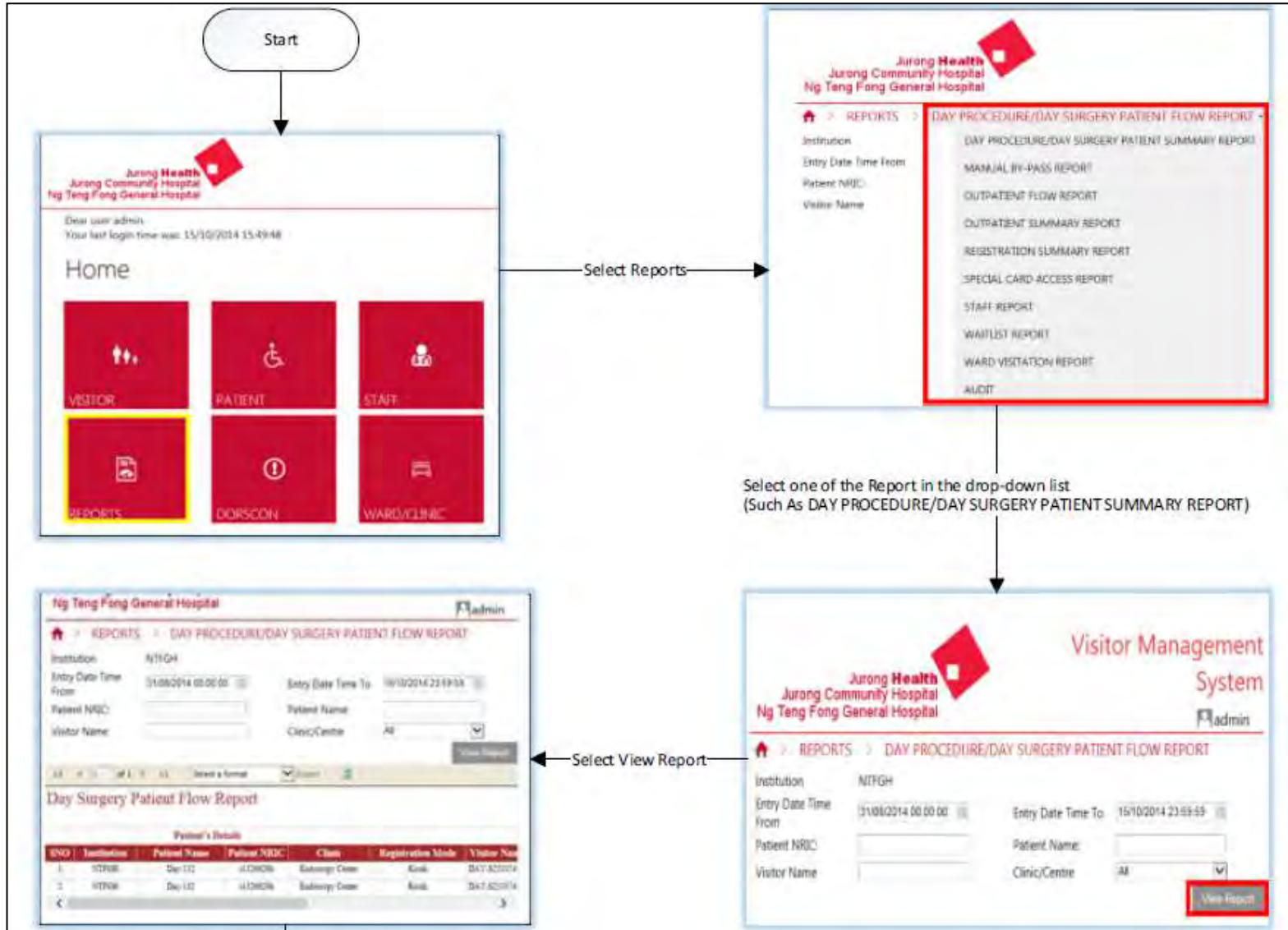


- Staff access using staff card
- Visitor access using NRIC or temp pass dispense at reg kiosks or counters



Visitor (Ward)

Source of information: **Visitor management system (VMS)**



“Bang”

Two points to consider in any MCI response:

1. MCI patient access to care
2. MCI standards of care

Planning parameters

50 P1 patients

50 P2 patients

100 P3 patients

Able to cope with 50 – 60 patients in 1 hour over 3 to 4 hours.

Currently in other Hospitals

Ambulance parking area during MCI



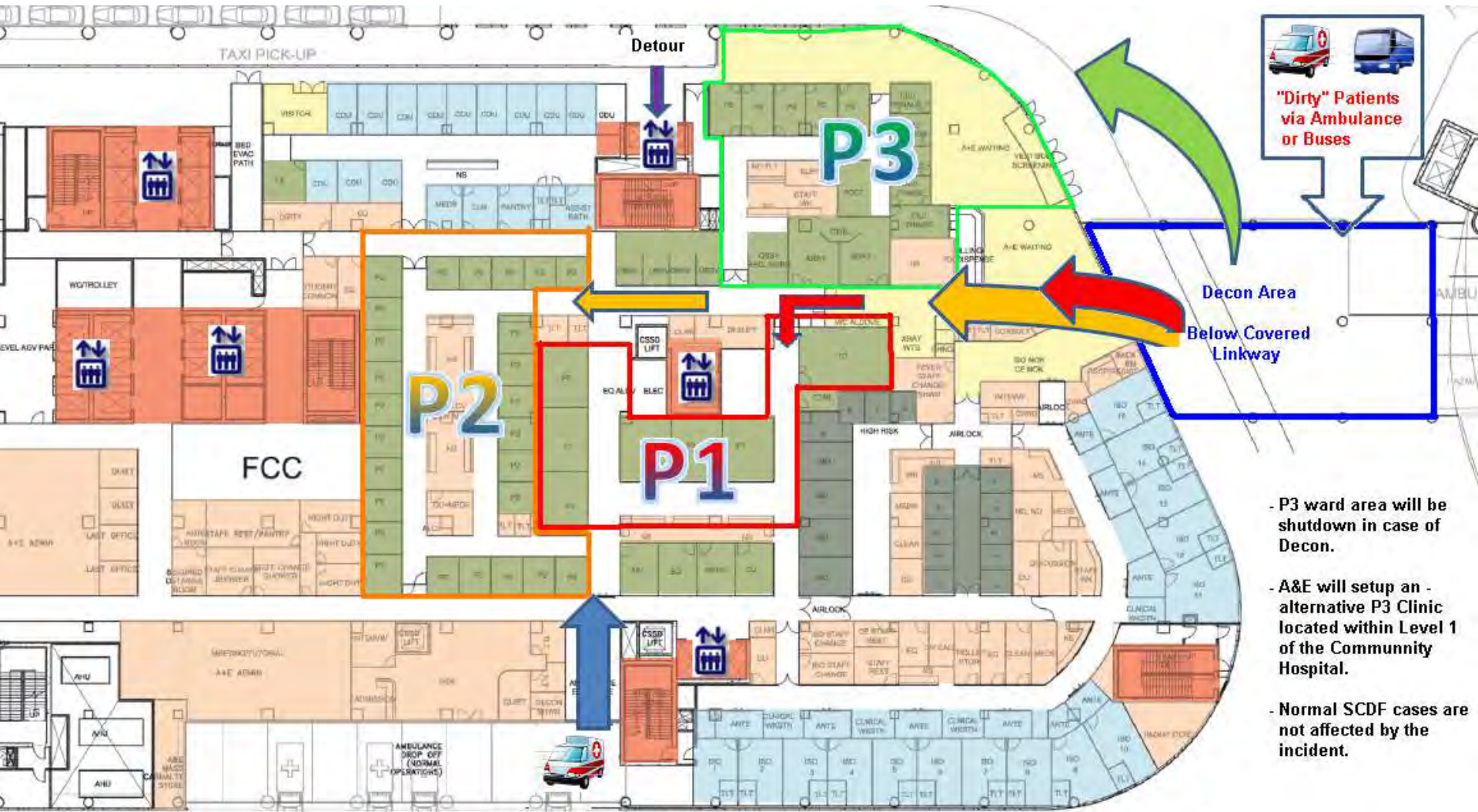
Ambulance entrance and parking during MCI



Both MCI ambulances and non-MCI ambulances will be dropping their patients at the same ambulance drop off, causing congestion and strain the resources and infrastructure.

Affecting access to care, not only for MCI patients, but also for non-MCI patients.

MCI/Decontamination Workflow & Setup



"Dirty" Patients via Ambulance or Buses

Decon Area Below Covered Linkway

- P3 ward area will be shutdown in case of Decon.
- A&E will setup an - alternative P3 Clinic located within Level 1 of the Community Hospital.
- Normal SCDF cases are not affected by the incident.

Normal SCDF Cases are not affected by the Decon Setup





EMERGENCY

IN CAR PARK P
AMBULANCE ACCESS
MAX. HT 2.5M









Lessons

- Important work lies outside the department
- Studying the operations now, forms the foundation of operations in the future
- Get a good “crystal ball” to gaze into
 - Geriatric Emergency Medicine
 - Trauma management - *Pan scans??*
 - Educating the future EP – *conducive learning environment*
 - New Models of Emergency Care - *partnering the community*
 - New technology and its applications – *EMR, cutting edge medical equipment*
- Be prepared
 - MCI
 - Pandemics/EID
- Leverage on technology
 - Transfer of information

10 Months into Operations

- Design fulfilled most of its intended function
- Circulation space was very well received by the staff
- Larger area means more manpower needed to man the facility – more subunits to manage
- Transition from old hospital to the new was both a science and an art
- Intense PDSA cycles to refine work processes



Thank You

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