Mackenzie Health: The Internet of Things in Healthcare

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Internet of Things (IoT)

- Internet of things (IoT) is an emerging technology where different machines are embedded with sensors to capture and relay data to each other
- Mackenzie Health (MH) implemented IoT in an acute medical unit to test and evaluate new technologies to improve care delivery
- The new system includes: smart beds, smart hand hygiene system, wall call stations, dome light indicators, and smart call bell system

Research Gap: No evidence produced to confirm the benefits of this intervention

Table 1: Smart Technologies Implemented in MH

Smart Bed			Smart badge
Blackberry Mobile Phones			Dome light indicators
Wall Call Station			Hand Hygiene Support Solution

Research Questions(RQ)

RQ1) What impact of IoT implementation has on quality of care dimensions (efficiency, Patient safety, timeliness):
 - Patient length of stay?, Patient fall rate?
  - Hand-Hygiene(HH) compliance?
  - Patient call bell response time?
  - Nurse distance travelled per shift?
  - Nurse satisfaction?

RQ2) How can we further improve the unit operations?
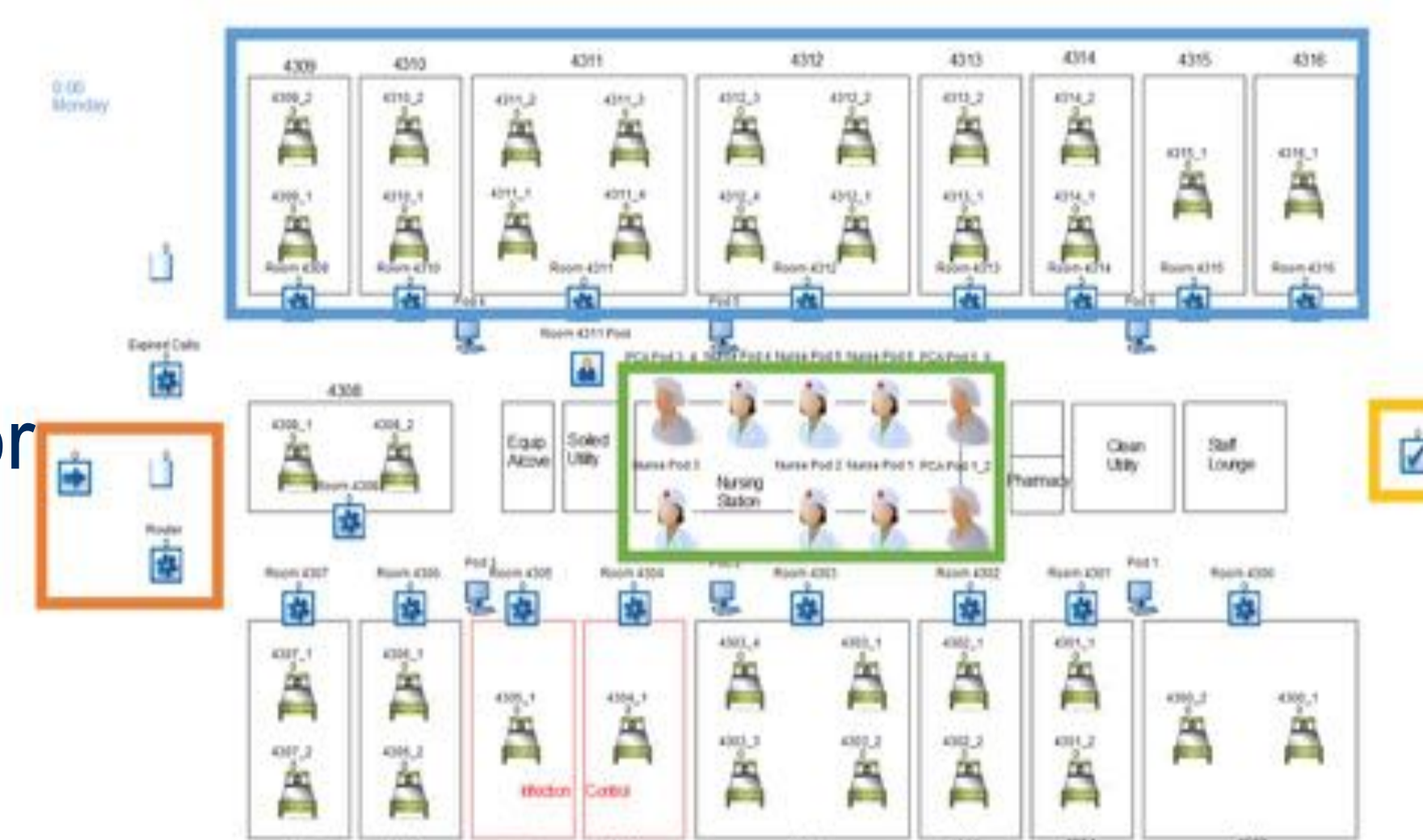
Methodology

RQ1) Evaluation:

- Interrupted Time series analysis to compare the pre and post intervention efficiency (length of stay) and patient safety (patient fall rate)

- Applied Rogers' Diffusion of Innovation Theory for nurse experience measurement

- Statistical analysis to measure Hand-Hygiene compliance rate and patient call response time
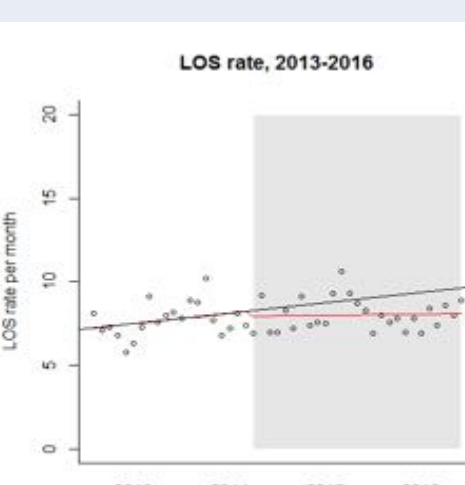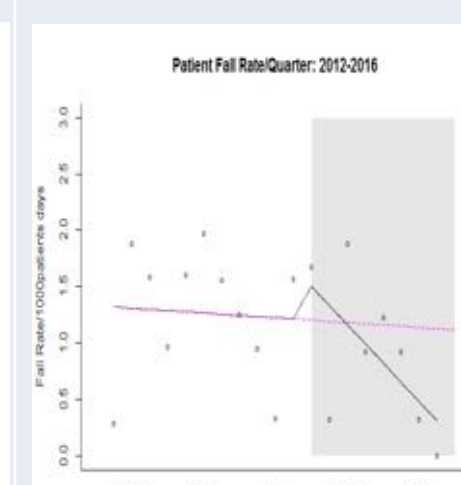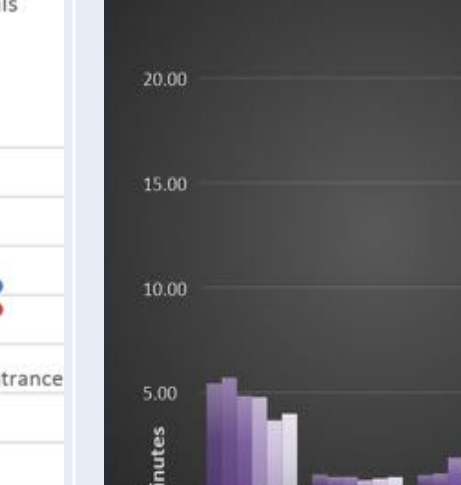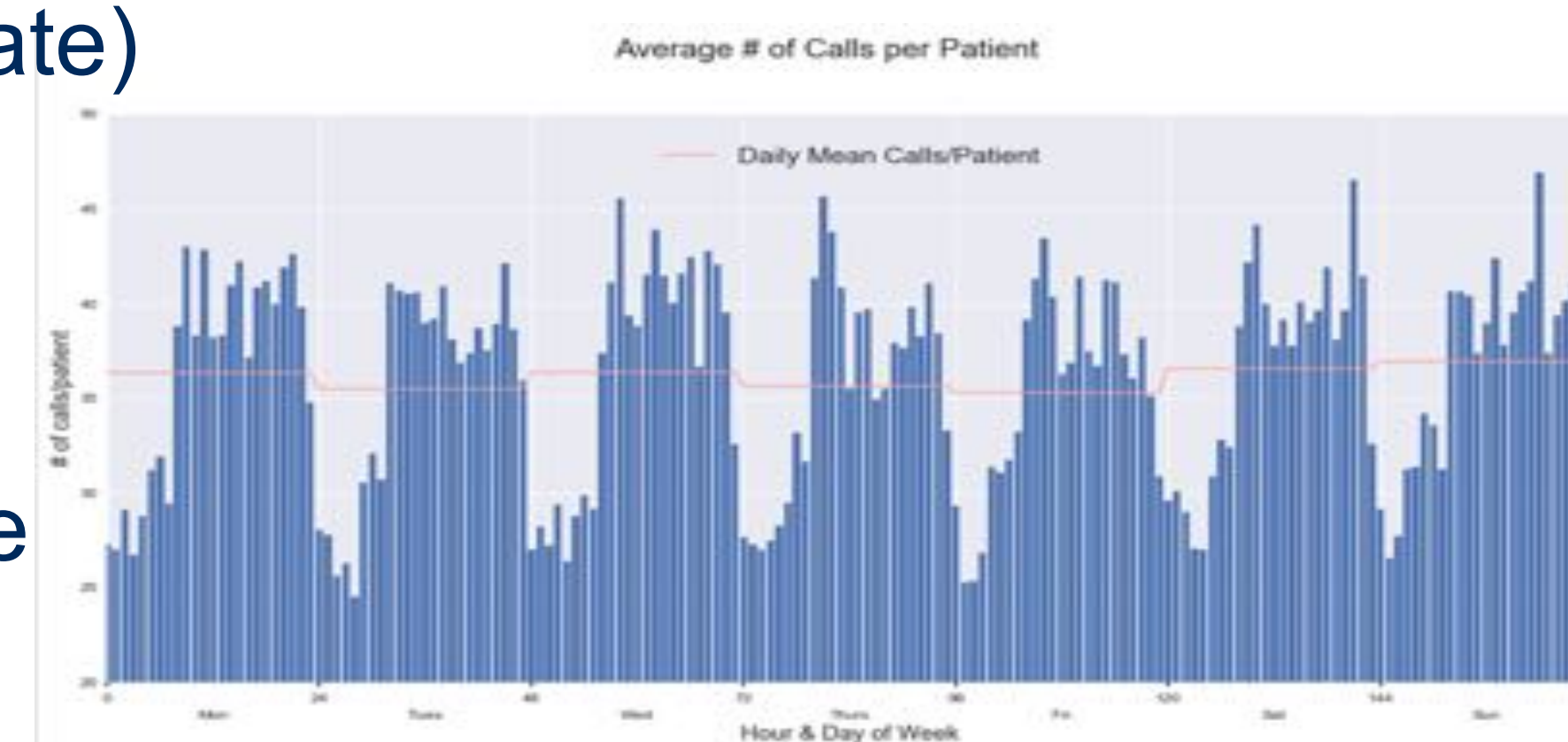
RQ2) Future Improvements:

- Discrete Event Simulation (DES) for future call routing improvement scenarios

Results – RQ1

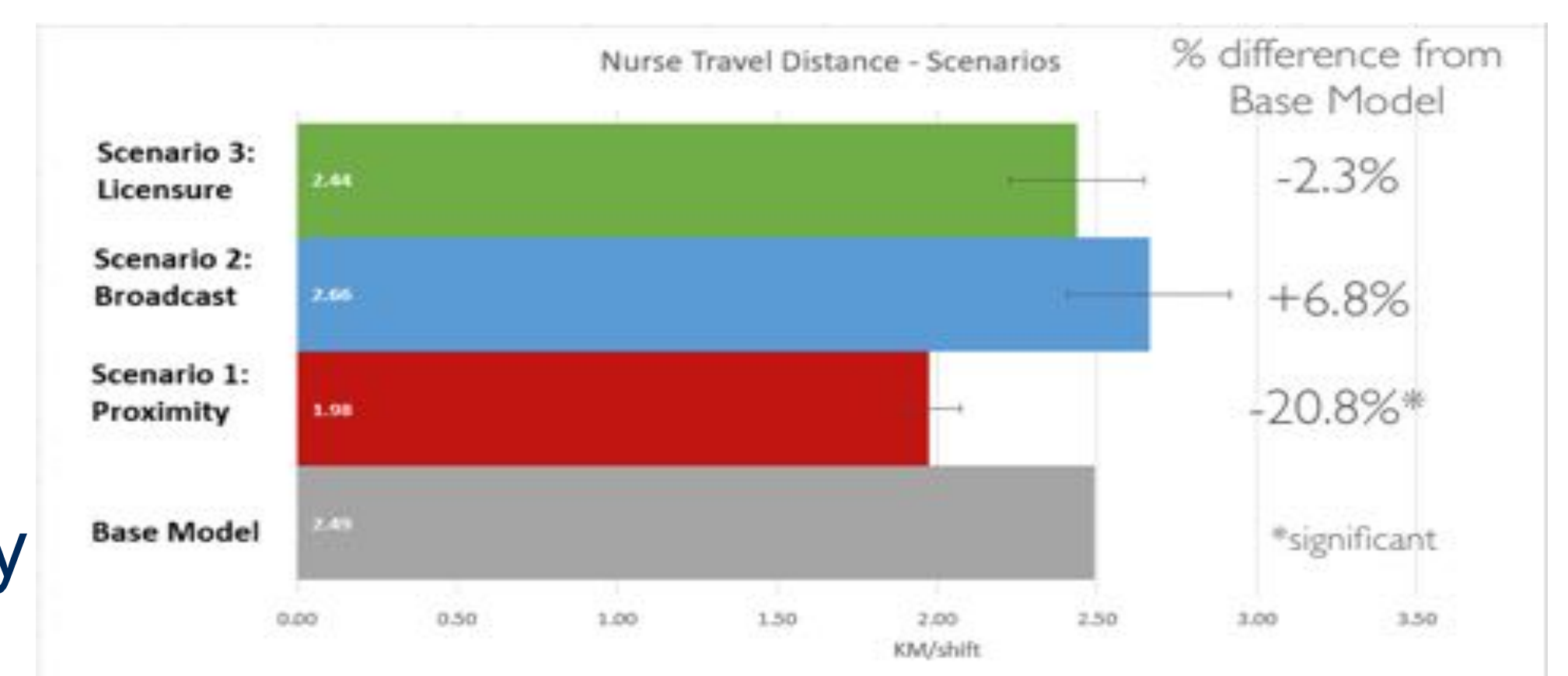| Efficiency	Patient Safety		Timeliness	Staff Experience
1. Length of Stay (LOS)	**2. Patient Falls**	**3. Hand-hygiene Compliance Rate**	**4. Patient Call Response Time**	**5. Interview with Nurses**
A non-significant incremental change post-intervention.	A non-significant incremental change post-intervention.	Increased up to 2015 followed by a decrease over 2015-2016.	Mixed trends in four main types of call response times.	Improvement in communication, direct patient care time and reduced number of patient falls.

Results – RQ2

Tested 3 alternative patient call routing scenarios:
- "Proximity" – nearest available nurse is sent call
- "Call Alternate Pod" (CAP) – call is sent to a less busy pod of nurses for them to assist
- "Call by Licensure" - calls are sent to relevant staff based on call type (e.g. bathroom calls sent to Personal Care Aids (PCAs)/Support Workers

- Mean response times could be further reduced by ~6-18% depending on call strategy
- Nurse travel distance can be reduced by up to ~20%

	Base	Scenario 1: Proximity	Scenario 2: Broadcast	Scenario 3: Licensure
Mean (minutes)	2.49	1.98	2.66	2.44
% Difference from base	0%	-6.1%	-18.5%	-11.8%

Conclusion

1. Application of IoT at MH improved the efficiency (length of stay), patient safety (patient falls, HH-compliance rate), timeliness (patient call response time) and staff experiences
2. Further improvement in unit operations is possible through the use of alternative patient call routing strategies

Acknowledgements

Ontario Centres of Excellence
Where Next Happens

Mackenzie Health