

USING DISCRETE EVENT SIMULATION IN ACUTE CARE – A NEW TOOL FOR INNOVATION IN NURSING WORK DESIGN

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ACKNOWLEDGEMENTS

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**NSERC
CRSNG**

Natural Sciences and Engineering
Research Council of Canada



CRE-MSD

Centre of Research Expertise for the
Prevention of Musculoskeletal Disorders

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CHALLENGES IN HEALTHCARE

OVERTIME

20,150,000 hours

Cost => **\$968 million dollars**

ABSENTEEISM

24,600 Registered Nurses absent weekly!

Cost => **\$989 million dollars**

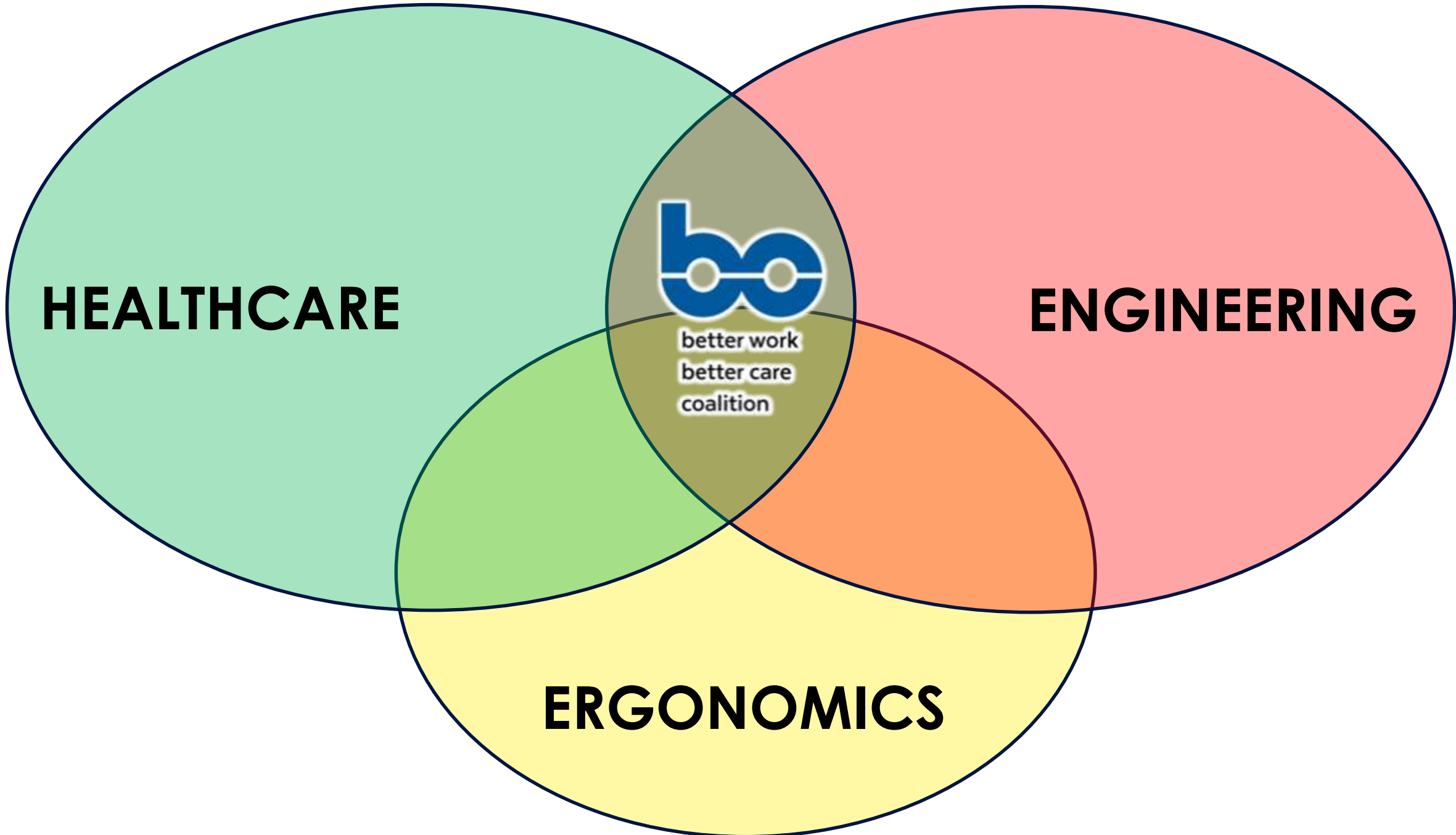
BURNOUT

71% *Nurses experienced burnout*

INJURY/WMSD

*Healthcare is **#1** in lost-time injuries (including WMSD)*

*A shortfall of **60,000** full-time nurses by 2022*



HEALTHCARE

ENGINEERING

ERGONOMICS

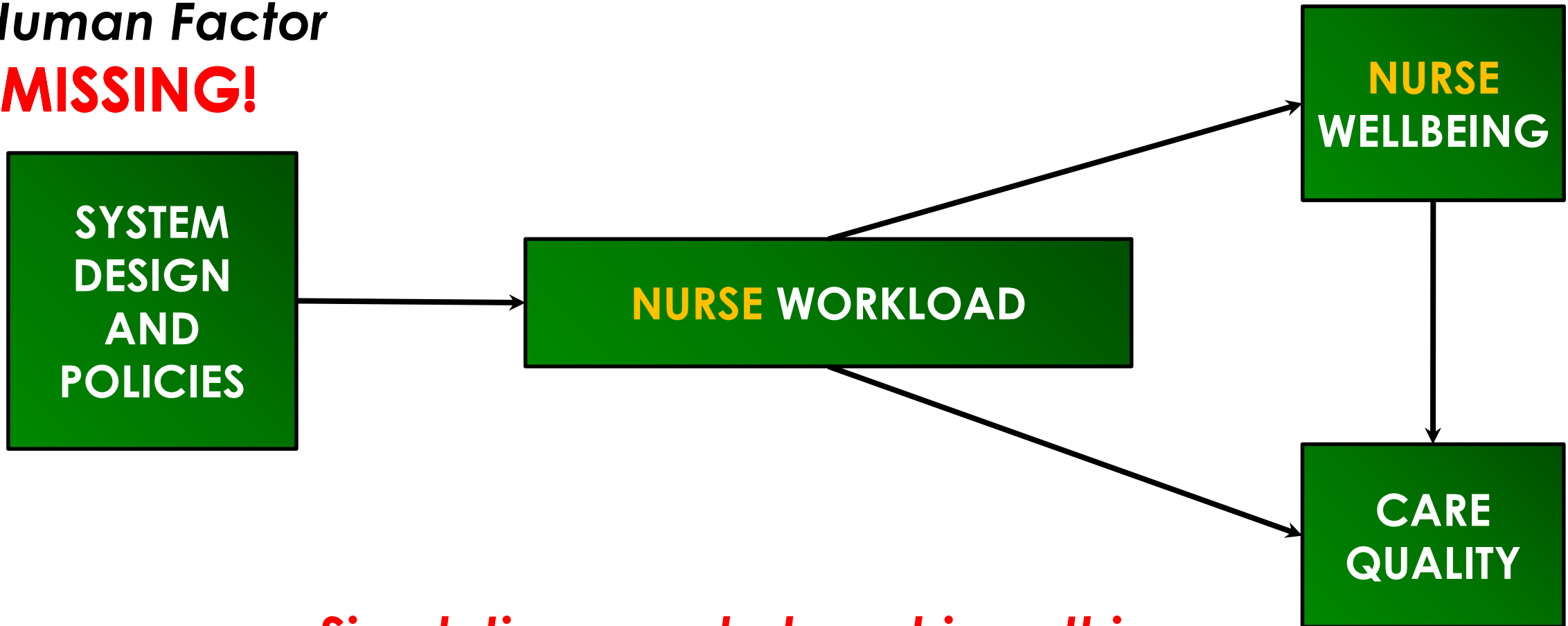


RESEARCH AIMS

- Simulate the **process of care delivery for Nurses**
- Quantify **Nurse workload & Care Quality**
 - Patient Acuity
 - Nurse-Patient ratio
 - Nurse Priority Scheme
 - Location Based Patient Assignment
- Validate outcomes via **Field Study**
- **Test** the **Unit Manger's** key variables of interest

CONCEPTUAL MODEL

Human Factor
MISSING!



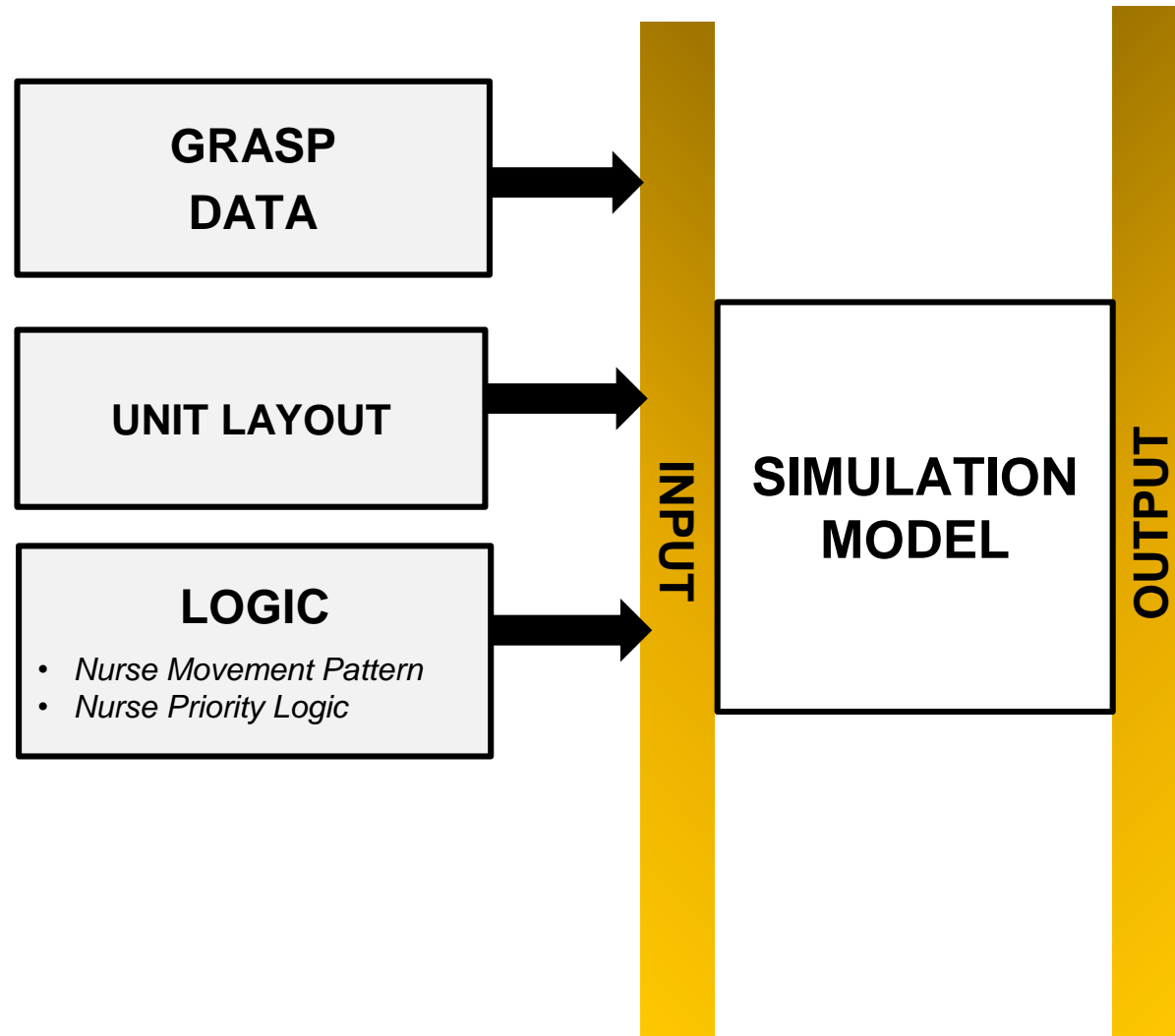
Simulation may help achieve this

(Miles et al., 1998)

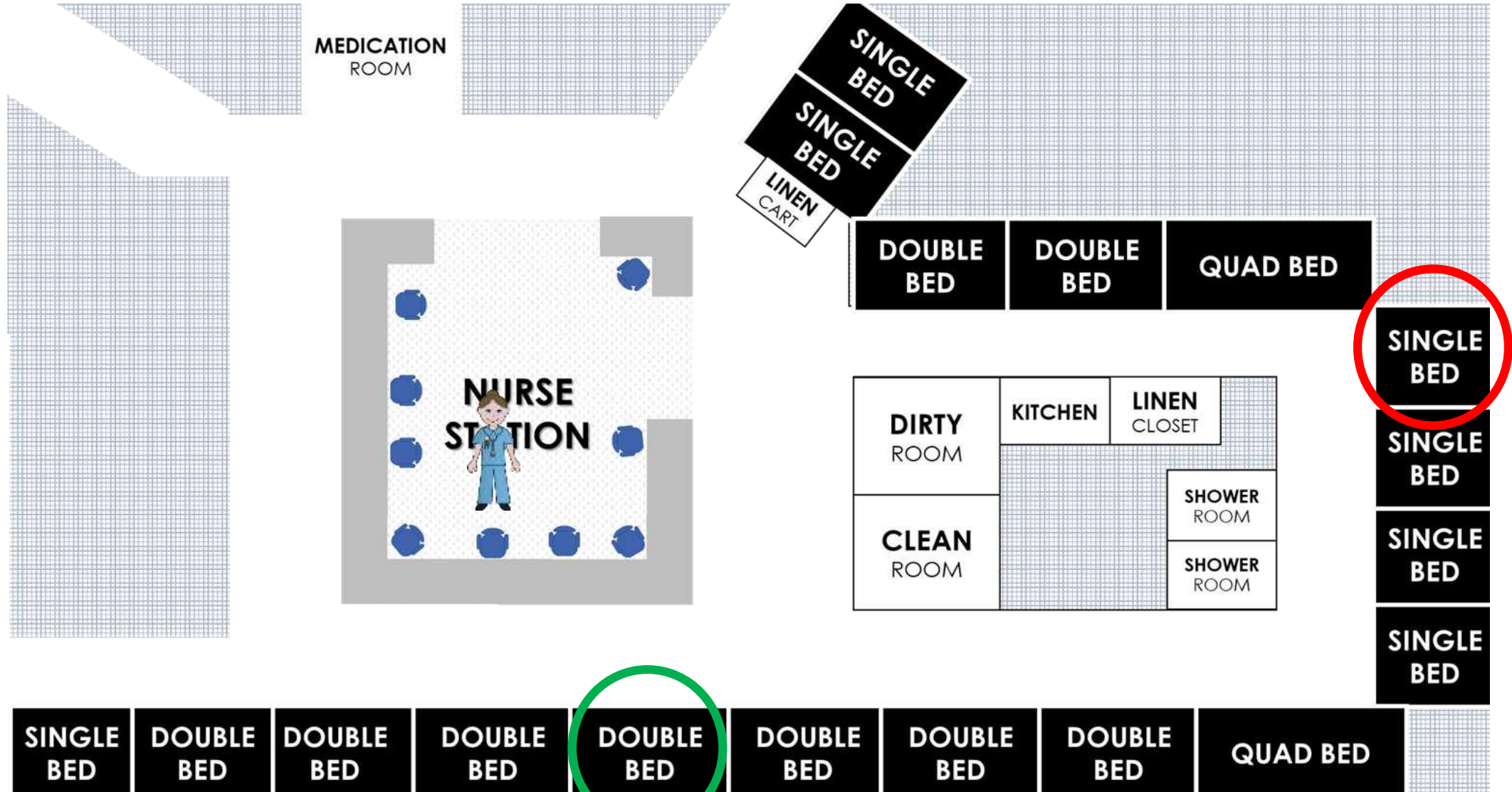
DISCRETE EVENT SIMULATION (DES)

- Operations research technique
- Mimics complex structures
 - *at discrete intervals*
- Proven successful tool in other service industries
 - *e.g. Manufacturing*

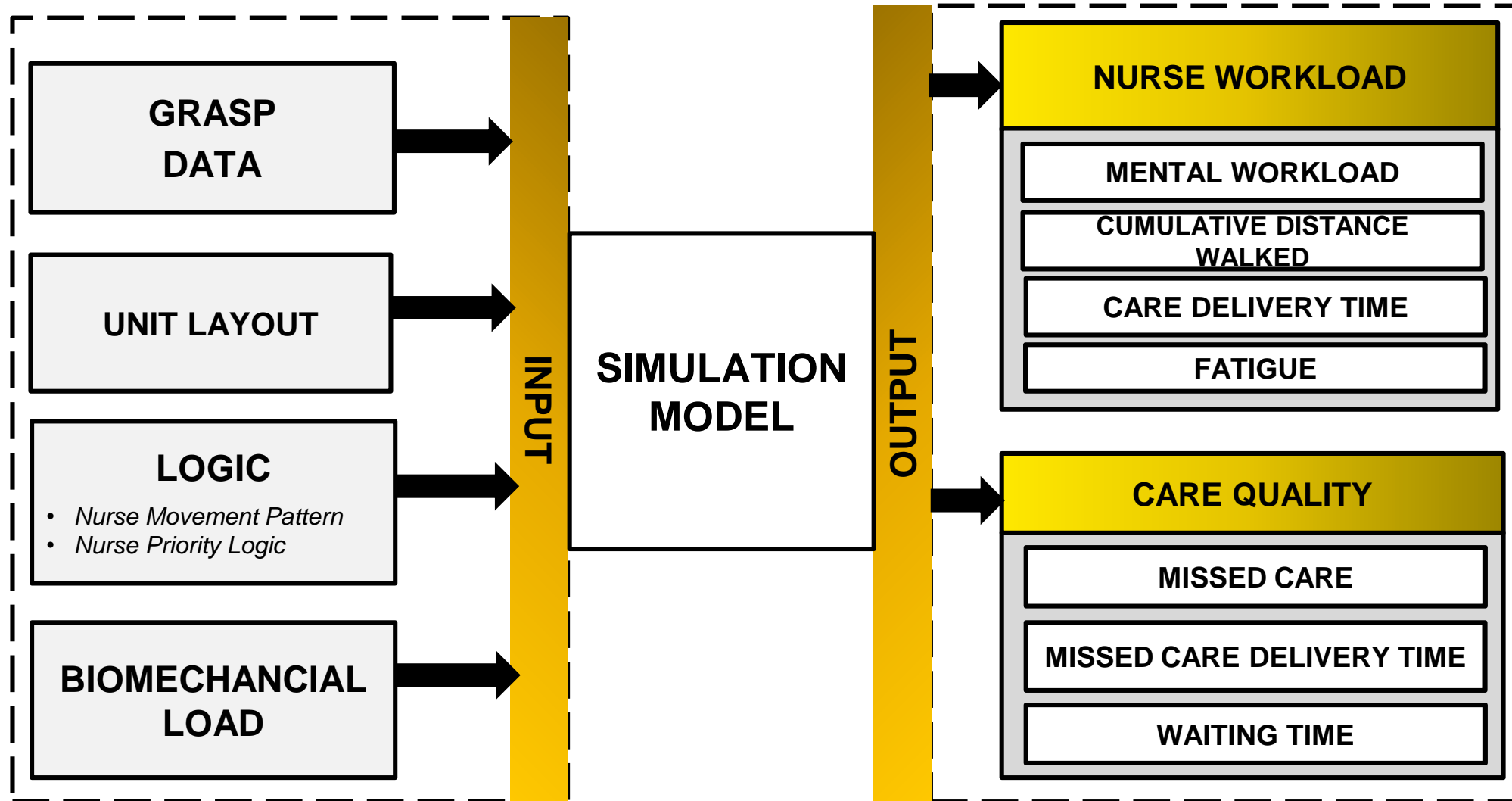
PART 1: SIMULATION MODEL CREATION



NUISANCE TREATMENT UNIT 2 in 1 Medication/SURGERY/ICU/CCU/Tube Unit



PHASE 1: SIMULATION MODEL CREATION



PHASE 2: **FIELD STUDY**

- Video Recording Study
- Nurse Job Shadowing
- FitBit™ Study
- Survey
- Focus Group

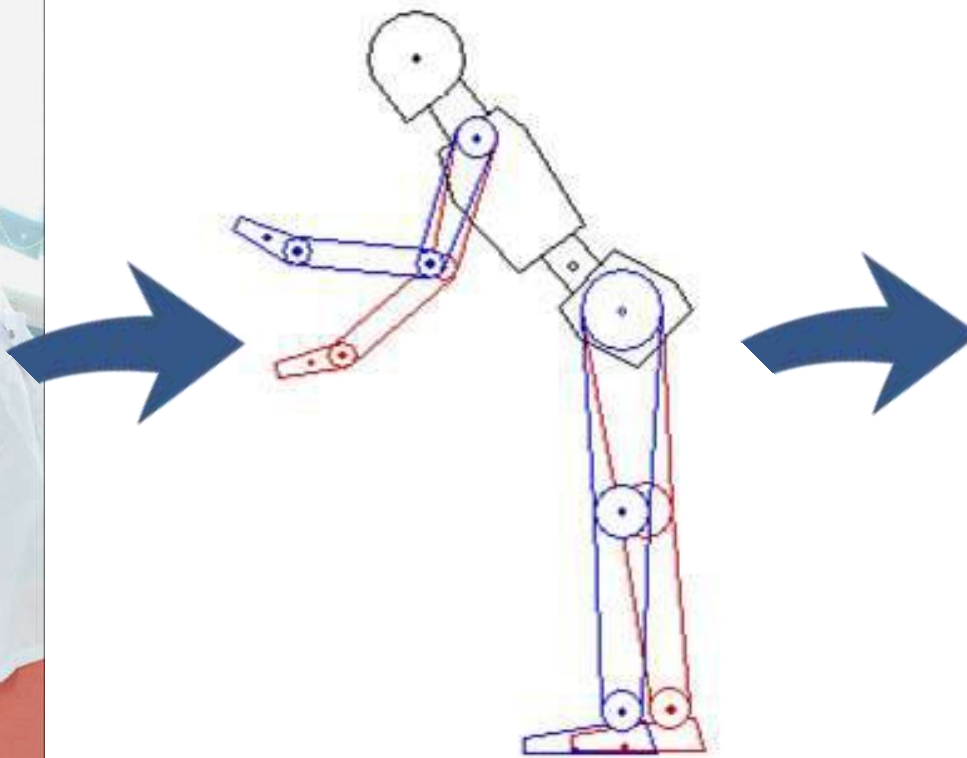
VIDEO RECORDING STUDY



VIDEO Recording



4D WATBAK modelling



FATIGUE

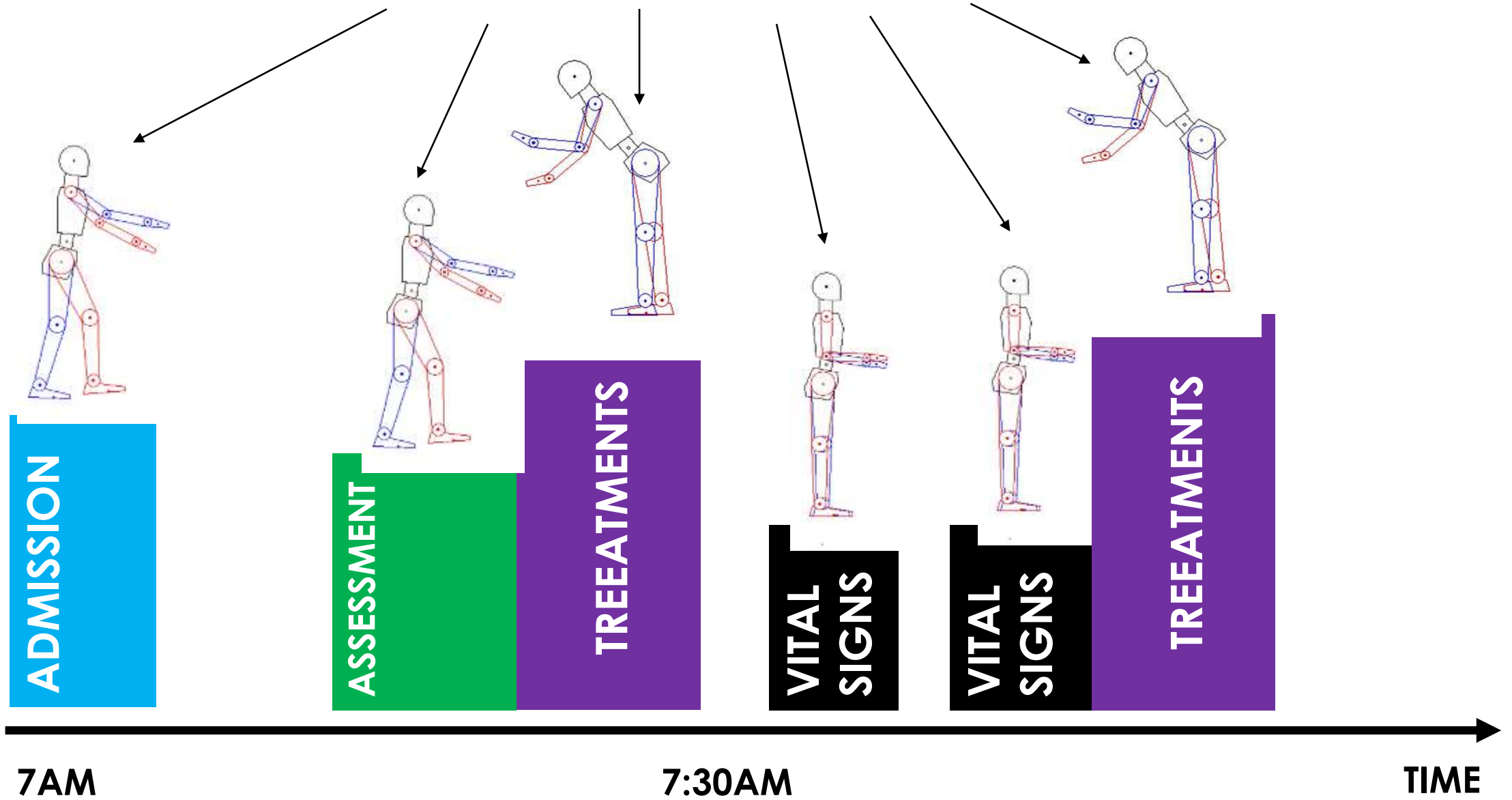
L4/L5 LOAD

(Peak & Cumulative)

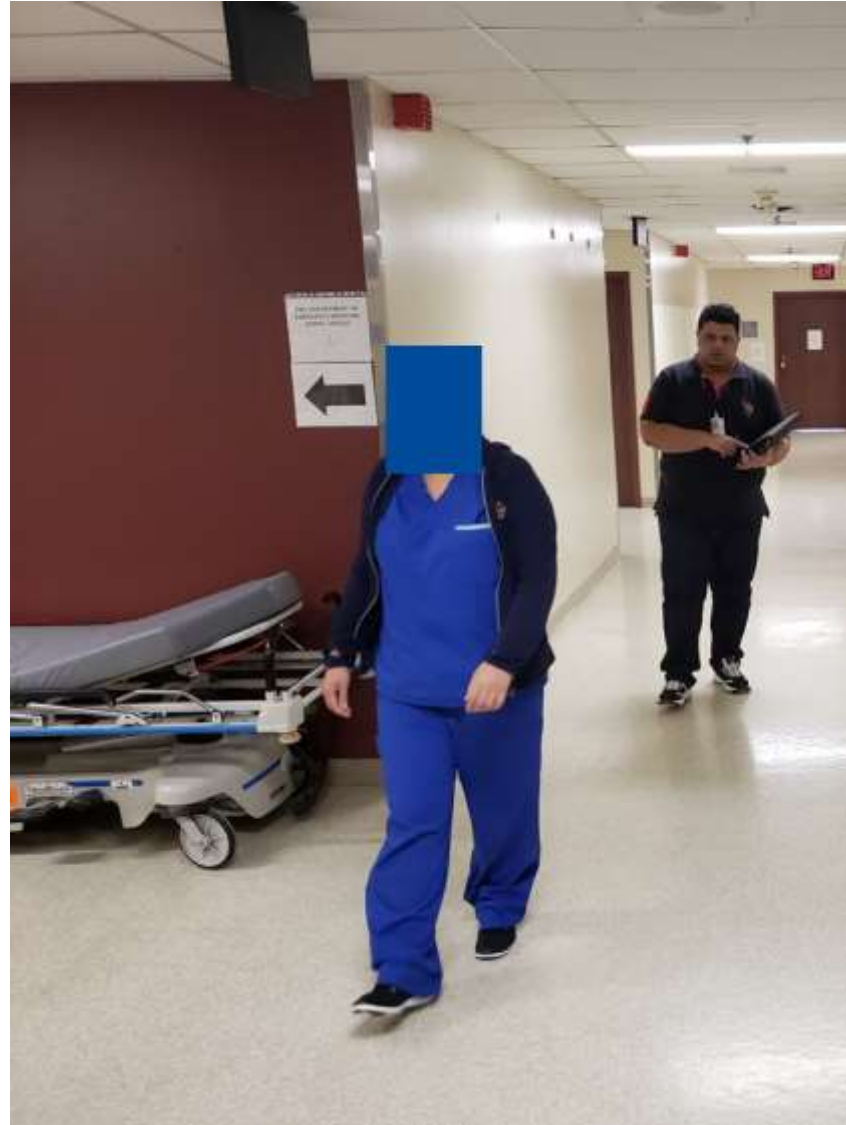
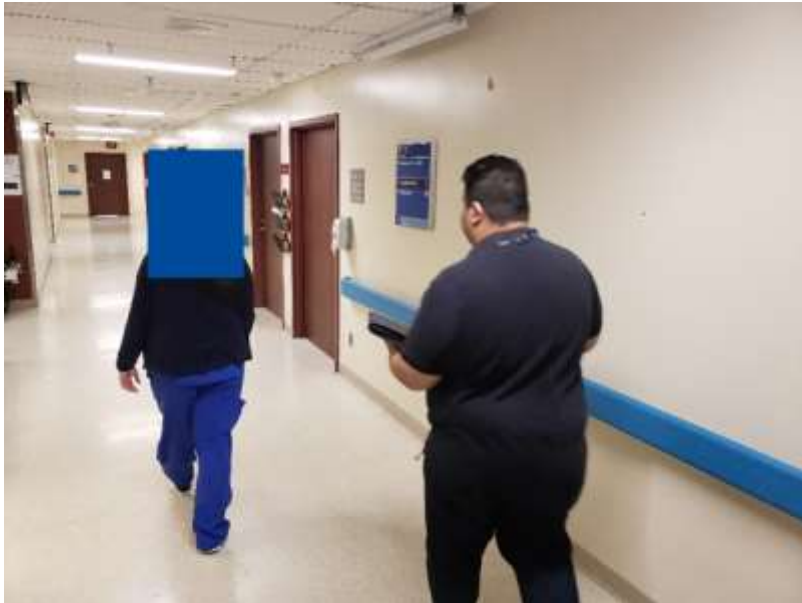
**SHOULDER
JOINT LOAD**

(Peak & Cumulative)

Digital Human Models



NURSE JOB SHADOWING



FITBIT™ STUDY



FOCUS GROUP STUDY

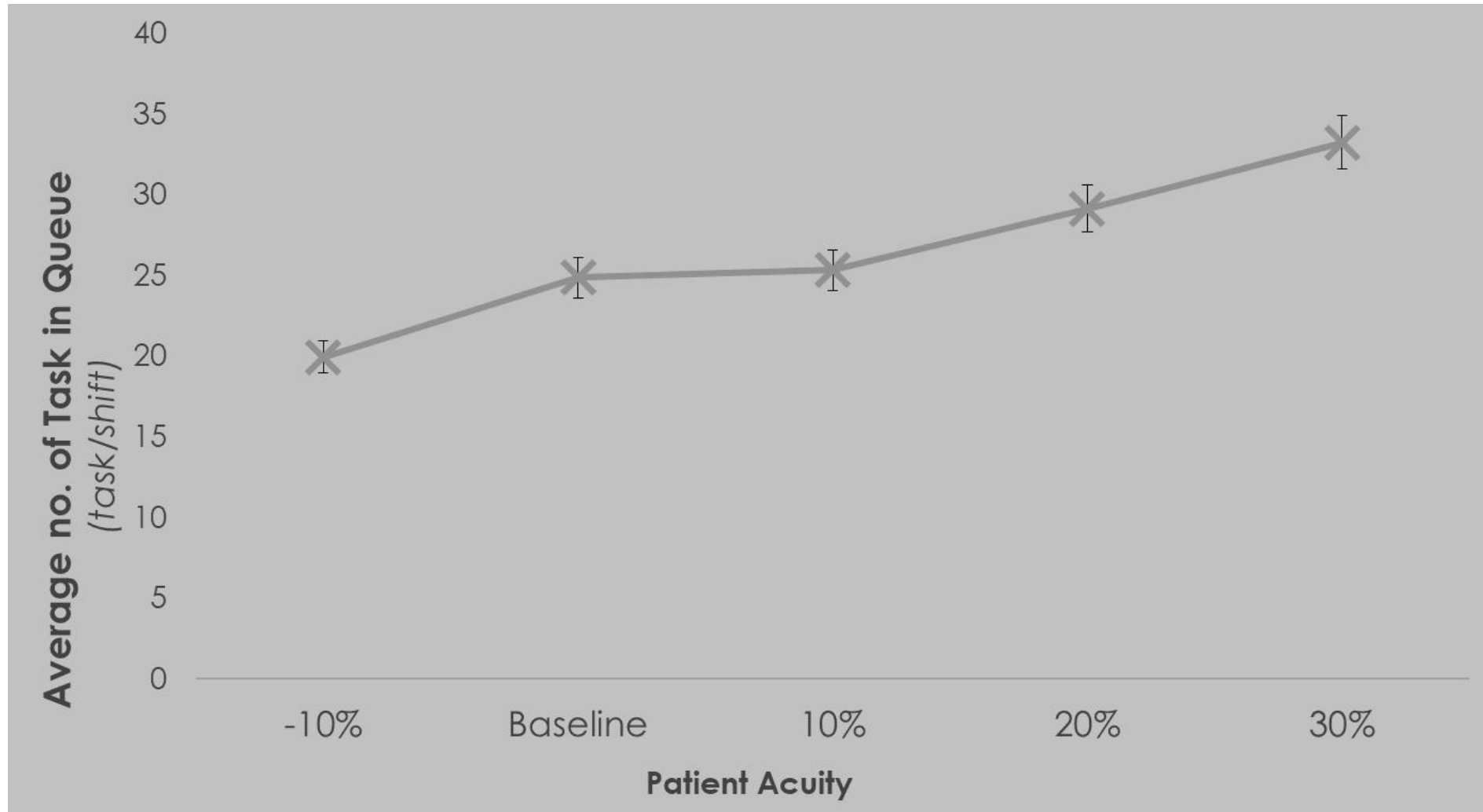
- Patient Acuity
- Care Task Priority Sequence
- Nursing Care Delivery Logic

SURVEY

- **Perceptions of Missed Care**
 - MISSCARE (Kalisch et al., 2009)
- **Perceptions of Physical Exertion**
 - Borg (1998)

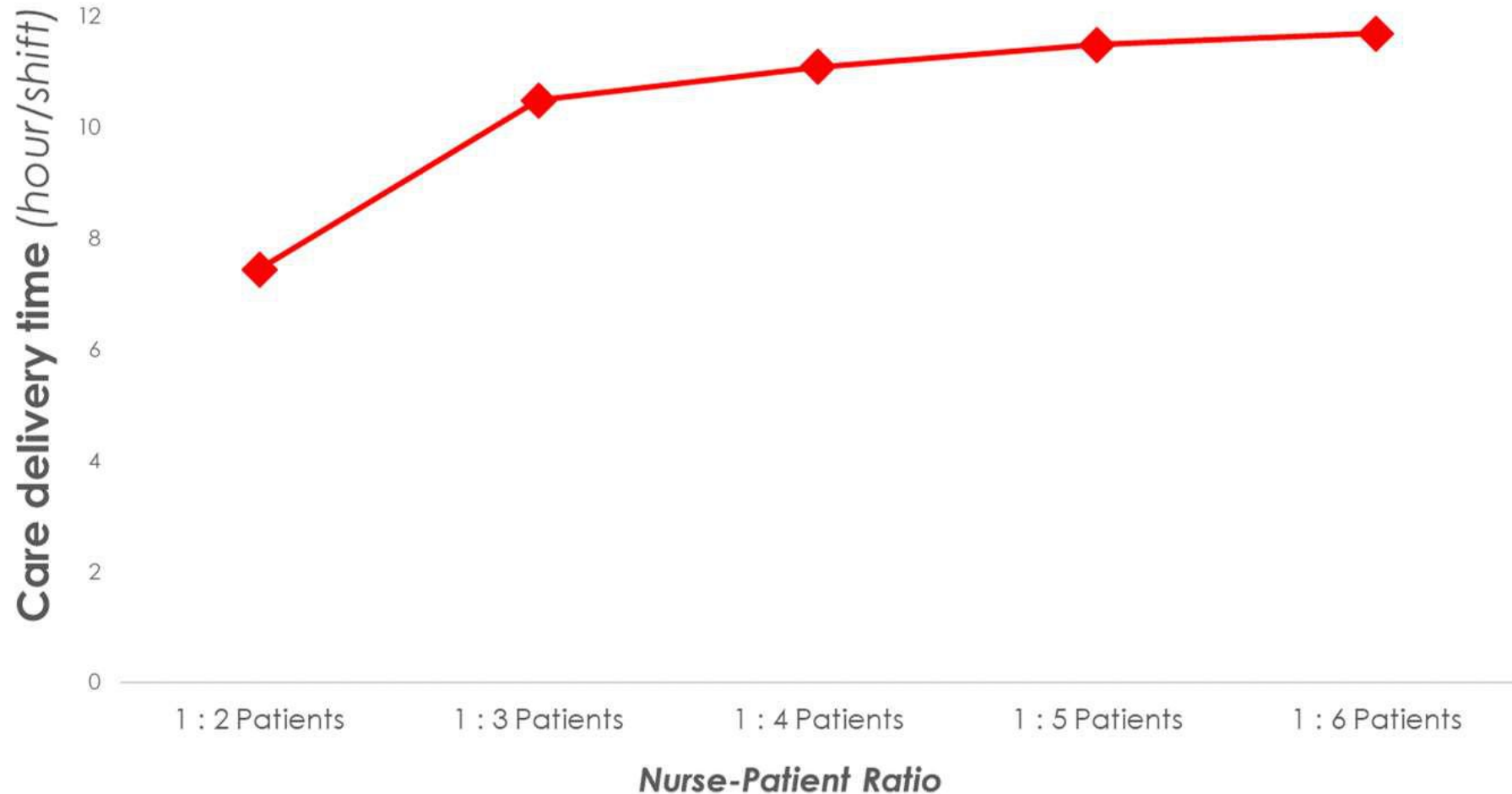
Simulation Results – Impact of *Patient Acuity*

MENTAL WORKLOAD



Simulation Results – Impact of *Nurse-Patient Ratio*

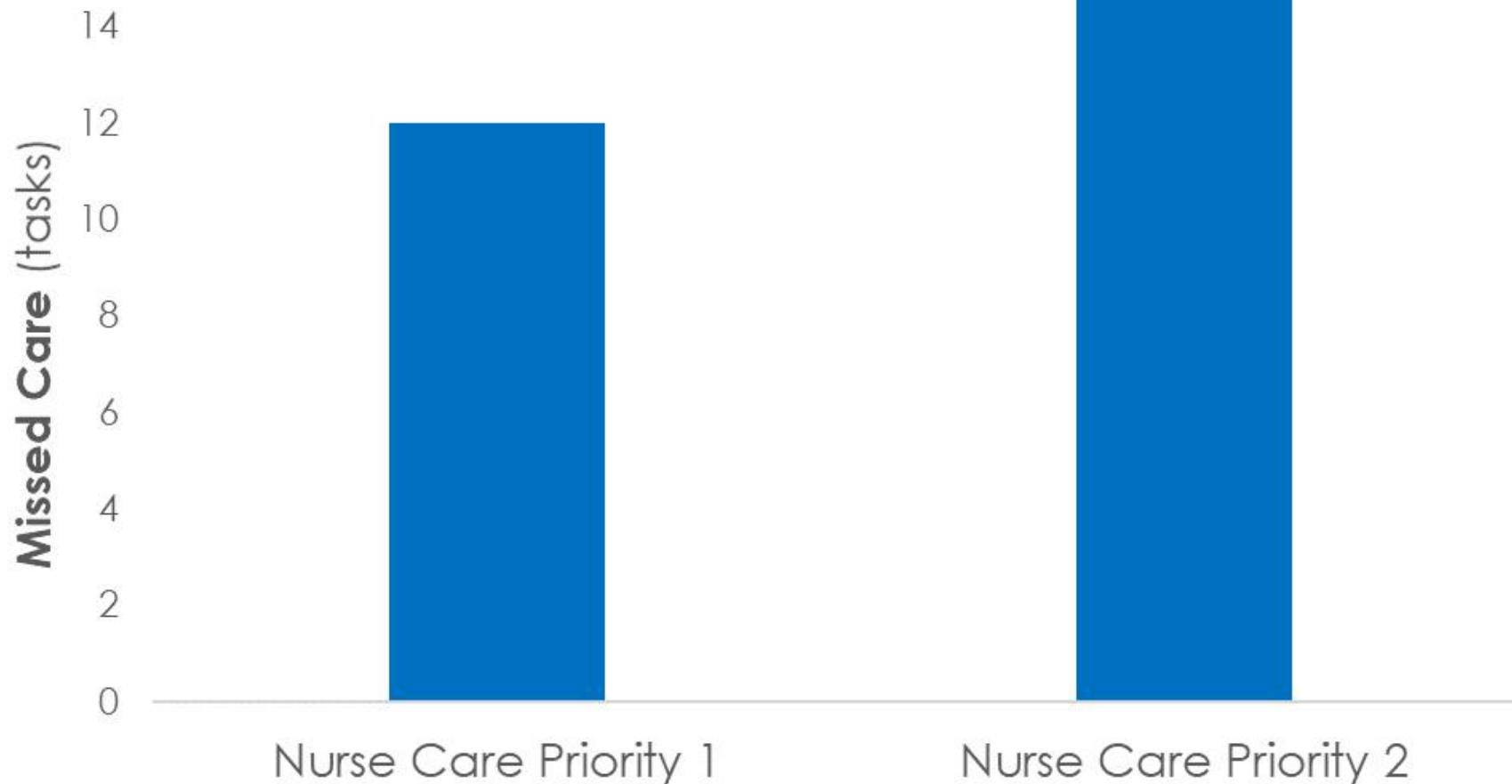
CARE DELIVERY TIME



Findings consistent with the Time & Motion study of 36 hospitals (Hendrich et al., 2017)

Simulation Results – Impact of *Nursing Care Priority Sequence*

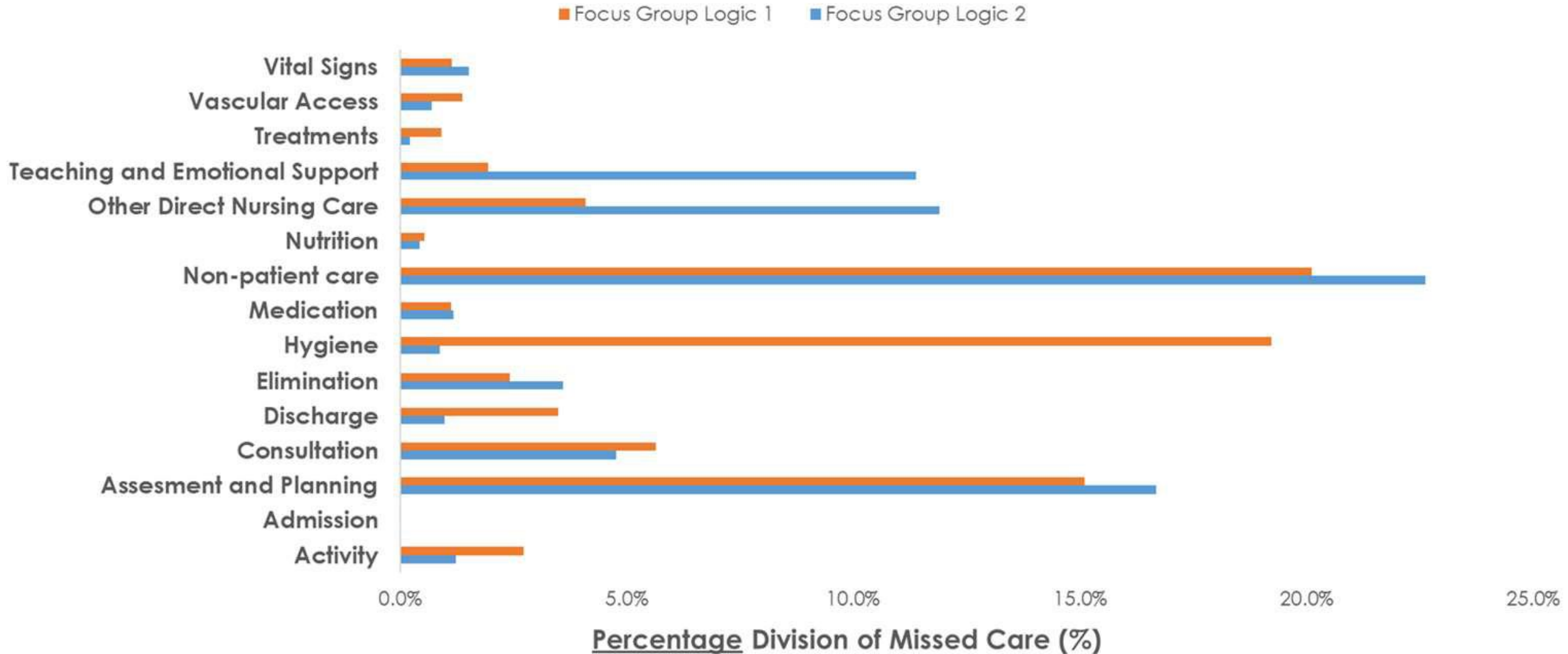
MISSED CARE



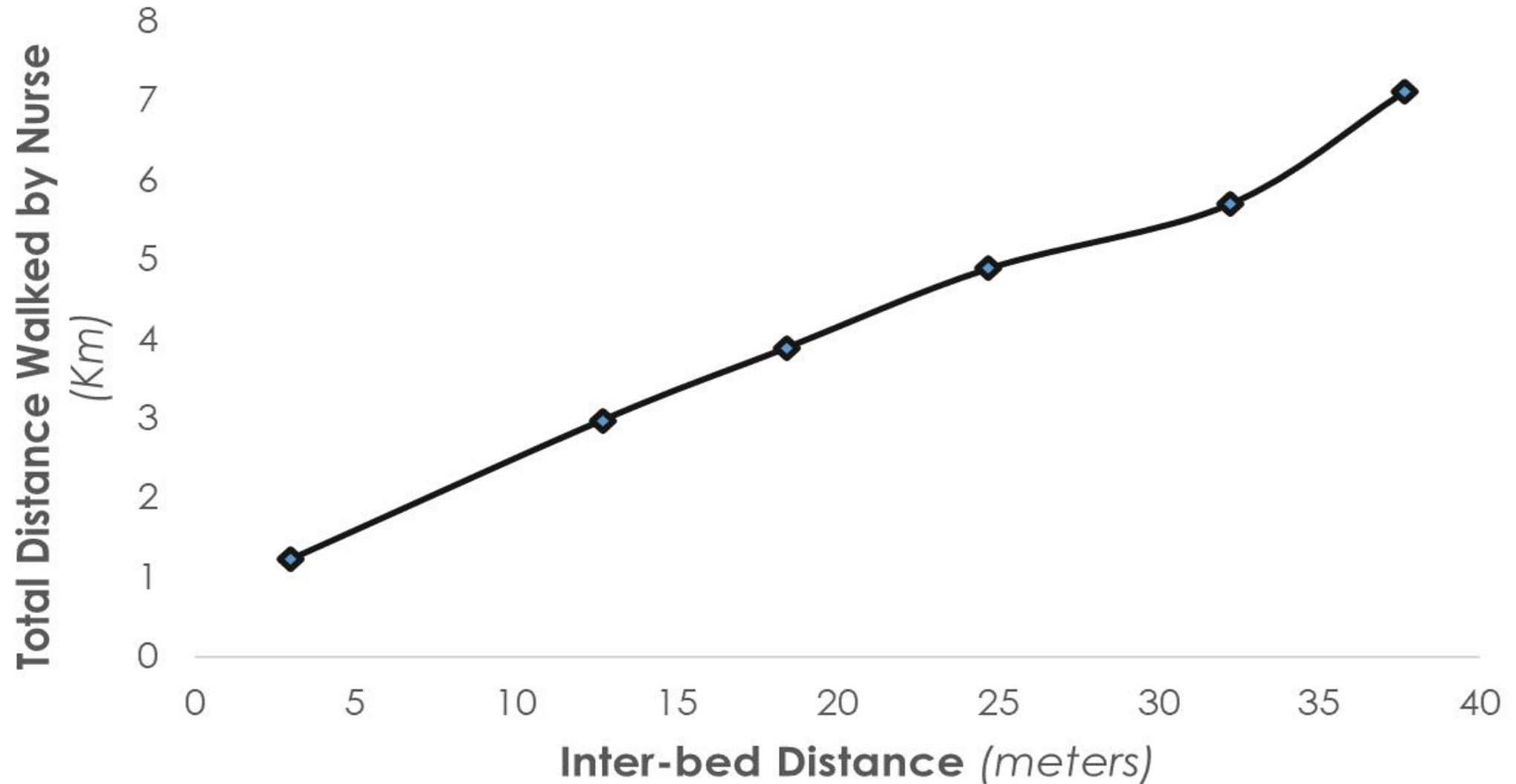
Findings consistent with the study of hospitals across 12 European countries (Ausserhofer et al., 2017)

Simulation Results – Impact of *Nursing Care Priority Sequence*

DIVISION OF MISSED CARE



TOTAL DISTANCE WALKED BY NURSE (ONE SHIFT)



Measured using **FitBit™**

TOTAL DISTANCE WALKED BY NURSE (ONE SHIFT)



BENEFITS TO THIS STUDY?

- Predictive – Proactive approach
- No more trial and error!
- Adaptable
- Quantifies *Nurse workload* and *Care Quality*

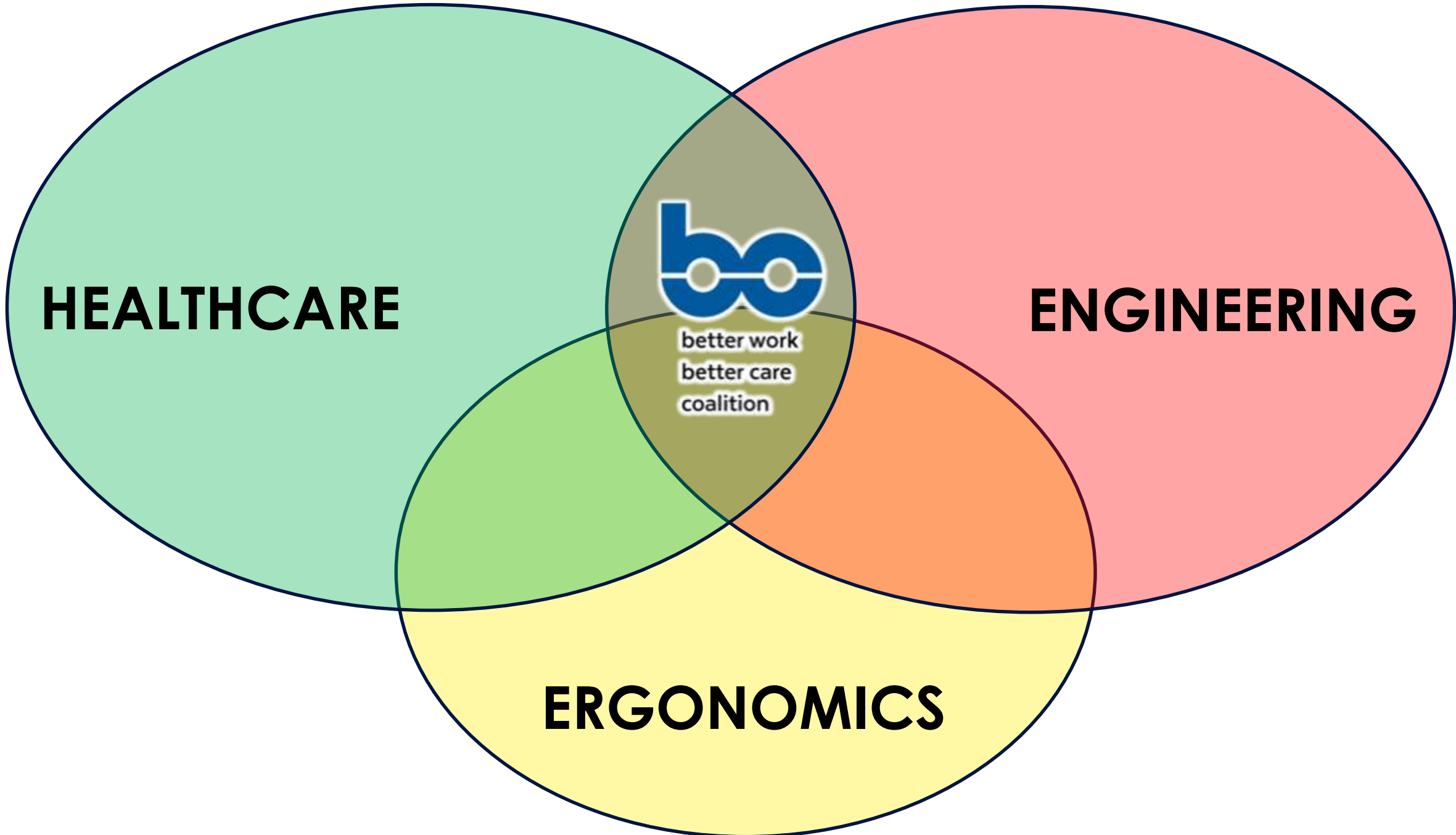
RELEVANCE - POTENTIAL USES

UHN perspective

- Augment current information regarding planned changes
- Application to current projects
 - *Impact of new 'call bell direct to nurse' phones*
 - *Impact of intentional rounding*
 - *Skill mix and staffing changes*
 - *Patient assignments*
- Strategic planning - support for decisions impacting work environment or care planning

RELEVANCE - POTENTIAL USES (cont.)

- Other perspectives
 - Architecture, etc. (renovate, new build)
 - Health system decision makers – use in policy



HEALTHCARE

ENGINEERING

ERGONOMICS



NEXT STEPS?

- **Analysis of the Video recording Study**
 - Biomechanical load
 - Fatigue
 - Error rates
- **Assist Unit Manger's decisions – Simulation model**
 - Usability testing of the simulation model

CONTACT INFORMATION

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Qureshi, S.M., Purdy, N., Mohani, A., & Neumann, W. P. (2019) Predicting the effect of nurse-patient ratio on nurse workload and care quality using Discrete Event Simulation. *Journal of Nursing Management* (in press).

Let's Discuss