The background features a photograph of a building entrance with a large, arched doorway. The entrance is framed by a stone archway, and the words "DODD CHAUX HALL" are visible above the door. A large, dark silhouette of a tree is overlaid on the left side of the image, partially obscuring the building. The right side of the image is a solid dark green color with a subtle grid pattern.

# **Standardization of Electronic Note-Based Communication in Inpatient Practice**

R. Leigh Mansfield, MS, MSN, AGACNP

# Introduction

- ▶ Breakdown in healthcare communication has been shown to be one of the strongest predictors for healthcare related harm and threatening patient safety (Randmaa, Mårtensson, Swenne, & Engström, 2014; Joint Commission, 2012).
- ▶ VUMC Primary Cardiology communicates via electronic note-based handoff and has no standardized handoff communication between advanced practice providers during shift change
  - Staff note a general dissatisfaction, frequent missed information, and a lack of efficiency in the current handoff process.
  - A QI project to evaluate and standardize the electronic note-based communication has been requested by the team.

# Introduction

- ▶ Handoff communication errors affect both the institution, provider, and patient.
  - Joint Commission notes that 80% of medical errors can be credited to breakdowns in communication during handoff (Joint Commission, 2012).
  - Communication errors in provider-to-provider handoff can increase patient's risk of mortality (American Thoracic Society, 2016).
  - Lapses in reliable communication of medical results and objective findings are a leading cause of paid malpractice claims (Gerber, 2013).
- ▶ Standardization may help:
  - Standardization of handoff can reduce missed diagnosis leading to readmission (Joint Commission, 2012)
  - Standardization of handoff has been shown to improve provider performance outcomes, patient safety outcomes, organizational outcomes, reduced medical errors, and quality of patient care (Keebler et al., 2016).

# Problem Statement

- ▶ Lack of standardization with current provider handoff for VUMC PC team leading to staff dissatisfaction, missing information, and lack of efficiency.
  - Prior to the project the PC team was using an electronic note-based handoff (ENBHO) utilized between providers at shift change to transfer care of patients.
- ▶ Problem was identified through informal verbal polling during monthly staff meeting in which both day and night staff expressed concerns with the handoff communication process.

# PICOT

- ▶ During provider to provider (P) handoff, does standardization of an electronic note-based handoff (SENBHO) communication tool (I) reduce missed information, improve efficiency, and improve staff satisfaction (O) when compared to a non-standardized electronic note-based (ENBHO) handoff communication tool (C) during a 7 day period (T)?

# Purpose and Objectives

- ▶ Evaluate the effectiveness of a standardized electronic note-based handoff (SENBHO) to be utilized between advanced practice providers during shift change for an inpatient cardiology service at VUMC.
- ▶ Objectives:
  1. Identify the problem with the current electronic note-based handoff.
  2. Using input from both dayshift and nightshift providers, create a new standardized electronic note-based handoff tool (SENBHO).
  3. Observe a 7 day baseline data gathering period in which the current ENBHO is evaluated followed by implementation the SENBHO for a 7 day period.

# Background

- ▶ Primary Cardiology (PC) team
- ▶ Staffed by APPs with attending physician coverage
- ▶ Operates 24/7 with an uncapped capacity
- ▶ Averages 25 patients on census
- ▶ 16 total APPs on PC split evenly between dayshift/nightshift
- ▶ Average of 3 admissions a day and 3 admissions overnight
- ▶ 3 APPs staffed during the day handed off to a single (1) cross-cover APP staffed overnight who is responsible for the total PC service of patients (~25 patients)

# Background

- ▶ Both dayshift (3) and nightshift (1) APPs are responsible for chest pain evaluations in the ED, cardiac rapid responses, acute events, and general medical needs that arise with the PC patients.
- ▶ Dayshift APPs complete an electronic note-based handoff (ENBHO) to provide cross-cover APP with up-to-date information, night APP does not reciprocate
- ▶ PC team requested QI project related to current ENBHO given current staff dissatisfaction, frequently missed information and poor efficiency.
- ▶ Given the patient load/risk of emergencies for the nightshift APP, QI project designed to standardize information nightshift APP receives to better prepare them for emergencies or episodic care.



# Concepts

## ▶ Handoff Communication:

- The act of exchanging information regarding a patient from one healthcare professional to another using a common language, terminology, and structure. (Manser, Foster, Gisin, Jaeckel, & Ummenhofer, 2010)

## ▶ Standardization:

- A concrete measurable process by which a standard of care or practice can be measured to ensure consistency and regularity. (Merriam-Webster, 2021; Xie, Hall, McCarthy, Skitmore & Shen, 2016)

# Framework – Model for Improvement (Langley et al., 2009)

## Part 1: Fundamental Questions

- ▶ What are we trying to accomplish?
  - To determine if standardization of handoff would improve staff satisfaction, reduce number of patients missing information, and improve time efficiency.
- ▶ How will we know that a change is an improvement?
  - Using descriptive statistics to analyze changes to pre-intervention and post-intervention surveys.
- ▶ What changes can we make that will result in improvement?
  - If improvements are noted to staff satisfaction, reduction in missed information, and better time efficiency are noted, then the SENBHO may become a part of standard practice for the cardiology team.

# Framework – Plan-Do-Study-Act (Langley et al., 2009)

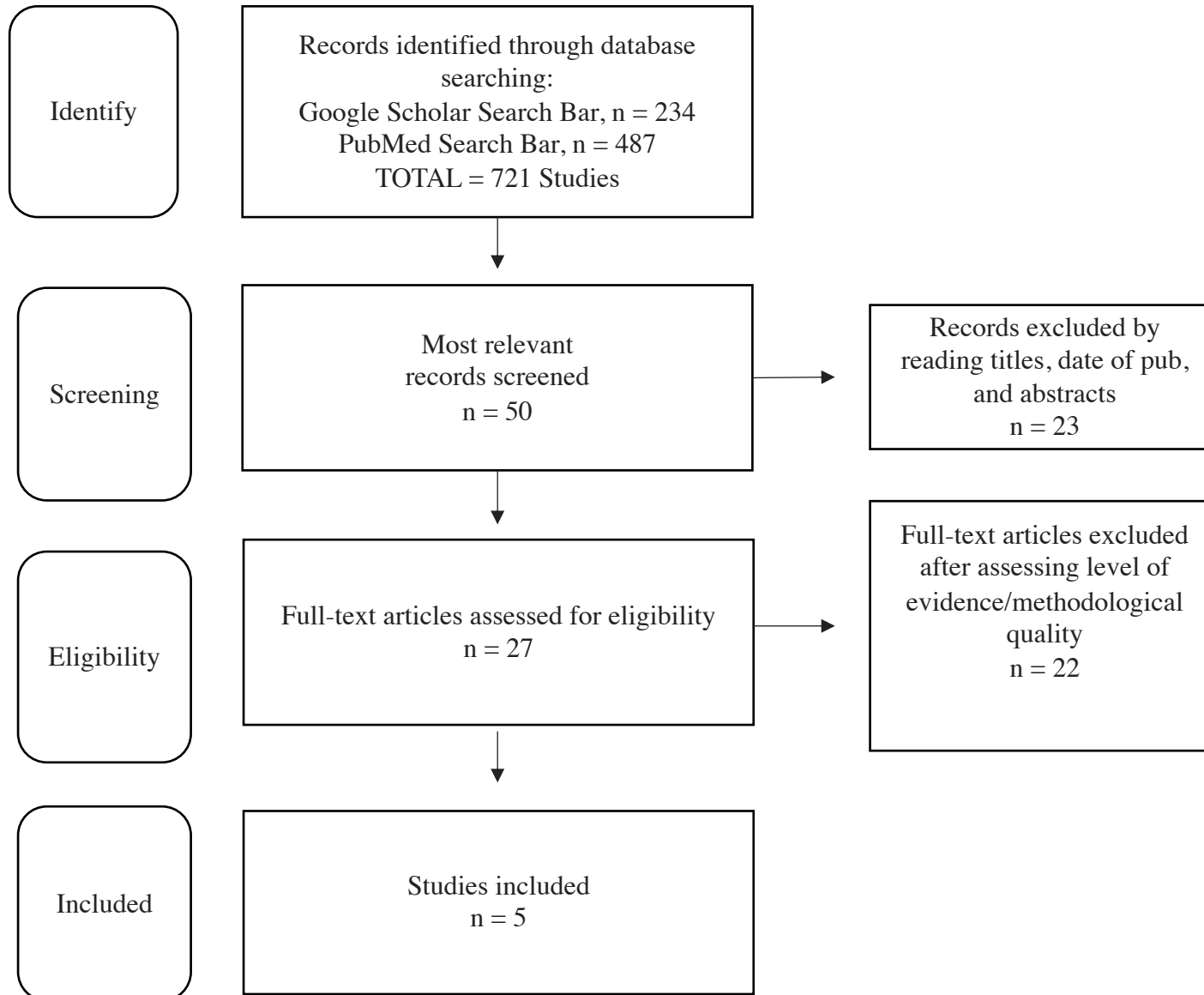
## Part 2: Plan-Do-Study-Act

- ▶ Plan: planning the test or change and identifying data collection tools to be used
  - Verbal Survey
  - Identification of QI project needed for current ENBHO inconsistency
- ▶ Do: implementing intervention on a small scale
  - Gather baseline data from ENBHO (7 days) and compare to SENBHO data (7 days)
- ▶ Study: analyzing results and comparing the results to predictions
  - Data analysis of ENBHO vs SENBHO
- ▶ Act: planning the next steps
  - Adapt? Adopt? Abandon?

# Synthesis of the Evidence: Evidence Search

- ▶ Literature Review:
  - January 2020 – May 2020
- ▶ Various combinations of terms: “Healthcare”, “Communication”, “Handoff”, “Standardization”, “Inpatient”, “Provider”, “Note-based”, and “Shift Change”
- ▶ GoogleScholar, PubMed, references from discovered studies
- ▶ Inclusion Criteria: Full text articles, written in English, published within the last 5 years

# Synthesis of the Evidence: Evidence Search



- ▶ Target population:
  - Providers completing handoff (face-to-face or note-based)
- ▶ 27 initial articles were reviewed
  - 5 were selected for relevance to the PICOT

# Synthesis of the Evidence

- ▶ High quality evidence with limited available studies evaluating provider-provider handoff standardization
- ▶ Common Themes:
  - General trend of current evidence supports handoff standardization with reduction in missed information, omissions, and improvements in perceived preparedness (American Thoracic, 2016; Gillikin & Apatov, 2016; Hoskote et al., 2017; Joint Commission, 2012; Mukhopadhyay et al., 2018; Parent et al., 2018)
  - Staff satisfaction can be improved with handoff standardization (Gillikin & Apatov, 2016; Mukhopadhyay et al., 2018; Parent et al., 2018)
  - Standardization of handoff yielded no increase in time to complete handoff, perceived or otherwise (Gillikin & Apatov, 2016; Joint Commission, 2012; Mukhopadhyay et al., 2018; Parent et al., 2018)
  - Each study used a pre-test/post-test methodology comparing the non-standardized handoff to a new standardized handoff (American Thoracic, 2016; Gillikin & Apatov, 2016; Hoskote et al., 2017; Joint Commission, 2012; Mukhopadhyay et al., 2018; Parent et al., 2018)
  - Using a self created handoff tool created by input from participating staff can be **successful** (American Thoracic, 2016; Gillikin & Apatov, 2016; Hoskote et al., 2017; Mukhopadhyay et al., 2018; Parent et al., 2018)

# Synthesis of the Evidence

## ▶ Gaps:

- Available evidence is limited that focuses on provider-to-provider handoff, limited even further in exclusively APP handoff

## ▶ Strengths:

- Literature review included 5 studies that included the use of a self-made handoff tool, 3 that use an electronic note-based handoff standardization
- More data in the last 5 years utilizing electronic handoff

## ▶ Further Research:

- Focus on provider-to-provider handoff including APP specific handoff

# Methods

## ▶ Project Design

- QI project designed to standardize the handoff completed by dayshift when transferring care to nightshift
- Utilizing a pre-test/post-test methodology to compare the previous ENBHO to a new SENBHO

## ▶ Setting

- VUMC→VHVI→PC Team
- APP run team with 3 dayshift providers and 1 nightshift provider per day
- A total of 14 days, 7 days for baseline data and 7 days for implementation will be captured

## ▶ Participants

- 16 total APPs are staffed on the service
- Approved by DAP and Medical director for VHVI





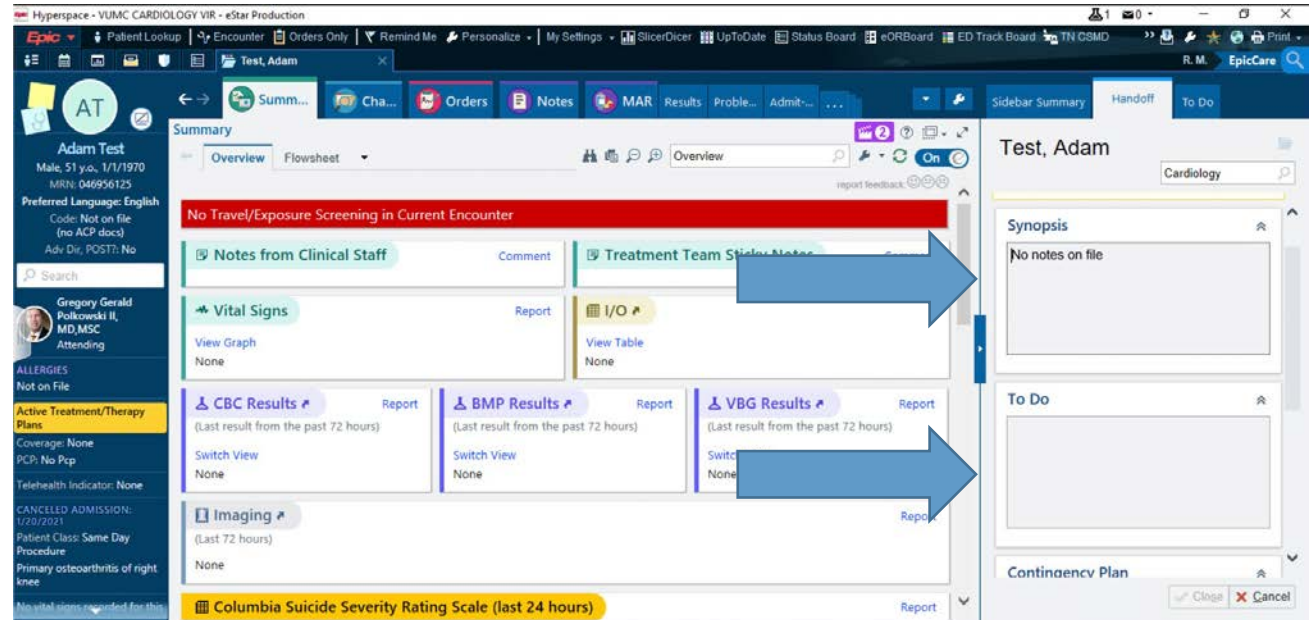
# Methods - Dayshift and Nightshift

- ▶ Dayshift (PC A,B, or C)
- ▶ 3 APPs per day
  - Averages 6-8 pts/APP
  - Completing handoff on each patient
  - Responsible for patient's primary inpatient care
- ▶ Handoff Goal:
  - standardize information nightshift APP receives to better prepare them for emergencies or episodic care.
- ▶ Nightshift
- ▶ 1 APP per night
  - Covers total service of patients
  - Provides episodic and emergency care
- ▶ Does not independently complete handoff
  - Evaluating handoff completed by Dayshift

# Methods - ENBHO

## Electronic Note-Based Handoff

- Previously in use by PC day team
- Free text box located within the sidebar of the EMR
- No standardization
- Often not completed at all
- Each dayshift member completes their own version of handoff with varying information



# Methods – SENBHO

- ▶ Standardized Electronic Note-Based Handoff
  - New version of handoff to be evaluated
  - Self designed, using input from both dayshift and nightshift APPs
  - Provides sections for information to be added
  - Was designed to auto-populate in the EMR handoff tab pictured previously

- ▶ Standardized Items Included in new SENBHO
  - Attending:
  - Admission Dx:
  - Alerts:
  - Active Plan:
  - Changes for the Day:
  - Interventional Hx:
  - Diagnostic Hx:
  - Procedures:
  - Disposition:
  - Barriers to Discharge:
  - Nights To Do:

# Methods – Implementation

- ▶ 7 day baseline data gathering period to evaluate the ENBHO, followed by a 7 day implementation period to evaluate new SENBHO
- ▶ Daily evaluation completed using Redcap Survey System
- ▶ Each provider (dayshift/nightshift) was be emailed a survey link for Redcap evaluate the ENBHO
- ▶ Using the data from the Redcap surveys, the ENBHO and SENBHO was be compared in Excel

# Methods - Surveys

- ▶ Pre-Intervention Survey (PIS)
  - given to both dayshift and nightshift providers during the 7 day baseline data gathering period to evaluate the ENBHO
- ▶ Post-Intervention Survey (POIS)
  - given to both dayshift and nightshift providers during the 7 day intervention period to evaluate the SENBHO
- ▶ Provider was be emailed a Redcap link to the corresponding survey daily
- ▶ Surveys are team specific

# Methods - Dayshift Surveys PIS vs POIS

## Pre-Intervention Survey Dayshift (Assessment of non-standardized handoff)

Date: \_\_\_\_\_

1. Please select current team: A B C
2. Using a whole number, how many patients are on your team census (A, B, or C) at the end of your shift?  
Census: \_\_\_\_\_
3. On a scale of 1 to 5, with 1 being the least satisfied and 5 being the most satisfied, how satisfied were you with this non-standardized handoff structure? Please select one.

1                      2                      3                      4                      5  
Very Dissatisfied    Dissatisfied        Neutral              Satisfied            Very Satisfied

4. At the end of your shift, when completing the current non-standardized handoff, what was the perceived amount of time required to complete handoff for your total census of patients? Please select one.

0-5min    5-10 min    10-15 min    15-20 min    >20 mins

5. Please add any additional comments below:

## Post-Intervention Survey Dayshift (Assessment of standardized handoff tool)

Date: \_\_\_\_\_

1. Please select current team: A B C
2. Using a whole number, how many patients are on your team census (A, B, or C) at the end of your shift?  
Census: \_\_\_\_\_
3. On a scale of 1 to 5, with 1 being the least satisfied and 5 being the most satisfied, how satisfied were you with this standardized handoff structure? Please select one.

1                      2                      3                      4                      5  
Very Dissatisfied    Dissatisfied        Neutral              Satisfied            Very Satisfied

4. At the end of your shift, when completing the current standardized handoff tool, what was the perceived amount of time required to complete handoff for your total census of patients? Please select one.

0-5min    5-10 min    10-15 min    15-20 min    >20 mins

5. Please add any additional comments below:

# Methods - Nightshift Surveys PIS vs POIS



## Pre-Intervention Survey Night Shift

Date: \_\_\_\_\_

1. How many patients are on the Page Campbell census at the start of your shift?

Census: \_\_\_\_\_

2. Was handoff completed on all of the Page Campbell patients? If no, please specify the number of patients without a completed handoff.

YES or NO      Number of patients with no handoff: \_\_\_\_\_

3. What was the perceived amount of time required to complete handoff for your total census of patients? Please circle one

0-5 min    5-10 min    10-15 min    15-20 min    >20 min

4. On a scale of 1 to 5, with 1 being the least satisfied and 5 being the most satisfied, how satisfied were you with this standardized handoff structure? Please circle one.

1            2            3            4            5  
Very Dissatisfied    Dissatisfied    Neutral    Satisfied    Very Satisfied

5. During this shift, were there times you felt the handoff provided insufficient information to provide adequate care for this patient?

Number of times: \_\_\_\_\_

Please provide additional information:

6. Please add any additional comments below:

## Post-Intervention Survey Night Shift

1. How many patients are on the Page Campbell census at the start of your shift?

Census: \_\_\_\_\_

2. Was the standardized handoff completed on all of the Page Campbell patients? If no, please specify the number of patients without a completed handoff.

YES or NO      Number of patients with no handoff: \_\_\_\_\_

3. What was the perceived amount of time required to complete handoff for your total census of patients? Please circle one

0-5 min    5-10 min.    10-15 mins    15-20 mins.    >20 mins

4. On a scale of 1 to 5, with 1 being the least satisfied and 5 being the most satisfied, how satisfied were you with this standardized handoff structure? Please circle one.

1            2            3            4            5  
Very Dissatisfied    Dissatisfied    Neutral    Satisfied    Very Satisfied

5. During this shift, were there times you felt the handoff provided insufficient information to provide adequate care for this patient?

Number of times: \_\_\_\_\_

Please provide additional information:

6. Please add any additional comments below:

# Methods – Survey Distribution in REDCap®

Distributed via email link to  
providers daily.

Selections would populate for  
Dayshift vs. Nightshift based on  
answers.

## Handoff Survey

Page 1

Please complete the survey below.

Thank you!

---

Today's Date: \_\_\_\_\_

---

Are you a dayshift or nightshift provider?  Dayshift  Nightshift

---

Please select current team:  A  B  C

---

Using a whole number, how many patients are on your team census (A, B, or C) at the end of your shift? \_\_\_\_\_

---

How many patients are on the Page Campbell census at the start of your shift? \_\_\_\_\_

---

Was handoff completed on all of the Page Campbell patients?  Yes  No

---

If no to the previous question, please specify the number of patients without a completed handoff. \_\_\_\_\_

---

On a scale of 1 to 5, with 1 being the least satisfied and 5 being the most satisfied, how satisfied were you with this non-standardized handoff structure? Please select one.  1 - Very Dissatisfied  2 - Dissatisfied  3 - Neutral  4 - Satisfied  5 - Very Satisfied

---

What was the perceived amount of time required to complete/review handoff for your total census of patients?  0-5 minutes  5-10 minutes  10-15 minutes  15-20 minutes  >20 minutes

---

During this shift, were there times you felt the handoff provided insufficient information to provide adequate care for this patient? \_\_\_\_\_

---

Please provide additional information on information missing from the handoff (if any). \_\_\_\_\_

---

5. Please add any additional comments: \_\_\_\_\_

---



# Analysis

- ▶ Completed using both qualitative and quantitative data points from the PIS and PIOS and compared to determine:
  - change in provider satisfaction measured on a Likert Scale
  - missed information represented numerically
  - time efficiency represented in number of minutes to complete
- ▶ Descriptive statistics
  - Excel

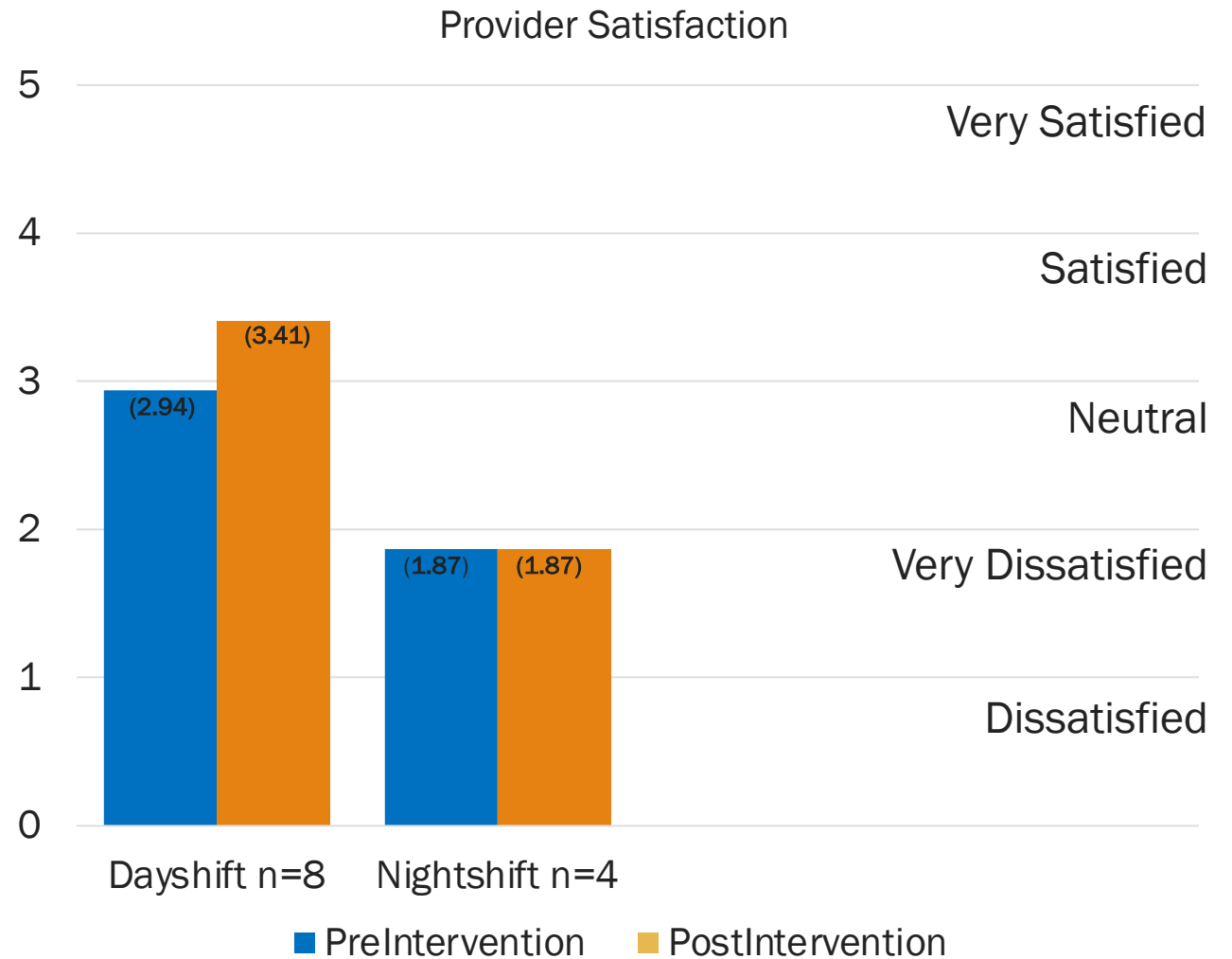
# Results

- ▶ Participants (N=12, dayshift n=8, nightshift n=4)
- ▶ Total surveys sent n=56, total received n=48
  - response rate: 81% dayshift, 100% nightshift
- ▶ During data gathering average provider patient ratios were 1:7 for dayshift and 1:21 for nightshift
- ▶ Overall, the data suggests that the problems surrounding inadequate and incomplete handoff were not corrected with handoff standardization in this current climate of healthcare.
- ▶ Reassuringly, some improvements were noted a may yield different results with a longer time of study.

# Results – Provider Satisfaction

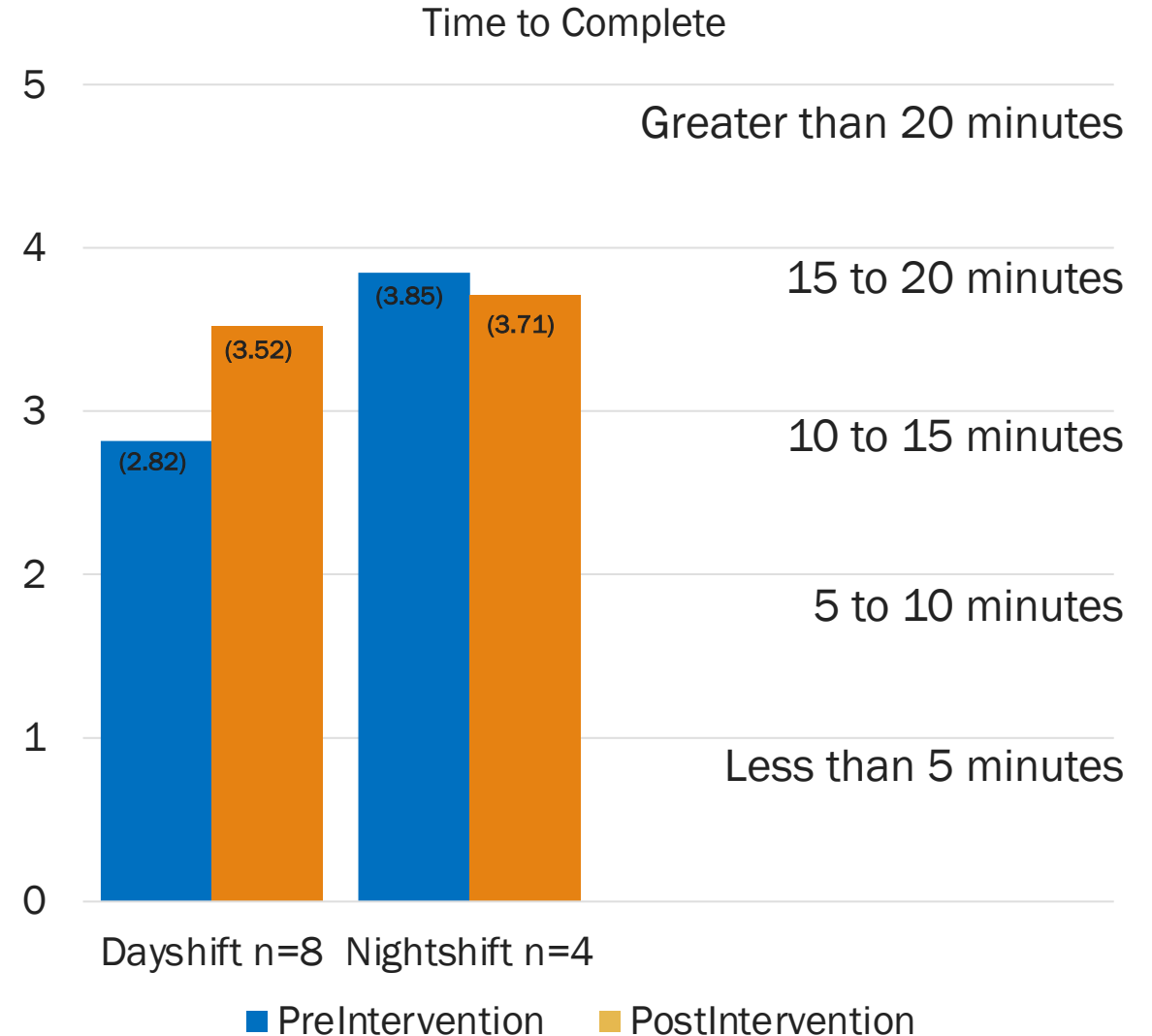
Preintervention nightshift reported an average handoff satisfaction of “(1) very dissatisfied to (2) dissatisfied” (1.87), this satisfaction did not change in the post-intervention period with the introduction of the standardized handoff.

Preintervention dayshift reported an average handoff satisfaction of “(2) dissatisfied to (3) neutral” (2.94), this satisfaction did improve slightly post-intervention with the standardized handoff, dayshift then reported an average satisfaction of “(3) neutral to (4) satisfied” (3.41).



# Results – Time Efficiency

- ▶ Pre-intervention the dayshift average time to complete handoff was between (2) “5 to 10 minutes” and (3) “10 to 15 minutes” (2.82). Time to complete rose slightly for dayshift post-intervention with standardized handoff between (3) “10 to 15 minutes” and (4) “15 to 20 minutes” (3.52).
- ▶ Pre-intervention the nightshift average time to complete handoff was between (3) “10 to 15 minutes” and (4) “15 to 20 minutes” (3.85). Time to complete decreased minimally for nightshift post-intervention while reviewing standardized handoff but remained between (3) “10 to 15 minutes” and (4) “15 to 20 minutes” (3.71).



# Results – Patients with missing handoff?

## ▶ Nightshift Preintervention

- The nightshift noted an average of 4 patients (4.28) nightly with missing or incomplete handoff
- Preintervention an average of **20.83%** of patients with missing or incomplete handoff

## ▶ Nightshift Post-Intervention

- The nightshift providers again noted an average of 4 patients (4.14) with missing or incomplete handoff, this number did decrease slightly from previous.
- Post-intervention averages decreased slightly post intervention to **19.71%** of patients with missing or incomplete handoff.

# Results – Qualitative comments section

## ▶ ENBHO Dayshift

- “labor intensive when starting with new patients”
- “I use my own dotphrase, so it’s pretty quick”
- “also always give nightshift a brief verbal handoff”
- the non-standardized handoff includes “a lot of information that may not be necessary”

## ▶ ENBHO Nightshift

- “difficult to get through”
- worse than usual”
- “handoff was adequate today”
- “many patients with no handoff”
- “information provided but unimportant”
- “incomplete handoff on multiple patients requiring additional chart review”



# Results – Qualitative comments section

## ▶ SENBHO Dayshift

- “new handoff tool takes longer”
- “hard to get used to with such a high census”
- “I like the new format. Would add PMH section”
- “it depends if the handoff has been completed properly prior to my shift”
- “not bad, helpful”

## ▶ SENBHO Nightshift

- “I like all the additional information included in handoff”
- “takes a long time to dig through charts to find information”
- “still missing a lot”
- “to do and plan of care were not updated”

# Results – Human Error Component

- ▶ Nightshift report of communication breakdown
  - During implementation of SENBHO one provider noted that a patient had been transferred out of the ICU and the SENBHO had been completed on the patient.
  - There was no mention of chest imaging follow-up in the SENBHO and overnight the patient was found to have a large saddle PE requiring unit transfer and intervention.
  - This did not lead to a negative outcome for the patient in this instance but demonstrates a continued breakdown of communication despite standardization.
  - **This may suggest that human error plays a role in healthcare communication breakdowns.**



# Discussion



Overall, the results suggest that despite handoff standardization, lack of satisfaction with handoff and breakdown in communication still persists, however some improvement was noted.



Findings differed slightly from predictions, the expectation was to see increases in provider satisfaction for both teams, a reduction in the number of patients with missing handoff, and subtle increases in times to complete for dayshift but a decrease in time to complete for nightshift.



These predictions were not met, this is thought to be due to the external factors and reduced amount of time to implement the project.

# Discussion– Limitations

## Timeline

- intervention period was only 7 days and likely a longer timeframe could yield different results

## Pandemic Delta Variant Surge

- the cardiology team wanted to limit the amount of time to pilot a new handoff tool
- Patient acuity increased
- the hospital initiated stricter protocols

## Team Utilization

- cardiology team became divided and took on patients with COVID-19 related needs that were not cardiology patients
- additional patient load increased overall team census and acuity
- reduced the utility of the SENBHO for the COVID-19

## Nightshift Scheduling

- Due to nightshift scheduling blocks, only 4 nightshift providers were captured
- This may have skewed the results given only 4 total opinions were received

# Discussion – Strengths

## Self created handoff

- This tool was created by the team that piloted it and was tailored to the patient population

## Requested by Staff

- This project was requested by all parties involved and that likely contributed to the high response rate

## Completed using exclusively APPs

- Few studies have been completed examining communication in APPs exclusively



## Discussion– Where to go from here?

- ▶ Additional research is needed that focuses on APP provider-to-provider communication.
- ▶ This project was limited by time and pandemic circumstances.
- ▶ In the future the author would recommend a longer implementation period.
  - studies found during literature review, the minimum amount of time for implementation was a 1-month time frame, and 3-month and 6-month time frames

# Conclusion

- ▶ At this time the cardiology team has elected to continue with the previous non-standardized handoff until such time as another pilot project can be completed to evaluate a new standardized handoff under different circumstances.
- ▶ Implementing the project under less stressful conditions may improve overall satisfaction and reduce human error.

# Conclusion

- ▶ Given the increased utilization of APPs in the inpatient environment, more research is needed into the standardization of APP provider-to provider communication.
- ▶ Minimal improvements were noted with standardization suggesting that under different circumstances a more favorable outcome may have been achievable.

# References

- ▶ American Thoracic Society. (2016, May 16). Monthly resident handoff of patients may increase risk of dying. *ScienceDaily*. Retrieved September 18, 2019 from [www.sciencedaily.com/releases/2016/05/160516151608.htm](http://www.sciencedaily.com/releases/2016/05/160516151608.htm)
- ▶ Gillikin, K. E., & Apatov, N. (2016). The effectiveness of an anesthesia handoff tool: An electronic health record application to enhance patient safety. *Anesthesia eJournal*, 4(1).
- ▶ Graber, M. L. (2013). The incidence of diagnostic error in medicine. *BMJ Qual Saf*, 22(Suppl 2), ii21-ii27.
- ▶ Hoskote, S. S., Racedo Africano, C. J., Braun, A. B., O'Horo, J. C., Sevilla Berrios, R. A., Loftsgard, T. O., & Smischney, N. J. (2017). Improving the quality of handoffs in patient care between critical care providers in the intensive care unit. *American Journal of Medical Quality*, 32(4), 376-383.
- ▶ Joint Commission. (2012). *Joint commission center for transforming healthcare release targeted solutions tool for hand-off communications*. Retrieved from [http://www.jointcommission.org/assets/1/6/TST\\_HOC\\_Persp\\_08\\_12.pdf](http://www.jointcommission.org/assets/1/6/TST_HOC_Persp_08_12.pdf)
- ▶ Langley, G.J., Moen, R.D., Nolan, K.M., Nolan T.W., Norman, C.L., & Provost, L.P. (2009). *The Improvement Guide: A practical approach to enhancing organizational performance*. San Francisco, CA: Jossey-Bass: A Wiley Imprint.
- ▶ Likert, Rensis (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 140, pp 44-53.
- ▶ Manser T, Foster S, Gisin S, Jaeckel D, Ummenhofer W. (2010) Assessing the quality of patient handoffs at care transitions. *Qual Saf Health Care*. 2010;19(6):e44

# References

- ▶ Mukhopadhyay, D., Wiggins-Dohlvik, K. C., MrDutt, M. M., Hamaker, J. S., Machen, G. L., Davis, M. L., ... & Shake, J. G. (2018). Implementation of a standardized handoff protocol for post-operative admissions to the surgical intensive care unit. *The American Journal of Surgery*, 215(1), 28-36.
- ▶ Parent, B., LaGrone, L. N., Albirair, M. T., Serina, P. T., Keller, J. M., Cuschieri, J., & Moon, S. D. (2018). Effect of standardized handoff curriculum on improved clinician preparedness in the intensive care unit: a stepped-wedge cluster randomized clinical trial. *JAMA surgery*, 153(5), 464-470.
- ▶ Randmaa, M., Mårtensson, G., Swenne, C. L., & Engström, M. (2014). SBAR improves communication and safety climate and decreases incident reports due to communication errors in an anaesthetic clinic: a prospective intervention study. *BMJ open*, 4(1), e004268
- ▶ Merriam-Webster (2021). Webster's Online Dictionary. Definition of: Standardize, Standardization. Retrieved May 20<sup>th</sup>, 2021 from <https://www.merriam-webster.com/dictionary/standardize>
- ▶ Xie, Z., Hall, J., McCarthy, I. P., Skitmore, M., & Shen, L. (2016). Standardization efforts: The relationship between knowledge dimensions, search processes and innovation outcomes. *Technovation*, 48, 69-78.