Reducing Emergency Department Referrals for Dehydration Following Bariatric Surgery

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Abstract

Problem: Following bariatric surgery, approximately 20-25% of post-surgical patients in the weight management clinic of a large academic medical center are referred to the emergency department (E.D.) for intensive treatment of symptoms related to dehydration. Current literature indicates that implementing dehydration prevention measures in post-bariatric surgery patients could decrease the number of these patients referred to the E.D. for treatment through additional surveillance and early intervention. **Purpose:** This quality improvement project aims to reduce the number of post-operative patients referred to the E.D. for treatment of dehydration through standardized screening and early identification of at-risk patients. This will translate into reduced E.D. referral rates and outcomes improvement with early identification of potential problems. **Methods:** Over fifteen weeks, the New Geriatric Dehydration Screening Tool (NGDST) was implemented in the outpatient bariatric surgery clinics of a large teaching hospital centrally located in a medium-sized city. Each post-operative care clinic provider completed education and training on the application of the NGDST, the recording and interpretation of results, and the new screening pathway for interventions. The NGDST was then implemented and utilized in screening post-operative patients within the first month of bariatric surgery. **Results:** There was one E.D. referral for dehydration during the NGDST implementation period, compared to fourteen E.D. referrals during the same time the previous year resulting in a 2% E.D. referral rate representing a significant reduction from the 20% rate before implementation. **Conclusions:** A standardized dehydration screening tool significantly decreased referrals to the E.D. for dehydration compared to the same period in the previous twelve months.

Keywords: bariatric surgery, dehydration, post-operative care, dehydration screening tool, New Geriatric Dehydrations Screening Tool, NGDST

Reducing Emergency Department Referrals for Dehydration Following Bariatric Surgery

Dehydration is one of the most commonly cited reasons for emergency department (E.D.) referrals in post-surgical bariatric patients. According to Chen et al. (2018), approximately half of all E.D. referrals following bariatric surgery are preventable. Less than a quarter of those presenting to the E.D. require subsequent inpatient admission. Each year approximately 25% of post-bariatric surgery patients present to the E.D. for dehydration and factors contributing to dehydration, such as nausea, vomiting, and abdominal pain (Ivanics et al., 2019). Untreated dehydration can lead to rehospitalization, kidney injury, seizures, hypovolemic shock, or death. Ivanics et al. (2019) stated that dehydration has resulted in many bariatric clinics establishing dehydration protocols that include increased surveillance, improved post-discharge instructions, and outpatient intravenous rehydration. Unfortunately, there is no standard for assessing or preventing dehydration across the spectrum of care following bariatric surgery.

Likewise, E.D. referral rates from the bariatric surgery clinics at a large academic medical center centrally located in a mid-sized urban setting reflect the specialty trend, with 20% of the last one hundred bariatric surgery patients referred for treatment related to dehydration. E.D. referrals continue to occur despite an extensive pre/post-surgery education programprescribed anti-emetics, and analgesics for symptom management. These escalations in care result in delayed treatment progression post-surgery, increased patient burden, increased care costs, and increased risk of complications. The purpose of this quality improvement project is to implement the New Geriatric Dehydration Screening Tool (NGDST) in the outpatient bariatric surgery clinics of a large academic medical center, to identify at-risk post-operative bariatric patients and to evaluate the effectiveness of identification in preventing E.D. referrals.

While all clinic providers screen for dehydration, this assessment is completed differently by providers of each discipline (see Appendix A).

Literature Review

The phenomenon of E.D. referrals for interventions after bariatric surgery are well known across the field, and many facilities have conducted internal reviews to identify the physiological causes. Chen et al. (2017) explored one such thought associated with a university hospital at their facility. A retrospective study of the electronic medical records (EMR) of 361 post-operative bariatric surgery patients was conducted independently by six healthcare providers. They found that sixty-five patients, or 18%, were referred to the E.D. for interventions in the first ninety days after surgery. In addition, 27.9% of the preventable E.D. visits were attributed to nausea, vomiting, and dehydration, accounting for most E.D. referrals. Two other contributors to poor hydration status: post-operative pain at 25.6% and compliance issues at 14%, accounted for a significant portion of the return for emergent interventions. (see Table 1)

Similar conclusions were obtained in a larger study conducted by Ivanics et al. (2019), who reviewed 256,817 records of post-bariatric surgery patients in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) Participant Use Data File. This study confirms that dehydration was a significant cause of E.D. return post-operatively but went further in identifying some of the demographics that place patients at risk for dehydration. Researchers found that patients who were < 40 years old, female, and had a history of hypertension (HTN) and gastroesophageal reflux disease (GERD), among other factors, were at a higher risk of E.D. return for treatment of dehydration. Patients with a past medical history of HTN and GERD account for a large portion of the bariatric surgery population, therefore putting most post-operative patients at increased risk for dehydration.

Despite evidence indicating post-operative dehydration is of significant concern in bariatrics, the decision to utilize a dehydration tool from geriatrics was necessary as there was no validated tool specifically designed for the post-bariatric surgery population. The Geriatric Dehydration Screening Tool (GDST), developed in 2010, measured an individual's hydration risk through eleven questions that identify factors that contribute to dehydration at a sensitivity of 95% (Vivanti et al., 2010). Three studies involved validation studies with subsequent revisions to the GDST. Rodrigues et al. (2015) built on the tool validated by Vivanti et al. (2010) by adding four questions on drinking habits and removing four questions that relied on physical examination results; validation was confirmed with a Cronbach's alpha of > 0.5. (see Table 1)

Guastaferro et al. (2018) further improved upon the GDST screening through the development of a new tool that built upon the original eleven question GDST. The new tool called the NGDST included an additional 6 questions on muscle cramps, dizziness, urine quality/color, dry sticky mouth, irritability and modes of hydration. Like its predecessor the NGDST was proven to be reliable at predicting dehydration risk with a Cronbach's alpha 0.63. This newer edition of the tool also provided a reference score that the previous two versions did not. Researchers determined that a score of "6 or higher" on the NGDST indicated that an individual was at increased risk for dehydration at a sensibility of 78% and specificity of 70%. The inclusion of a quantitative score as a guide improved the ability to trend a patient's dehydration status over time based on their computed scores. (see Table 2)

Theoretical Framework

The framework for this initiative is the Representational Approach (RA), a health behavior theory that prompts actionable change through the application of knowledge and

education. This theory leans heavily on the Common-Sense Model (CSM) as the cornerstone of conceptual change. It consists of seven components: representational assessment, exploration of individual knowledge gaps or concerns or misconceptions, creation of conditions for change, new information, goal setting and management strategies, summarization, and evaluation of strategies with revision. (see Figure 1) All of this mid-level theory steps have already been applied at each phase during project development and implementation. For the remainder of the project, the evaluation/new information step will be used weekly, utilizing steps 4 through 7, enabling identification, goal development, and confirmation of adjustments to implementation with future evaluation. (See Figure 1) The RA is uniquely suited to this quality improvement project. It accounts for recognition of gaps/deficits, integration of these findings in ongoing education, and reassessment with the application of changes to improve positive outcomes.

Helfrich et al.'s (2007) Conceptual Framework of Complex Innovation Implementation applies to this initiative, encompassing many elements needed to ensure successful project implementation. Both external and internal data have positively contributed to the *implementation climate* with all the stakeholders understanding and desiring the need for change. The clinic leadership, physician/surgeon, and the certified nurse practitioner (CRNP) provided management support for the project and active participation in its development. In addition, the *innovation champion* is not only the clinical site representative (CSR) for the project but also the bariatric program administrator, increasing the probability of continued buy-in and sustainability. *Resource availability* impacts will be minimal for this project as the tool will be integrated into the existing electronic health record (EHR) and administered during regularly scheduled visits. There is support at the larger health system level for this project, as a reduction in E.D. referrals after surgery and improved patient outcomes positively affect institutional ratings and revenue.

Methods

The NGDST was implemented in the outpatient bariatric clinics of a large teaching hospital centrally located in a medium-sized urban setting. It was administered to all post-surgical bariatric patients without exception during the observation period. It was necessary to include all patients who completed surgery so that they all had the opportunity to benefit from this initiative. The patient population is diverse and included patients from throughout the state along with neighboring jurisdictions. The post-surgical population included: adult > 18 years old, cis male, cis female, one transgender female, white, black, and Latino patients with BMI > 39. No patients of other racial groups underwent bariatric surgery during the observed period.

The implementation period for NGDST was designated over fifteen weeks, from August 2021 to December 2021. The providers who offered post-surgical care in the first month included one CRNP, two registered dietitians (RDH), and one registered nurse (RN). An educational session was completed with each post-operative care clinic provider on the application of the NGDST, the recording and interpretation of results, and the new screening pathway for interventions. Training tools to assist with education included a PowerPoint presentation and a copy of the NGDST with scoring instructions (see Appendix B). Providers were also educated on the new clinic workflow incorporating the NGDST (see Appendix C) and provided the opportunity to ask questions. The NGDST was then implemented and utilized in screening post-operative patients within the first month of bariatric surgery.

During the pre-implementation period, data on E.D. referrals for dehydration was collected on the previous twelve months and plotted on a run chart (see Appendix D). This was completed to compare E.D. referrals to both the three months immediately preceding the implementation period and the same fifteen week period the previous year. Patient information

was de-identified by removing all patient identifiers and assigning a random number for tracking. Data was collected on NGDST scores and E.D. referrals at the first post-operative call and the first post-operative visit (See Appendix E). Data was collected weekly and analyzed to identify trends. In the first month, after the NGDST, scoring showed lower than expected scores based on reported symptoms. refresher training was completed, and an electronic copy of the scoring sheet was provided for reference.

Results

During the pre-implementation period, an educational session on NGDST was completed with 100% of post-operative providers through an in-service. Additional education was provided at thirty days to ensure reliability among providers by providing the scoring key. The administration of the NGDST to 100% of post-operative patients was achieved before the target date of 12/01/2021. The NGDST was administered to forty-six clinically appropriate patients at the first post-operative call and again at the first post-operative appointment. Only one patient was not administered the NGDST during the implementation period as the subject was referred to the E.D. to rule out pulmonary embolism. This resulted in a tool administration rate for post-surgical patients of 98%. NGDST scores for the first post-operative call ranged from 0 to 5, with a mean score of 2. At the first post- operative visit, scores ranged from 0 to 5, with a mean score of 1. Out of forty-six patients administered the NGDST, only one patient was referred to the E.D. for dehydration during the implementation period (see Appendix D). This represents an E.D. referral rate of 2% compared to 20% during the same three months in 2020.

Discussion

Deficits during the implementation period were identified and evaluated using the mid-level nursing theory, the RA. The main issue identified was poor consistency in scoring between providers for similar symptoms or complaints. Although all providers completed in person training sessions during the pre-implementation period, additional training was required accompanied by the tool scoring key to ensure reliability between providers. Application of the NGDST correctly identified patients at risk for dehydration enabling providers to educate on signs and symptoms, along with home interventions to improve patients' status. Scores from the post operative call and the first post-operative appointment were analyzed for trends to help predict patients at risk for dehydration.

Limitations

In comparison to published literature on expanded screening for dehydration, the implementation period for the project was relatively short, fourteen weeks. The implementation period coincided with the Sars-Cov-2 pandemic, resulting in fewer surgeries and post-operative patients. As a result, the observed patients consisted of a small convenience sample, therefore further research with larger sample sizes are needed to validate findings. Finally, because this tool was initially designed for use in the geriatric population, not all components are applicable or appropriate in bariatric surgery. This tool should be modified to remove elements not applicable in bariatrics for future use.

Conclusions

Though designed for use in geriatric settings, the NGDST proved to effectively identify patients at risk for dehydration in bariatric surgery. The tool identified 100% of patients at risk for dehydration in the first post-operative month and allowed providers to apply outpatient

interventions to prevent related E.D. referrals. Patient referrals to the ED for dehydration decreased from 20% pre-implementation to just 2% during the implementation period. Therefore, using a standardized post-operative dehydration tool for patients in the first month following surgery is effective when implemented in the outpatient bariatric surgery setting.

References

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Gerontology & Geriatrics, *50*(2), 156–164. https://doi-org.proxy-hs.researchport.umd.edu/10.1016/j.archger.2009.03.003

Tables

Table 1. Evidence Review

Citation: Citation: Vivanti, A., Harvey, K., & Ash, S. (2010). Developing a quick and practical screen to improve the identification of poor hydration in geriatric and rehabilitative care. *Archives of Gerontology & Geriatrics*, *50*(2), 156–164. https://doi-org.proxy-hs.researchport.umd.edu/10.1016/j.archger.2009.03.003					**Level (Melnyk)** IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"Consequently, the aim of this study was to develop a simple, sensitive dehydration screening method for use with older people in the clinical care setting."	Phased, cross sectional, diagnostic, observational study	**Sampling Technique**: Convenience sample **Eligible Participants**: adults > 60 years admitted to a Geriatric and Rehabilitative Care Unit (GARU) **Excluded**: < 60 years, had pacemaker, unable provide informed consent, involuntarily admitted # **Eligible**: 100 # **Accepted**: 86 # **Control**: N/A # **Intervention**: 86 **Group Homogeneity**: 86 elderly adults Male: 39 (45.3%) Women: 47 (54.7%)	**Control**: N/A **Intervention:** Administration of 13 item questionnaire corresponding to possible clinical indicators of dehydration **Intervention fidelity (describe the protocol)**: Phase 1: compiled a list of potential screening parameters of hydration status to be explored (90 questions & 38 parameters). Phase 2: larger number of participants with a narrowed list of screening parameters from phase 1. Questions that did not prove to be valid in predicting dehydration were removed (11 parameters) Phase 3: distinguished the inter/intra-reliability of parameters most strongly indicative of dehydration (1 item)	DV: **Measurement tool (reliability), time, procedure**: Development of the 13-item GDST including SBP and orthostatic B.P., mobility and functionality, thirst, nutrition status and mental health. **Time:** 2008-2009	**Statistical Procedures(s) and Results:** The GDST was shown to be a reliable predictor of dehydration status with a sensitivity > 95%. The tool provided results at the time of administration that were confirmed using traditional means of identifying dehydration (provider exam/assessment, lab values)

This study though > 10 years old was the original study that developed the GDST

Citation: Rodrigues, S., Silva, J., Severo, M., Inácio, C., Padrão, P., Lopes, C., Carvalho, J., do Carmo, I., & Moreira, P. (2015). Validation analysis of a geriatric dehydration screening tool in community-dwelling and institutionalized elderly people. *International journal of environmental research and public health*, *12*(3), 2700–2717. https://doi.org/10.3390/ijerph120302700					**Level** IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"The aim of this study was to perform validation analysis of a geriatric dehydration-screening tool (GDST) in the assessment of hydration status in elderly people."	Observational, analytic cross-sectional study	**Sampling Technique**: Convenience sample **Eligible participants**: community dwelling (living in their own homes) and institutionalized individuals (living in long-term care > 30 days) > 60 years who attended a physical activity class **Excluded:** those taking diuretics, cognitively impaired, unable to complete interviews, incomplete urine samples for 24-hr creatinine clearance # **Eligible**: 185 # **Accepted**: 103 # **Intervention**: 103 Classified into 2 age groups: 60-79 years or >80 years. The groups were further classified into groups according to education (no schooling and at minimum elementary school level education) **Power analysis**: Cronbach's alpha > 0.5 (allowable d/t small sample size and low # items) **Group Homogeneity**: 103 elderly adults, 28.2 institutionalized. Institutionalized: Women 55.2%, Men: 44.8% Community dwelling: Women 62.2%, Men: 37.8%	**Control:** N/A **Intervention**: Administration of the GDST **Intervention fidelity**: Socio-demographic information, PMH and clinical data was collected. Body Mass Index (BMI) was measured and classified by World Health Organization BMI values. Alcohol use and 24hr dietary recall was performed. A 24hr urine sample was analyzed for creatinine, osmolality, and volume. The GDST was administered following collection of urine samples and each item evaluated by factor analysis.	**Measurement tool (reliability)**: The GDST was used to assess dehydration risk. It utilizes 4 physical signs (decreased SBP, dry tongue, body weight and skin turgor) and 7 questions on pain, mobility, and thirst. An additional 4 questions were added on drinking habits. **Time**: November 2012-June 2013	**Statistical Procedures(s) and Results:** 5 items on thirst/preferences and 5 questions on pain/mobility were validated on the GDST with Cronbach's alpha > 0.5) Scales were useful in determining hydration status in the study. 4 items from the original study by Vivanti et al. (2010), postural B.P., low body weight, decreased skin turgor and tongue dryness were excluded as they were not as reliable in predicting hydration status.

Citation: Guastaferro, R., Rosi, I. M., Milos, R., Messina, E., Cerra, A., & Bonetti, L. (2018). Development of a screening tool to assess dehydration in hospitalized older population: a diagnostic, observational study. Sviluppo di uno strumento di screening per valutare la disidratazione nella popolazione anziana ospedalizzata: uno studio diagnostico, osservazionale. *Professioni infermieristiche*, *71*(3), 178–187. https://doi-org.proxy-hs.researchport.umd.edu/10.7429/pi.2018.713178					**Level** IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"To develop a screening tool to detect dehydration in older people in hospital settings."	Cross sectional diagnostic, observational study	**Sampling Technique:** Convenience sample **Eligible Participants**: adults > 65 years with serum labs < 48hrs old **Excluded:** Individuals with impaired cognitive function # **Eligible**: 127 # **Accepted**: 127 # **Control:** N/A # **Intervention**: 127 **Power analysis**: Cronbach's alpha (0.5) **Group Homogeneity**: 127 elderly adults Male: 59 (46.5%) Female: 68 (53.5%) Poly-pathology: 73 (58.4%) Poly-therapy: 94 (74%)	**Control:** N/A **Intervention:** Administration of the 17-question new GDST **Intervention fidelity (describe the protocol):** Patient demographic data and physical attributes were collected. The questionnaire was then administered and compared to clinical data such as vital signs and lab results	**Measurement tool (reliability)**: The New Geriatric Dehydration Screening Tool (NGDST): 11 questions from the GDST plus 6 additional questions on the risk of dehydration (muscle cramps, dizziness, dark-yellow urine, dry sticky mouth, irritability, modes of hydration) **Time**: September and October 2016	**Statistical Procedures(s) and Results:** The NGDST was significantly correlated to serum osmolality (Spearman's rho=0.47, $p<0.0001$), a higher score positively correlated with higher serum osmolality, higher risk for dehydration. Cronbach's alpha 0.63 A score higher than 6 proved to indicate increased dehydration risk providing a point requiring intervention.

Citation: Ivanics, T., Nasser, H., Leonard-Murali, S., & Genaw, J. (2019). Dehydration risk factors and impact after bariatric surgery: an analysis using a national database. *Surgery for Obesity and Related Diseases*, *15*(12), 2066–2074. https://doi-org.proxy-hs.researchport.umd.edu/10.1016/j.soard.2019.09.054					**Level** VI
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results

"To identify risk factors for the development of post-operative dehydration requiring treatment after bariatric surgery."	A retrospective, qualitative study using the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) Participant Use Data File	**Sampling technique:** Convenience sample **of** patients who underwent LRYGB or LSG bariatric surgery **Eligible:** **Excluded: E**mergent surgeries, conversions, or revisions who were < 18 years old and those without 30-day follow-up data **# Eligible:** 256,817 **Power Analysis:** Pearson x^2 test or Fischer's exact test **Group Homogeneity:** 79.6% female, 20.4% male, functionally independent, preoperative BMI of 40–49 (51.7%) and American Society of Anesthesiologists class 3	**Control:** N/A **Intervention:** N/A **Intervention Fidelity:** N/A	**DV:** Outpatient treatment of dehydration in the first 30 days s/p surgery **Procedure:** **Time:** January 1st, 2016, to December 31st, 2017	**Statistical Procedures(s) and Results:** Patients requiring treatment for dehydration were more often younger than age 40 (18–29 yrs.: 16.5% versus 11.4%, 30–39 yrs.: 31.9% versus 25.4%; P< 0 .001), female (88.8% versus 79.2%; P< 0.001), experienced a postoperative complication (11.7% versus 3.36%; P< 0.001) Post-operative complication during the index hospital admission was the strongest independent risk factor. LRYGB had an AOR of 1.26 (95% confidence interval [CI]: 1.20–1.32; P< 0.001) for requiring postoperative dehydration treatment compared with LSG. Predictors of dehydration treatment after bariatric surgery include LRYGB procedure, LOS _3 days, age < 40 years, female sex, black race, GERD, HTN, previous DVT, prolonged operative time, and chronic steroid/immunosuppression.

Citation: Chen, J., Mackenzie, J., Zhai, Y., O'Loughlin, J., Kholer, R., Morrow, E., Glasgow, R., Volckmann, E., & Ibele, A. (2017). Preventing Returns to the Emergency Department Following Bariatric Surgery. *Obesity Surgery*, *27*(8), 1986–1992. https://doi-org.proxy-hs.researchport.umd.edu/10.1007/s11695-017-2624-7					**Level** VI
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
"This study aimed to identify potential strategies aimed at preventing unnecessary returns to the E.D. following bariatric surgery."	Retrospective qualitative study using facilities EMR	**Sampling technique:** Convenience sample of clinic patients **Eligible:** 361 **Excluded:** 0 **# Eligible:** 361 **Power Analysis:** N/A **Group Homogeneity:**	**Control:** N/A **Intervention:** N/A **Intervention Fidelity:** N/A	**DV:** Return to the E.D. **Measurement tool:** N/A **Time:** January 2010 to October 2015 **Procedure:** EMR of all bariatric surgery patients w/in the time period were reviewed independently by 6 providers. Data on procedure type, gender, age, preoperative BMI, obesity-related comorbid conditions, post-operative length of stay (LOS), and reasons for E.D. visits within 90 days of surgery were obtained. Reasons for E.D. referral were scored as preventable or non-preventable.	**Statistical Procedures(s) and Results**: The ≤90-day all-cause post-operative E.D. visit rate was 18% (*n* = 65). 65 patients had 91 E.D. visits 23 visits resulted in readmissions, 2 required operative interventions. Of the 91 E.D. visits, 47% were deemed preventable (*n* = 43). The most common preventable reasons for E.D. returns: - nausea, vomiting, dehydration (NVD) (27.9%) - post-operative pain (25.6%) - wound evaluations (20.9%) - compliance issues (14%)

Table 2. Evidence Synthesis

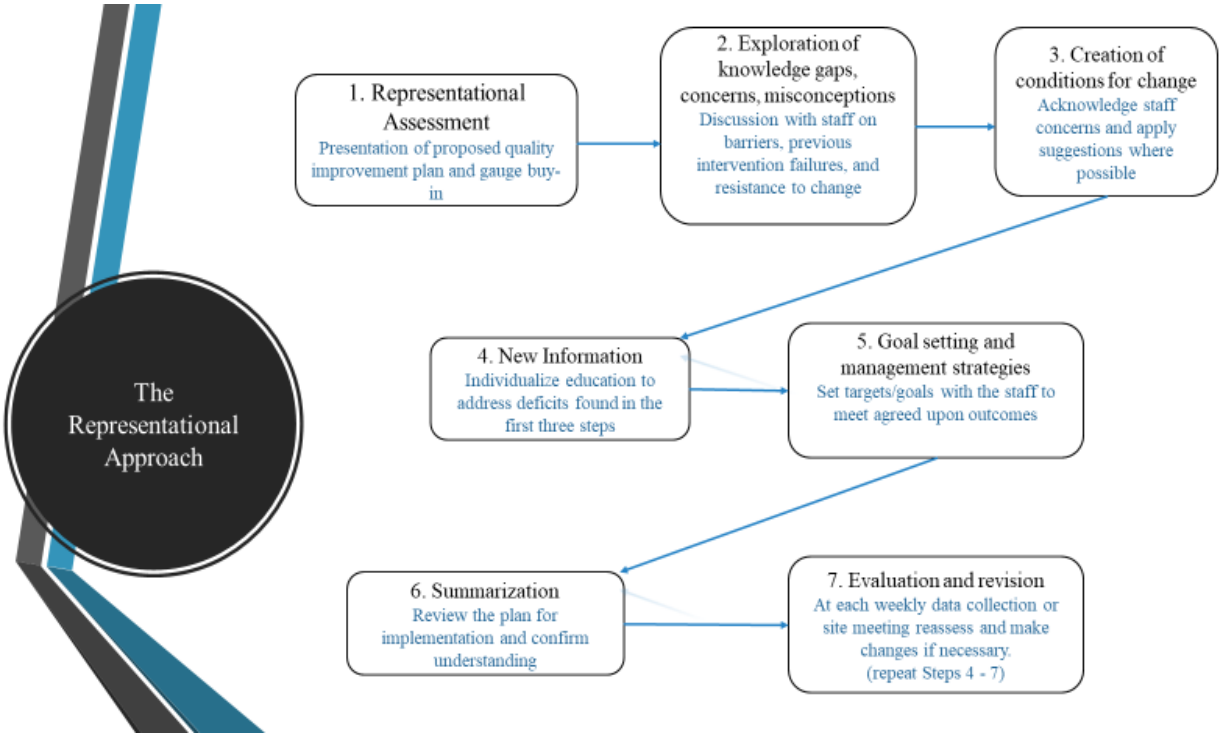
Evidence Based Practice Question (PICO): Will the administration of the NGDST at each post-operative appointment for the first month following bariatric surgery reduce the number of adult patients referred to the Emergency Department for treatment of dehydration?			
Level of Evidence	**# of Studies**	**Summary of Findings**	**Overall Quality**
IV	**3**	All three studies evaluating the validity and reliability of the GDST have shown that the administration of the GDST is a reliable predictor of hydration status in adults. Vivant et al. (2010) developed the tool to create a reliable indicator of dehydration that incorporated multiple sources of information to accurate predict dehydration risk. The questionnaire included questions on physical presentation, pain, mobility, and thirst. Results were confirmed by on exam and through laboratory results by healthcare providers Rodrigues et al. (2015) built upon previous research by Vivanti et al. (2010) and validated the original GDST. In this study researchers tested the tool's validity using participant who were in-patient, as well as community-dwelling adults. The authors included an additional 4 questions on drinking habits in order to improve the accuracy in predicting dehydration. The tool was proven to be reliable and valid in predicting patient risk of dehydration. Gusterfarro et al. (2018) improved upon this tool and developed the NGDST which incorporated the 11 previous question plus an additional 6 assessing (muscle cramps, dizziness, dark-yellow urine, dry sticky mouth, irritability, modes of hydration). This tool also introduced a definitive point at which intervention is needed to reverse dehydration.	B: Good Quality The studies were reasonably consistent, sample size though small was sufficient and Cronbach's alpha was adjusted accordingly. All three studies resulted in fairly definitive conclusions; they were all reasonably consistent recommendations based on the literature review that included appropriately referenced to scientific evidence.

VI	**2**	These two studies explored the causes of E.D. referral after bariatric surgery to determine what factors are most likely to result in referral and whether the referral reason was preventable. They were both retrospective qualitative studies that examined post-operative bariatric patients, record if they were referred to the E.D. and the reason for referral Chen et al. (2015) examined the reasons for E.D. referral at a single site after bariatric surgery. Though the study was conducted independently, the review was conducted by clinic providers. The results of this study identified the reasons for return to the E.D. as well as if the reason for referral was preventable. The larger study by Ivanics et al. (2019) confirmed dehydration as a major cause of E.D. return post-operatively but went further in identifying some of the demographics that place patients at risk for dehydration.	B. Good Quality Reasonably thorough and appropriate search; reasonably consistent results with sufficient numbers of well-defined studies; evaluation of strengths and limitations of included studies; fairly definitive conclusions. A. High Quality The studies were consistent well-defined, reproducible search strategies; consistent results; criteria-based evaluation of overall scientific strength and quality of included studies; definitive conclusions.

Figures

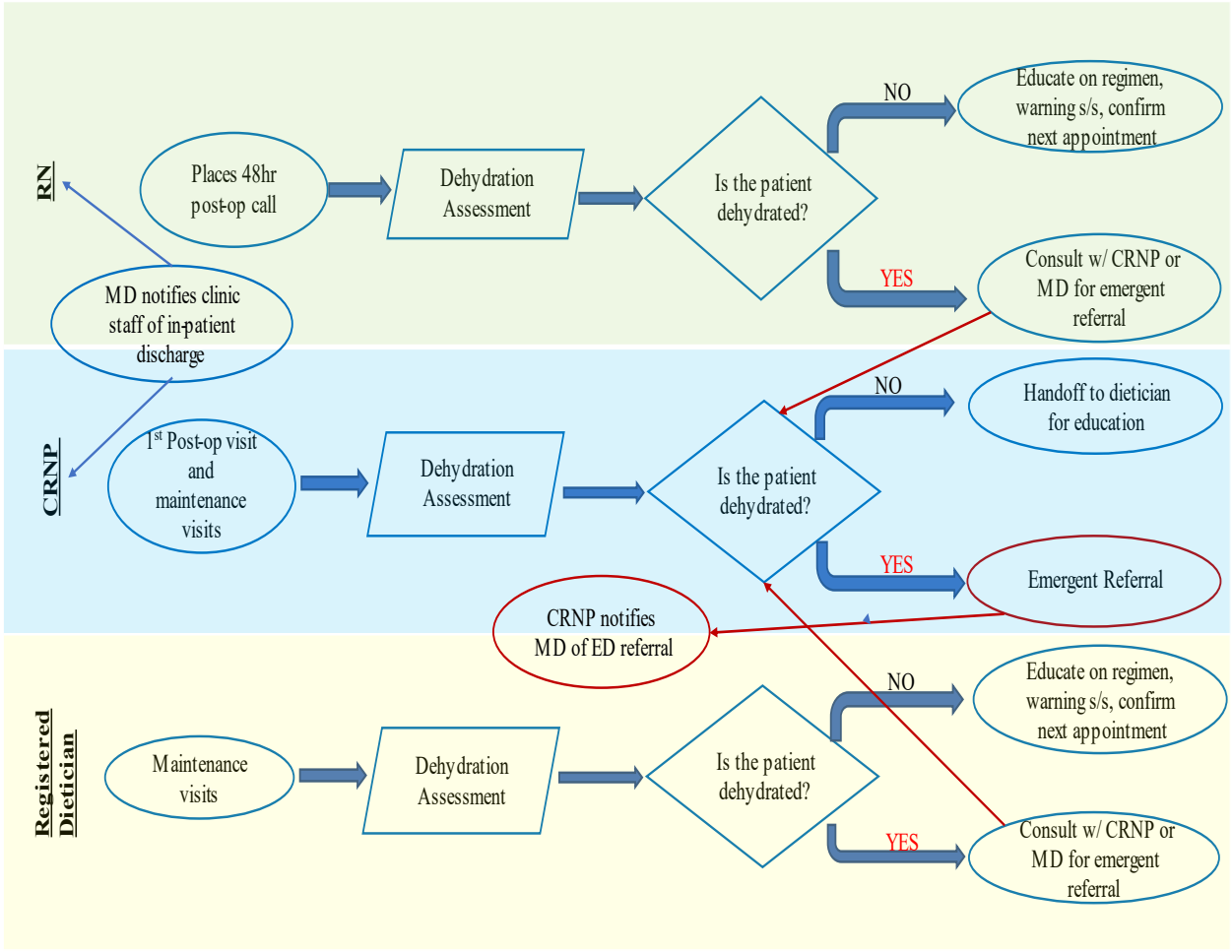
Figure 1

The Representational Approach



Appendix A

Process Map for Current Workflow



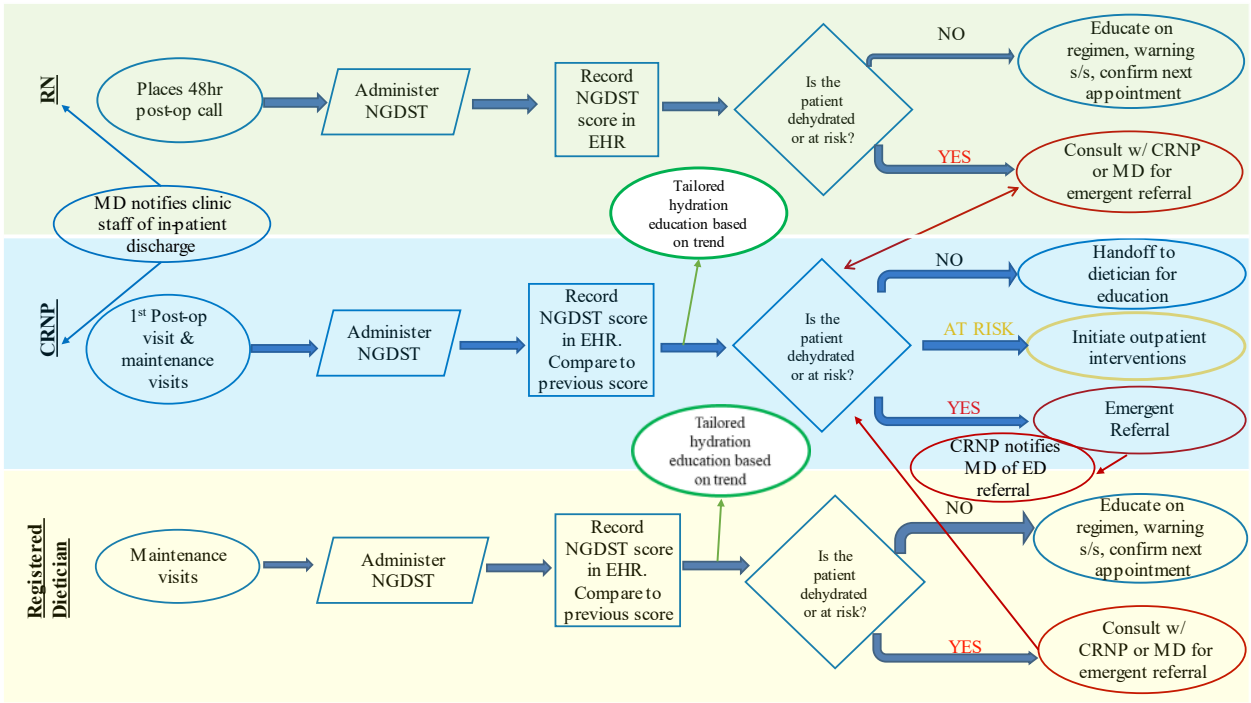
Appendix B

Copy of the NGDST w/ scoring

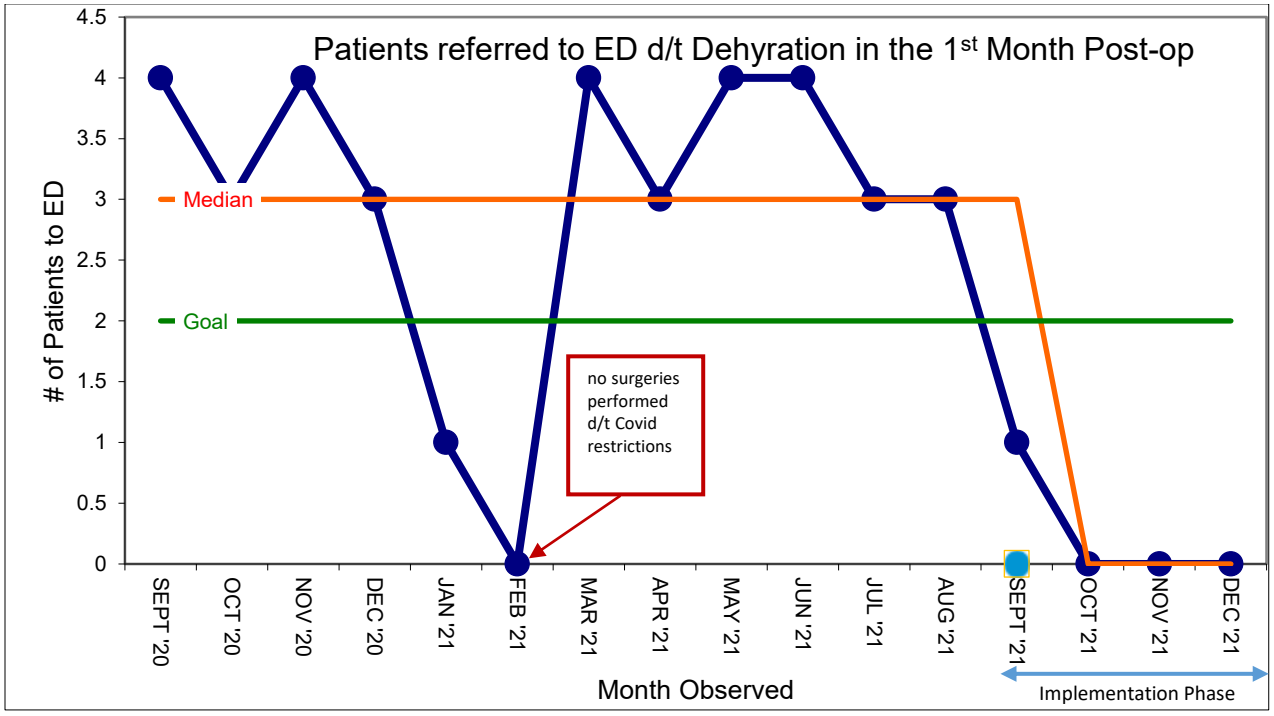
Questions			Answers	Score
1. Do you have difficulty moving your shoulders, arms or hands?			Yes=1 No=0	
2. In the past 2 weeks, did pain interfere with your daily activities?			Yes=1 No=0	
3. In the past 2 weeks did you have problems with pain of any kind?			Yes=1 No=0	
4. Have you had recurring headaches during the past week?			Yes=1 No=0	
5. Have you felt any lack of strength in your arms in the past two weeks?			Yes=1 No=0	
6. In the last 24 hours, did you have muscle cramps?			Yes=1 No=0	
7. In the last two weeks, did you feel dizzy?			Yes=1 No=0	
8. In the last 24 hours, did you notice concentred dark-yellow urine?			Yes=1 No=0	
9. When you speak, do you feel a dry mouth and sticky saliva?			Yes=1 No=0	
10. In the last 2 weeks, did you feel irritable?			Yes=1 No=0	
11. Did you feel thirsty in the past two weeks?			Yes=1 No=0	
12. Did you feel thirsty Yesterday?			Yes=1 No=0	
13. Do you like drink water?			Yes=0 No=1	
14. If you have a choice between different drinks, do you generally prefer to drink water?			Yes=0 No=1	
15. Do you think to drink enough?			Yes=0 No=1	
16. Do you usually drink during meals?			Yes=0 No=1	
Nurse assessment				
	Assessment	Scores		
17. Autonomy in fluid intake	He/She needs help=2			
	Autonomous, but with difficulties=1			
	Autonomous=0			
18. Daily hydric intake (we took this question from MNA)	Less than 3 glasses=2			
	From 3 to 5 glasses=1			
	More than 5 glasses=0			

Appendix C

Process Map for Desired Workflow



Appendix D


Patients referred to ED d/t Dehyration in the 1st Month Post-op
# of Patients to ED
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Median
Goal
no surgeries performed d/t Covid restrictions
SEPT '20
OCT '20
NOV '20
DEC '20
JAN '21
FEB '21
MAR '21
APR '21
MAY '21
JUN '21
JUL '21
AUG '21
SEPT '21
OCT '21
NOV '21
DEC '21
Month Observed
Implementation Phase

Appendix E

	# of Patients	Patient # (*randomly assigned)	Date of Surgery	Post op call (date)	Provider #	NGDST Score	Outpatient Interventions Initiated Yes =1 / No = 0	F/u call date if no ED Referral	Provider	F/u NGDST score	ED Referral for Dehydration after call Yes =1 / No =0	Date of ED referral	1st Post-op visit w/ CRNP (date)	NGDST Score	Outpatient Interventions Initiated? Yes = 1	ED Referral for Dehydration after 1st visit Yes =1 / No =0	Date of Referral	Comments
AUGUST	Week 1																	
	1	189	SL 8/31/2021	not completed			0				0		9/15/2021	0	0	0		no call completed as of 09/15/21
	1	156	SL 09/02/2021	not completed			0				0		9/15/2021	0	0	0		no call completed as of 09/15/21
	1	134	SL 09/02/2021	9/9/2021	2		0				0		9/15/2021	1	0	0		baseline data
Analysis	3					#DIV/0!				#DIV/0!				0.33333				
SEPTEMBER	Week 2																	
	1	213	RNY 9/7/2021	9/10/2021	2	4	0						9/20/2021	0	0			pain 5/10, N
	1	244	SL 09/07/2021	9/10/2021	2	3	0				0		9/22/2021	3	0	0		pain 8/10, N, yellow urine, referred to PCP for RUE doppler r/o thrombus
	1	263	SL 09/09/2021	9/14/2021	2	1	0				0		9/22/2021	0	0	0		pain 4/10, less than 32oz
	1	209	RNY 09/09/2021	9/14/2021	2	1	0						9/22/2021					pain 0-10, 49-64oz. 09/21/2021 vist completed w/ Dr. Kubicki NGDST not completed
	1	276	SL 09/09/2021	9/14/2021	2	1	0						9/22/2021	0	0	0		pain 4/10, constipation, 49-64oz
Analysis	8	5				2												
	Week 3																	
	1	301	RNY 09/14/2021	9/24/2021	2	3	0	10/8/2021	1		1	10/14/2021						pain 4/10, nausea, Fluid intake < 32oz; Pt directed to UC at 10/08/2021 f/u call for IV rehydration; ED referral on 101/14/2021 prior to 1st post-op appt
	1	320	RNY 09/14/2021	9/17/2021	5		1										0	not administered/ pt referred to ED for possile DVT/PE
	1	340	SL 09/16/2021	9/21/2021	5	3	0						10/12/2021	0				pain 2/10
	1	354	SL 09/16/2021	9/21/2021	2	3	1	9/24/2021	2				30-Sep	5	1	0	0	Pt endorses insufficient fluid intake at first call, education provided. 09/24/2021 pt endorsed constipation, provider did not administer f/u NGDST; Post-op visit NGDST 5, pt education, fluid intake <32oz increase fluids, take Zofran,
Analysis	11																	
	Week 4																	
	1	411	SL 09/21/2021	9/24/2021	2	2	1						10/12/2021	1	0	0		Pain 8/10, bright yellow urine, constipated, 32-48oz daily
	1	440	SL 09/23/2021	9/28/2021	2	4	1						10/6/2021	3	0	0		Pain 5/10 , constipation, dark yellow urine
Analysis	13																	
	Week 5																	
	1	505	RNY 09/28/2021	10/1/2021	2	4	1						10/12/2021	4	1	0		Pain 10/10, 32-48 oz; Post-op: Fluid intake 48-64oz, constipation, pt education, increase fluid intake
	1	525	RNY ABORTED															
	1	545	SL 09/30/2021	10/4/2021	5	4	1						10/12/2021	5	1	0		Pain 7/10, Constipation; Post-op appt: pt education, administer anti-emetics, fluid intake now 48-64oz increase to 64oz
	1	565	SL 09/30/2021															
Analysis	16	3																
OCTOBER	Week 6	OCTOBER																
	1	602	RNY 10/05/2021	10/8/2021	5	1	0						10/28/2021	0				Pain 0/10
	1	624	RNY 10/05/2021	10/8/2021	5	2	0						10/28/2021	1				Constipation
	1	648	SL 10/05/2021	10/11/2021	5	3	1						10/28/2021	4				Pain 4/10, Fluid intake 32-48oz
	1	677	SL 10/07/2021	10/11/2021	5	2	1						10/28/2021	0				Bright yellow urine, Fluid intake 49-64oz, instructed to increase fluid intake
	1	692	SL 10/07/2021	10/11/2021	5	1	1						10/28/2021	0				Pain 6/10, constipation, fluid intake 49-64oz, instructed to increase fluid intake, administer pain medication and stool softners
Analysis	5	5																
	Week 7																	
	1	701	RNY 10/14/2021	10/19/2021	2	5	1						10/28/2021	0				Nausea, dark yellow urine, Light-headedness, fluid intake 49-64. Instructed to take prescribed Zofran, increase fluid intake, drink warm/hot water w/ lemon. Contact office for symptom update in 2 days.
	1	720	RNY 10/14/2021	10/19/2021	2	1	1											Pain 7/10, fluid intake 49-64oz
	1	737	RNY 10/12/2021	10/15/2021	2	3	1						10/29/2021	4	1			Constipation, fluid intake 32-48oz, pt education, increase fluid intake to > 64oz
Analysis	8																	
	Week 8																	
	1	809	SL 10/19/2021										11/9/2021	0	0			Pain 4/10
	1	820	SL 10/21/2021	10/28/2021	2	2	0						11/9/2021	0	0			
	1	840	SL 10/21/2021	10/25/2021	5	3	1						11/9/2021	1	0			
Analysis	11																	
	Week 9																	
	1	930	RNY 10/26/2021	10/29/2021	2	1	0						11/9/2021	1	0			
	1	947	SL 10/26/2021	10/29/2021	2	1	1						11/9/2021	0	0			Pain 5/10, drinking < 32oz/day
	1	962	SL 10/26/2021	11/2/2021	6	1	1						11/9/2021	3	1			drinking 32-48oz
	1	968	RNY 10/28/2021	11/2/2021	6	0	0						11/9/2021	0	0			
	1	975	RNY 10/28/2021	11/2/2021	6	2	1						11/9/2021	2	0			drinking 32-48oz
	1	981	RNY 10/28/2021	11/3/2021	6	1	0											Pain 4/10
Analysis	14																	
NOVEMBER	Week 10	NOVEMBER																
	1	1050	RNY 11/02/2021	11/5/2021	2	0												
	1	1122	RNY 11/02/2021	11/5/2021	2	4	1											
	1	1025	RNY 11/04/2021	11/9/2021	2	1												
	1	1070	11/4/2021	11/9/2021	2	1							11/17/2021	N/C				
Analysis																		
	Week 11																	
	1	1114	RNY 11/09/2021	11/12/2021	2	1	0											
	1	1137	RNY 11/09/2021															
	1	1142	SL 11/11/2021	11/15/2021	2	1												
	1	1159	RNY 11/11/2021	11/15/2021	2	1												
	1	1163	SL 11/11/2021	11/15/2021	2	3	1											
	1	1175	SL 11/11/2021	11/15/2021	2	1												
Analysis																		
	Week 12																	
Analysis																		
	Week 13																	
Analysis																		
	Week 14																	
Analysis																		
DECEMBER	Week 15 12/06																	
Analysis																		