

Optimizing transition of care pharmacy services by evaluating medication related readmission
risk factors within the heart failure population

By

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Optimizing transition of care pharmacy services by evaluating medication related readmission risk factors within the heart failure population

Background: Heart failure (HF) is the leading cause of hospitalization amongst patients 65 years of age and older and represents a significant clinical and economic burden. Previous studies have sought to identify risk factors associated with readmissions in HF patients. However, no studies have evaluated the medication-related risk factors that present most frequently in readmitted heart failure patients. As the medication experts, pharmacists are in a unique position to intervene and address patients' medication related risk factors. Multidisciplinary transitions of care models have shown the positive impact on decreased readmissions within high-risk populations like HF when a pharmacist is involved in their care. A retrospective chart review of HF patients within a cardiology unit was conducted to determine medication-related risk factors within the HF patient population that can and should be prioritized for intervention by transitions of care pharmacists.

Methods: Patients identified with diagnosis related groups (DRGs) for heart failure admitted to the inpatient cardiology unit of Memorial Hermann Memorial City Medical Center between January 1, 2019 to December 31st 2019 were included in this study. Two groups were evaluated: HF patients readmitted within one year of their initial admission for any reason and HF patients not readmitted within one year of their initial admission. Patients were excluded from the study if they were (1) deceased during their primary admission or (2) were discharged to hospice.

Data was retrospectively analyzed based on patient information from the electronic medical record (EMR). Data points analyzed included patient demographics, date of initial admission, date to first readmission and medication-related readmission risk factors (number of medications at initial discharge, number of comorbidities, eGFR during initial admission, and length of stay at initial admission, and presence of high-risk medications at discharge including anticoagulants, antidiabetics, diuretics).

Results: A total of 89 patients were included in the final analysis. No statistical significance was noted between the dependent variables and readmission status. However, variables of interest included number of medications at initial discharge and presence of anticoagulants at discharge. Results of a stepwise binomial regression did not reveal that any of the studied medication related risk factors assessed in this study were independently associated with readmission status.

Discussion: Due to the lack of statistical significance in medication related readmission risk factors between the two groups, there is insufficient evidence to support that transitions of care pharmacists should prioritize any of the risk factors assessed over others. However, the results of this study does highlight the need for the involvement of comprehensively trained transitions of care pharmacists, who are able to elicit clinic reasoning and judgement in the assessment of medication related readmission risk factors present in patients. Limitations of this study include small sample size, inability to ascertain readmission status for patients readmitted external to our institution and reliance on data entered into the EMR.

Conclusion: In the setting of a large community hospital, this study did not identify specific medication-related readmission risk factors in HF patients that should be prioritized over others by transitions of care pharmacists. However, this study did highlight the need for involvement of comprehensively trained transitions of care pharmacists who are able to identify HF patients at increased risk of readmission. These clinicians should place emphasis on addressing inappropriate medication therapy through discharge medication review and anticoagulant counseling while also thoroughly assessing each patient for risk factors that may present on a case-by-case basis.

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Background

Today, approximately 6.2 million adults in the United States (US) are living with heart failure (HF).¹ The prevalence of HF is expected to increase by 46% from 2012 to 2030, with more than 8 million adults living with this chronic, progressive disease state.² This rise in the number of patients living with HF is attributed to the rise in the aging population, with 1 in 5 Americans projected to be 65 years or older by 2030, as well as improvements in HF treatment.³

Amongst adults > 65 years old, HF is the leading cause of hospitalization in the US and represents a significant clinical and economic burden.⁴ In addition, HF has the highest readmission rate in this age group, with more than 50% of patients readmitted to the hospital within 6 months of discharge.⁵ In 2013, HF was the sixth most expensive condition treated in U.S. hospitals at \$10.2 billion, with readmissions accounting for \$2.7 billion.⁶

The implementation of the Hospital Readmissions Reduction Program (HRRP) by the Centers for Medicare and Medicaid Services (CMS) in 2012 meant that hospitals with excessive 30-day readmission rates for certain conditions, including HF, would be penalized. This penalty called for a reduction in reimbursement rates to hospitals with excessive 30-day readmission rates of Medicare patients. Recently, CMS has penalized more than 2,000 hospitals, cutting reimbursement by as much as 3 percent for each Medicare readmission during fiscal year 2021.⁷ Consequently, both national research and hospital driven efforts have been focused on reducing HF readmission rates and predicting which patients with HF are likely to be readmitted.

Previous studies have identified a number of factors that are associated with increased risk of readmission in patients with HF. In a study of 155,146 HF patients, Mirkin et al found that number of comorbidities, length of stay, and sociodemographic factors such as sex, age, race, and Medicare coverage were all associated with increased risk of readmission in this patient population.⁸ Additionally, there has been an increasing focus on medication related readmissions, due to their observed negative impact on healthcare costs and decreased quality of life.⁹ Medication related readmissions can be defined as readmissions due to problems around pharmacotherapy or due to adverse drug events.¹⁰ Uitvlugt et al found that out of 1,111 readmissions, 181 (16%) were medication-related, of which 40% were potentially preventable.¹²

Previous studies have identified multiple medication related risk factors, including, but not limited to excessive polypharmacy, therapy non-adherence, presence of multiple comorbidities, renal disease, cognitive impairment, higher age, presence of high risk medications, and length of stay in the hospital.^{13,14} While many studies have identified risk factors for medication related hospital admissions and readmissions, there is limited data available to support which of these medication related risk factors should be prioritized for intervention by transitions of care pharmacists.

Many studies have proven the positive impact that transitions of care pharmacists can have on patient satisfaction, cost avoidance and preventing hospital readmissions.¹⁵ Today, pharmacists play a key role within multidisciplinary transitions of care teams, as evidenced by transitions of care models such as Project Re-Engineered Discharge (RED)TM. First implemented by Boston University Medical Center (BUMC) in collaboration with the Agency for Healthcare Research and Quality, Project RED is a 12-step standardized approach to discharge planning and education implemented to reduce re-hospitalization rates.¹⁶ In this model, pharmacists are responsible for

ensuring that medication reconciliation and education is performed, reviewing patient medication regimens, and reinforcing the discharge plan, amongst other duties.¹⁷ Project RED as well as other studies and transition of care models have shown that pharmacists are in a unique position to aid in decreasing medication-related readmissions when provided with the necessary resources to do so. .¹⁶

One study found that clinical pharmacists spent a substantial amount of time performing clinical interventions. The total time spent working clinically per patient on interventions per shift, such as medication reconciliation and medication review, was 3.5 hours per patient.¹⁸ In elderly patients with complex medication regimens and multiple comorbidities, this timeline could be even longer. Given the time that pharmacists in these transitional settings must commit to their patients, it is important that a streamlined approach is in place to address how to prioritize the medication-related risk factors that most commonly cause patients to be readmitted to the hospital. Although many studies have identified medication-related readmission risk factors, few studies have examined which are most frequently associated with readmission in high-risk patient populations such as HF and therefore should be prioritized. This gap in literature could potentially serve as the foundation for a more streamlined approach to transitions of care pharmacy services, allowing pharmacists to more readily identify and conduct necessary interventions in HF patients.

About Memorial Hermann Health System

Memorial Hermann Health System is the largest non-profit healthcare system in southeast Texas, with 14 different hospitals. Many efforts have been implemented to decrease hospital readmissions in patients with complex disease states such as HF throughout the health system. In early 2021, a Project RED pilot was rolled out at the Memorial City campus from February to April 2021 to determine if the application of Project RED strategies within one cardiology unit would decrease 30-day readmission rates.

While the Project RED pilot was primarily case management and nursing led, the pharmacy department was tasked with the responsibility of handling any medication related facets of the pilot. This included drug regimen review, patient education and telephonic reinforcement of the discharge plan amongst other duties by the unit-based pharmacist. Transitions of care pharmacists involved in the Project RED pilot conducted within the cardiology unit of Memorial Hermann Memorial City Medical Center were able to positively contribute to a 15% reduction in 30-day readmissions, but cited time and resource commitment required as major limitations, as is the case with similar studies.

Figure 1 shows the time spent on average for 38 HF patients admitted during the Project RED pilot as documented by the transitions of care pharmacists. On average, transitions of care pharmacists spent a total of 22 minutes with each patient, allocating 7 minutes for education, 9 minutes for discharge medication review and 6 minutes resolving other medication related issues.

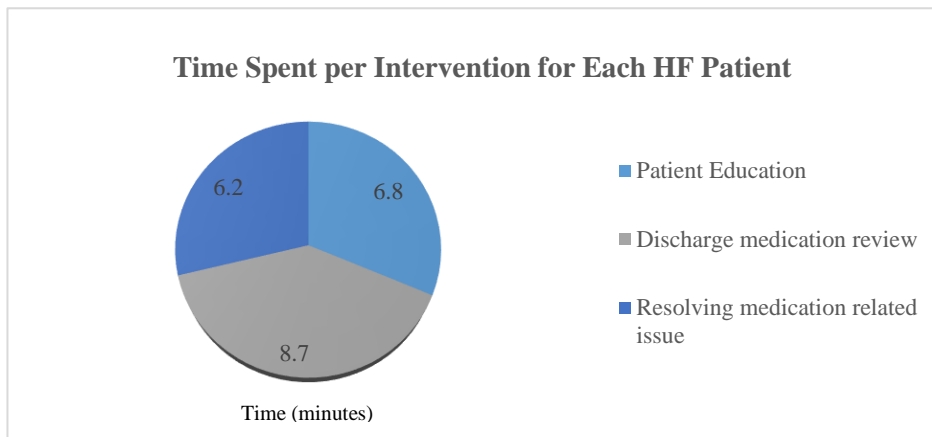


Figure 1. Time spent per documented intervention by transitions of care pharmacists for 38 HF patients admitted during Project RED pilot.

In addition to time spent per intervention for each patient, transitions of care pharmacists documented the various types of interventions performed during the pilot. **Figure 2** illustrates the frequency at which the various interventions were performed for the 38 HF patients identified within the Project RED pilot. As seen below, medication review was provided for 84% of HF patients during the pilot, followed by clinical intervention and patient education provided for 32% of HF patients.

Upon review of medications involved in clinical interventions as documented by pharmacists involved in the pilot, antibiotics, anticoagulants and antihypertensive medications were found to be a large area of focus. Twenty five percent of clinical interventions involved antibiotics while seventeen percent of clinical interventions involved anticoagulants and antihypertensive medications, as illustrated in **Figure 3**. Review of medications involved as documented by transitions of care pharmacists for patient education revealed that anticoagulant counseling (58%) was also a major focus area for these patients as seen in **Figure 4**.

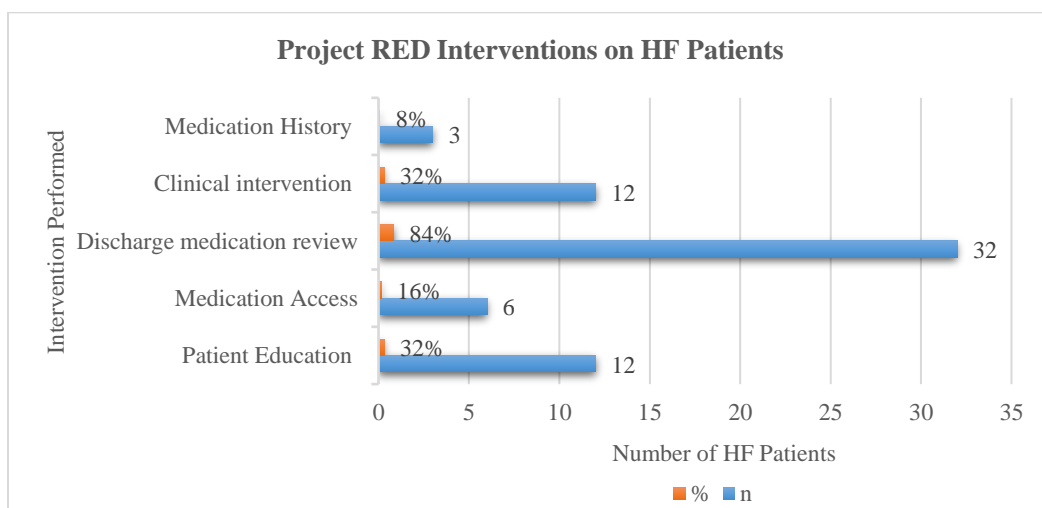


Figure 2. Interventions conducted on HF patients by transitions of care pharmacists during Project RED Pilot at Memorial Hermann Memorial City Medical Center

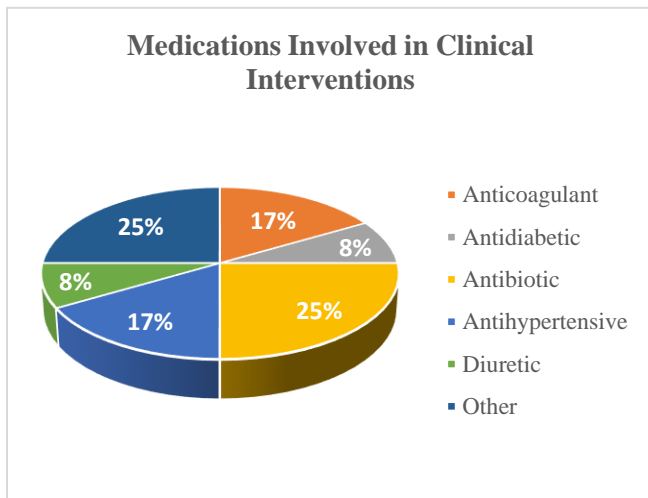


Figure 3. Medications involved in clinical interventions conducted by transitions of care pharmacists during Project RED. “Other” category includes colchicine, allopurinol and prednisone.

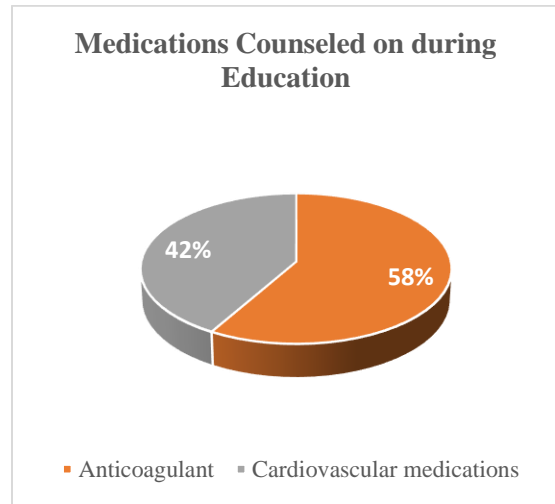


Figure 4. Medications involved in patient education conducted by transitions of care pharmacists during Project RED. “Cardiovascular medications” includes ranexa, isosorbide and entresto.

The purpose of this study is to determine medication-related risk factors within the HF patient population that can and should be prioritized for intervention by transitions of care pharmacists. This will serve as the foundation for a more streamlined approach to transitions of care pharmacy services, allowing pharmacists to more readily identify necessary interventions within the HF population.

Objectives

The primary objective of this study is to determine which medication-related readmission risk factors should be prioritized for intervention within the HF population by transitions of care pharmacists. Investigators hypothesize that some medication-related readmission risk factors will present more frequently in readmitted HF patients than in HF patients not readmitted.

The primary endpoint of the study evaluated the medication-related readmission risk factors present in two groups: HF patients readmitted to the hospital and HF patients not readmitted. The secondary endpoint evaluated the intervention types that should be prioritized by transitions of care pharmacists based off the medication-related readmission risk factors identified within readmitted HF patients.

IV. Methods

Setting and Procedures

Figure 5 illustrates the distribution of HF admissions across various units within Memorial City Medical Center. From July 2018 to June 2021, more than 50% of the 16, 578 HF admissions occurred on the 7E cardiology unit. Due to the large volume of HF admissions, our study evaluated HF patients whose primary admission occurred within this unit.

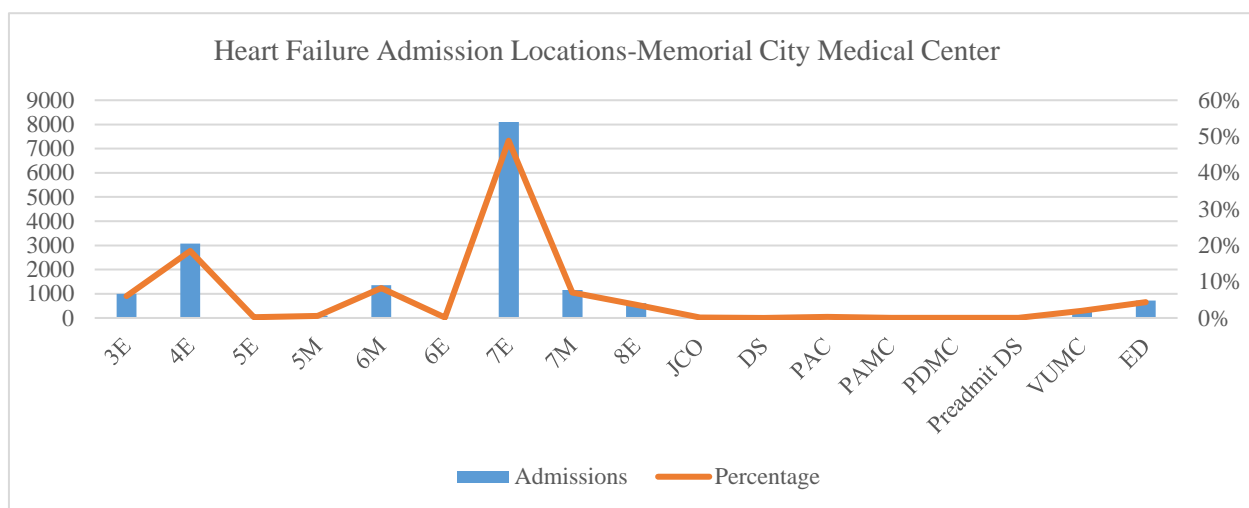


Figure 5. Heart failure patient admission locations at Memorial City Medical Center from July 2018- June 2021. Total of 16, 578 admissions with >50% of admissions occurring on cardiology unit (7E)

This single-center, retrospective study included HF patients who presented to the Memorial Hermann Memorial City Medical Center cardiology unit as previously specified between January 1, 2019 and December 30, 2019. Two groups were evaluated: HF patients readmitted within 1 year of their initial admission for any reason and HF patients not readmitted within 1 year of their initial admission. Patients were excluded from the study if they were (1) deceased during their primary admission or (2) were discharged to hospice.

Data Collection

Table 1 shows the data points that were collected for analysis. All data points were collected from the electronic medical record (EMR). Heart failure was defined as having a diagnosis related group (DRG) of 291, 292 or 293 classification. This classification included heart failure patients with both reduced ejection fraction (HFrEF) and preserved ejection fraction (HFpEF).

Number of comorbidities was determined based on ICD-10 codes present in patient record upon initial admission and review of active problems within the patient history and physical (H&P note). A cutoff of 3 comorbidities was utilized based on anecdotal information from transitions of care pharmacists as well as the finding in one study amongst 1382 HF patients that 86% had 2 or more additional comorbidities.²¹ Number of medications and presence of high-risk medications present was determined by review of patient medication lists at initial discharge. Based on an average number of 8 medications that HF patients are discharged, this cutoff was utilized during data collection.¹⁹ Anticoagulants, antidiabetics, and diuretics were identified as “high-risk” medications based on anecdotal information collected from unit based pharmacists regarding medications frequently found on readmitted HF patients’ medication regimens.

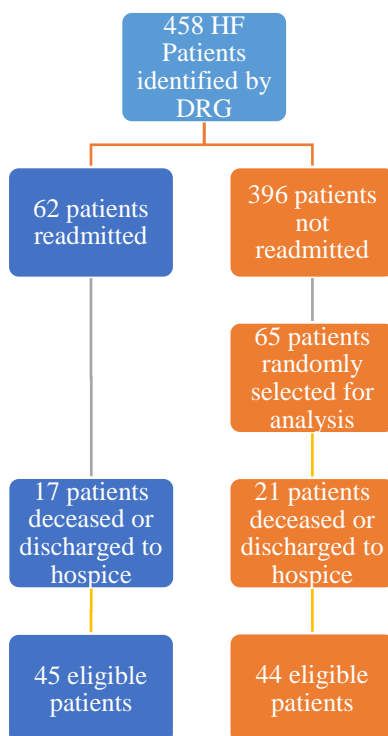
Table 1: Data Points Collected	
Demographics	
1.	Age
2.	Race
3.	Sex
4.	Primary language
5.	Insurance status
Admissions Data	
6.	Date of initial admission
7.	Date to first readmission
Medication-related readmission risk factors	
8.	Number of medications at initial discharge
9.	Number of comorbidities
10.	eGFR during initial admission
11.	Length of stay at initial admission
12.	Presence of high-risk medications at discharge (anticoagulants, antidiabetics, diuretics)

Data Analysis

Patients were separated into two groups for analysis: HF patients readmitted for all cause within one year of initial admission to the Memorial Hermann Memorial City cardiology unit and HF patients not readmitted as documented within the EMR. Patients were identified as not readmitted if no documented admission was identified within the EMR within one year from the primary admission date.

The statistics used to evaluate for medication-related risk factors that should be prioritized in HF patients by transitions of care pharmacists included Fisher’s exact for all categorical variables, t-tests for continuous variables, and a logistic regression for the adjusted models. All statistical tests were ran utilizing *RStudio* Version 4.0.3.

Figure 6. Patients Included in Study



V. Results

Between January 1, 2019 and December 31, 2019, 458 patients were admitted to the cardiology unit of Memorial Hermann Memorial City Medical Center for HF defined by DRGs (291, 292, 293). Of those, 62 HF patients were identified as readmitted within one year after primary admission. In the readmitted group, 17 patients were excluded as they were deceased or discharged to hospice.

In the non-readmitted group, 397 patients were identified. From the 397 non-readmitted, 65 patients were randomly selected for analysis. Of those 65, 21 patients were excluded as they were deceased or discharged to hospice. A total of 45 patients in the readmitted group and 44 patients in the non-readmitted group were included in the final analysis. **Figure 6** illustrates patients included in the study.

Primary Outcome

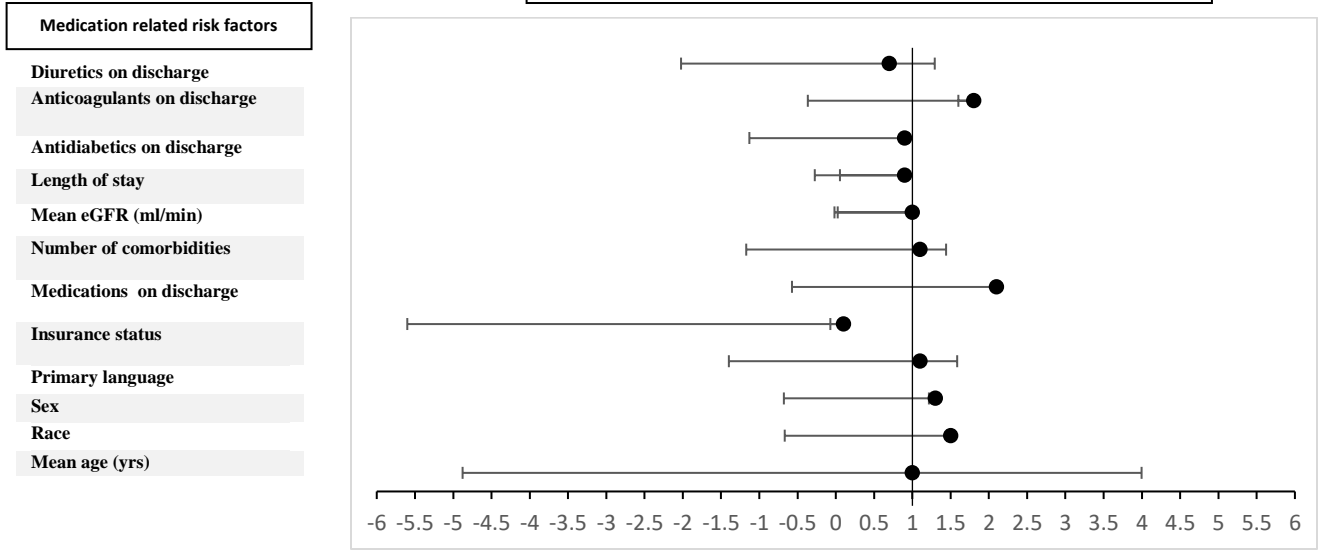
A Fisher’s Exact test for independence or t-test was conducted between the various data points collected including demographic data and medication-related readmission risk factor data as seen in **Table 2**. Although no statistical significance was noted between the dependent variables and readmission status, variables of interest included number of medications at initial discharge and presence of anticoagulants at discharge.

Table 2: Comparison of Medication-related Risk factors for Primary Outcome				
		Readmitted*	Not Readmitted*	p-value (CI)
Mean age (years)		74± 15.4	73± 13.2	0.358 (-8.404, 3.070)
Race	Caucasian	25 (56)	28 (64)	0.519 (0.550, 3.578)
	Non-Caucasian	20 (44)	16 (36)	
Sex	Female	21 (47)	19 (43)	0.832 (0.460, 2.886)
	Male	24 (53)	25 (57)	
Primary Language	English	40 (89)	39 (89)	1.000 (0.207, 4.601)
	Non-English	5 (11)	5 (11)	
Insurance status	Self-pay	5 (9)	1 (2)	0.361 (0.004, 2.577)
	Insured	41 (91)	43 (98)	
Medications at initial discharge	≤8 medications	7 (16)	12 (27)	0.204 (0.642, 6.828)
	> 8 medications	38 (84)	32 (73)	
Number of comorbidities	≤ 3 comorbidities	10 (22)	10 (21)	1.000 (0.336, 3.150)
	> 3 comorbidities	35 (78)	34 (79)	
Mean eGFR (ml/min)		50.8± 24.4	50.7± 27.1	0.712 (-13.063, 8.954)
Mean length of stay (days)		5± 3.3	5± 4.1	0.111(-0.275, 2.598)
Antidiabetics on discharge	Yes	22 (49)	21 (48)	1.000 (0.421, 2.611)
	No	23 (51)	23 (52)	
Anticoagulants on discharge	Yes	24 (53)	19 (43)	0.399 (0.601, 3.773)
	No	21 (47)	25 (57)	
Diuretics on discharge	Yes	41 (91)	39 (89)	0.739 (0.261, 7.110)
	No	4 (9)	5 (11)	
*Actual frequency (percent) **p-value for Fisher’s Exact test for categorical variables and t-test for continuous variables Mean age: calculated at time of initial admission Medications at initial discharge: determined based off discharge medication list at initial admission; cutoff of 8 medications based on average number of medications present on discharged HF patient medication regimen Masoudi et al ¹⁹ Number of comorbidities: determined based off patient History and Physical (H&P) during initial admission Mean eGFR: calculated at time of initial admission Antidiabetics, anticoagulants, diuretics on discharge: determined based off discharge medication from initial admission; Statistical software utilized: RStudio version 4.0.3				

A stepwise binomial logistic regression was then conducted to determine if there was a statistically significant variable independently associated with HF patients readmitted that should be prioritized for intervention by transitions of care pharmacists (**see Table 3**). Upon review of the medication related readmission risk factors assessed, none were found to be independently associated with readmission status. These results can also be visualized within **Figure 7**.

Table 3: Multivariate logistic regression analysis to assess effect of medication-related readmission risk factors on readmission status			
	Odds Ratio	95% Confidence Interval	p-value
Mean age (years)	1.0	-4.878,3.996	0.168
Race	1.5	-0.668,1.455	0.474
Sex	1.3	-0.679,1.215	0.585
Primary Language	1.1	-1.398,1.586	0.906
Insurance status	0.1	-5.601,-0.071	0.068
Medications at initial discharge	2.1	-0.573,2.121	0.280
Number of comorbidities	1.1	-1.171,1.441	0.843
Mean eGFR (ml/min)	1.0	-0.018,0.025	0.758
Mean length of stay (days)	0.9	-0.275,0.053	0.252
Antidiabetics on discharge	0.9	-1.130,0.957	0.871
Anticoagulants on discharge	1.8	-0.366,1.601	0.226
Diuretics on discharge	0.7	-2.023,1.293	0.670

Figure 7: Forest Plot of Multivariate logistic regression analysis to assess effect of medication-related readmission risk factors on readmission status



Secondary Outcome

The secondary outcome of this study was determination of interventions that transitions of care pharmacists should prioritized based off the most prevalent risk factors present in this population. **Table 4** shows medication-related readmission risk factors that have been identified by previous studies^{13, 14} and the correlated data point collected within this study.

Medication-related readmission risk factor	Corresponding Data Point
Polypharmacy	Number of medications at initial discharge
Multiple Comorbidities	Number of comorbidities at initial admission
Renal disease	eGFR
Higher age	Age
High risk medications at discharge	Antidiabetics, anticoagulants, diuretics present at discharge
Length of stay in the hospital	Length of stay in the hospital
Unintentional non-adherence (language barriers, affordability, education)	Primary Language Insurance Status Discharge Review

Sub-Group Analysis

A sub-group analysis was conducted to identify differences in the prevalence of medication related risk readmission risk factors present in HF patients readmitted within 30 days and those readmitted after 30 days. From January 1, 2019 to December 31, 2019, 10 out of the 45 patients included in this study were readmitted within 30 days to a Memorial Hermann hospital for cardiovascular related issues. Medication-related readmission risk factors present in these patients are identified in **Table 5**.

A stepwise binomial logistic regression was also conducted within this population to determine if there was a statistically significant variable independently associated with HF patients readmitted within 30 days. Upon review of the medication related readmission risk factors assessed, none were found to be independently associated with readmission risk within 30 days as seen in **Table 6**.

	Readmission ≤ 30 days	Characteristic	Readmission > 30 days
Mean age (years)	75±17.1		76±14
Race	6 (60)	Caucasian	19 (54)
	4 (40)	Non-Caucasian	16 (46)
Sex	4 (40)	Female	17 (49)
	6 (60)	Male	18 (51)
Primary Language	8 (80)	English	32 (91)
	2 (20)	Non-English	3 (9)
Insurance status	1 (10)	Self-Pay	3 (9)
	9 (90)	Insured	32 (91)
Medications at initial discharge	2 (20)	≤8 medications	5 (14)
	8 (80)	> 8 medications	30 (86)
Number of comorbidities	3 (30)	≤ 3 comorbidities	7 (20)
	7 (70)	> 3 comorbidities	28 (80)
Mean eGFR (ml/min)	63.2±33.6		49±22.1
Mean length of stay (days)	3.5±1.8		4.3±2.7
Antidiabetics on discharge	1 (10)	Yes	21 (60)
	9 (90)	No	14 (40)
Anticoagulants on discharge	6 (60)	Yes	18 (51)
	4 (40)	No	17 (49)
Diuretics on discharge	9 (90)	Yes	32 (91)
	1 (10)	No	3 (9)

Table 6: Multivariate logistic regression analysis to assess risk factors present in HF patients readmitted in 30 days

	Odds Ratio	95% Confidence Interval	p-value
Mean age (years)	1.0	-0.090, 0.166	0.639
Race	4.5	-4.754, 2.934	0.667
Sex	8.6	-3.870, 3.566	0.930
Primary Language	1.7	-1.398,1.586	0.995
Insurance status	5.7	-5.490, 4.010	0.810
Medications at initial discharge	10.0	-3.184, 3.178	0.999
Number of comorbidities	4.6	-4.120, 1.998	0.603
Mean eGFR (ml/min)	1.0	-0.011, 0.103	0.150
Mean length of stay (days)	4.4	-2.214, -0.085	0.114
Antidiabetics on discharge	1.5	-1.130,0.957	0.994
Anticoagulants on discharge	3.0	-6.021, 2.299	0.535
Diuretics on discharge	10.0	-13.634, 1.251	0.191

Discussion

Primary Outcome

Compared to 27% of non-readmitted HF patients, only 16% of readmitted HF patients had less than or equal to 8 medications on discharge, suggesting that higher number of medications at discharge may be a trend seen specifically in readmitted patients. Comparing presence of anticoagulants upon discharge between the two groups revealed that 53% of readmitted HF patients had anticoagulants upon discharge compared to 43% of non-readmitted HF patients. This suggests that presence of anticoagulants upon discharge may be a trend seen more often in readmitted HF patients.

While this study allowed investigators to identify trends in medication-related risk factors present within the heart failure population, it did not prove that any one risk factor was more important than another. This underscores the importance of the involvement of transitions of care pharmacists who have been trained to employ clinical reasoning and judgement to identify risk factors and patient-specific factors that may not be evident from a simple chart review.

For example, a chart review could flag a heart failure patient discharged with 11 medications and no insurance as high risk for readmission but would not be able to clearly capture the presence of a support system that ensures all the patients' medications are paid for and administered by a caretaker each day. Capturing this anecdotal information from patients allows transitions of care pharmacists, as the medication experts, to discern which medication related interventions should take precedence.

Although investigators aimed to streamline and optimize the time that transitions of care pharmacists spend with their patients, similar to studies surrounding pharmacists recommendations on improving care transitions²⁰, our study stresses the need to protect the time spent with the patient, allowing for the opportunity to address both medication related risk factors and patient specific factors.

Secondary Outcome

Researchers hypothesized that within the heart failure population, there are certain medication-related readmission risk factors that should be prioritized for intervention over others. Although no statistical significance was observed between the dependent variables collected within our study and readmission status, previous studies have identified a correlation between the risk factors collected and readmission.

Our study highlights number of medications and presence of anticoagulants at discharge within HF patients as potential points of intervention for our transitions of care pharmacists as both of these risk factors were found more frequently in HF patients. Readily identifying at risk patients through reviewing number of medications and presence of high-risk medications at discharge (such as anticoagulants) allows our pharmacists to provide the necessary comprehensive counseling and intervene sooner on potentially inappropriate medication therapy within this patient population.

These results are consistent with the results from the Project RED pilot, which demonstrated, that transitions of care pharmacists conducted discharge medication review to identify potentially inappropriate medication therapy as well as prioritize anticoagulation counseling to decrease risk of readmission.

Sub-group analysis

Literature has shown that $\geq 50\%$ of HF patients are readmitted within 6 months of their primary admission.⁵ However, there is a large focus on readmissions that occur within 30 days due to the penalties imposed by the Center for Medicare and Medicaid Services (CMS). The main trend identified of interest between HF patients readmitted within 30 days and those readmitted after 30 days was the shorter length of stay in readmitted HF patients as illustrated in **Table 5**. This finding supports literature citing that shorter lengths of stay after hospitalization for HF can be associated with increased rates of cardiovascular and HF readmissions but lower rates of non-cardiovascular readmissions.¹⁸

Limitations

The primary limitation of this study is the small sample size of patients included and analyzed. Of the sample size utilized, many of the patients were suspected to not be readmitted due to lack of subsequent documented admissions within the EMR. Additionally, all data for this study was extracted from the EMR, relying on the accuracy of what was entered and documented by a multi-disciplinary healthcare team. Researchers could only capture if a patient was readmitted within the Memorial Hermann Health System but could not accurately capture if a HF patient was readmitted to other neighboring institutions

Future Considerations

Based on the findings of our study, it is clear that there is more work to be done in optimizing the care provided for high-risk patients such as HF patients. To identify potential differences in risk factors present within readmitted compared to non-readmitted HF patients, a larger sample size would need to be identified. Our study focused specifically on HF patients admitted to one cardiology unit within one of our community hospitals as this was the same floor as the Project RED pilot.

While increasing the sample size to include additional floors and HF admissions throughout the hospital may introduce heterogeneity in the demographics, these findings would be more generalizable to external populations. Additionally, it is important to consider that all patient specific risk factors may not be objective and evident upon simple chart review. Employing a multidisciplinary approach to increase documentation of social factors that may impact readmission risk should also be further researched in this patient population.

Conclusions

In the setting of a large community hospital, this study did not identify specific medication-related readmission risk factors in HF patients that should be prioritized first by transitions of care pharmacists. Though not statistically significant, potential points for intervention for transitions of care pharmacists within the heart failure population identified within this study include addressing inappropriate medication therapy through discharge review and the provision of anticoagulant counseling.

Author's Conclusion

The purpose of this study was to identify which medication related risk factors should be prioritized over others in heart failure patients by transitions of care pharmacists. However, what this study highlighted was the need for the involvement of transitions of care pharmacists who are able to employ critical thinking and clinical judgement rather than using a one-size-fits all algorithmic approach to intervention management in this high-risk patient population. These clinicians should be able to place emphasis on addressing inappropriate medication therapy through discharge medication review and anticoagulant counseling while also thoroughly assessing each patient for risk factors that may present on a case-by-case basis.

Rather than aiming to optimize the time that our transitions of care pharmacists spend with their patients, our study suggests that we should focus on protecting this crucial time spent with high risk populations such as heart failure patients.

References:

1. Centers for Disease Control and Prevention. (2020, September 8). *Heart failure*. Centers for Disease Control and Prevention. Retrieved September 10, 2021, from https://www.cdc.gov/heartdisease/heart_failure.htm.
2. Ziaieian B, Fonarow GC. The Prevention of Hospital Readmissions in Heart Failure. *Prog Cardiovasc Dis*. 2016;58(4):379-385. doi:10.1016/j.pcad.2015.09.004
3. *Demographic changes and aging population – rhibub aging in place toolkit*. Demographic Changes and Aging Population – RHHub Aging in Place Toolkit. (n.d.). Retrieved September 10, 2021.
4. Azad N, Lemay G. Management of chronic heart failure in the older population. *J Geriatr Cardiol*. 2014;11(4):329-337. doi:10.11909/j.issn.1671-5411.2014.04.008
5. Desai AS, Stevenson LW. Rehospitalization for heart failure: predict or prevent? *Circulation*. 2012 Jul 24;126(4):501-6. doi: 10.1161/CIRCULATIONAHA.112.125435. PMID: 22825412.
6. Zohrabian A, Kapp JM, Simoes EJ. The economic case for US hospitals to revise their approach to heart failure readmission reduction. *Ann Transl Med*. 2018;6(15):298. doi:10.21037/atm.2018.07.30
7. Rau, J. (2020, November 2). *Medicare fines half of hospitals for Readmitting too many patients*. Kaiser Health News. Retrieved September 18, 2021, from <https://khn.org/news/medicare-fines-half-of-hospitals-for-readmitting-too-many-patients/>.
8. Mirkin KA, Enomoto LM, Caputo GM, Hollenbeak CS. Risk factors for 30-day readmission in patients with congestive heart failure. *Heart Lung*. 2017 Sep-Oct;46(5):357-362. doi: 10.1016/j.hrtlng.2017.06.005. Epub 2017 Aug 8. PMID: 28801110.
9. Leendertse AJ, Van Den Bemt PM, Poolman JB, Stoker LJ, Egberts AC, Postma MJ. Preventable hospital admissions related to medication (HARM): cost analysis of the HARM study. *Value Health*. 2011;14(1):34–40. <https://doi.org/10.1016/j.jval.2010.10.024>
10. Linkens, A.E.M.J.H., Milosevic, V., van der Kuy, P.H.M. *et al*. Medication-related hospital admissions and readmissions in older patients: an overview of literature. *Int J Clin Pharm* **42**, 1243–1251 (2020). <https://doi.org/10.1007/s11096-020-01040-1>
11. Pellegrin KL, Lee E, Uyeno R, Ayson C, Goo R. Potentially preventable medication-related hospitalizations: A clinical pharmacist approach to assessment, categorization, and quality improvement. *J Am Pharm Assoc* (2003). 2017 Nov-Dec;57(6):711-716. doi: 10.1016/j.japh.2017.06.019. Epub 2017 Aug 16. PMID: 28823545.
12. Uitvlugt EB, Janssen MJA, Siegert CEH, et al. Medication-Related Hospital Readmissions Within 30 Days of Discharge: Prevalence, Preventability, Type of Medication Errors and Risk Factors. *Front Pharmacol*. 2021;12:567424. Published 2021 Apr 13. doi:10.3389/fphar.2021.567424
13. Linkens, A.E.M.J.H., Milosevic, V., van der Kuy, P.H.M. *et al*. Medication-related hospital admissions and readmissions in older patients: an overview of literature. *Int J Clin Pharm* **42**, 1243–1251 (2020).
14. Glans M, Kragh Ekstam A, Jakobsson U, Bondesson Å, Midlöv P. Medication-related hospital readmissions within 30 days of discharge-A retrospective study of risk factors in older adults. *PLoS One*. 2021 Jun 10;16(6):e0253024. doi: 10.1371/journal.pone.0253024. PMID: 34111185; PMCID: PMC8191889.

15. March KL, Peters MJ, Finch CK, Roberts LA, McLean KM, Covert AM, Twilla JD. Pharmacist Transition-of-Care Services Improve Patient Satisfaction and Decrease Hospital Readmissions. *J Pharm Pract.* 2020 Sep 18;897190020958264. doi: 10.1177/0897190020958264
16. Cancino RS, Manasseh C, Kwong L, Mitchell SE, Martin J, Jack BW. Project RED Impacts Patient Experience. *J Patient Exp.* 2017;4(4):185-190. doi:10.1177/2374373517714454
17. Havnes K, Lehnbohm EC, Walter SR, Garcia BH, Halvorsen KH. Time distribution for pharmacists conducting a randomized controlled trial-An observational time and motion study. *PLoS One.* 2021 Apr 30;16(4):e0250898. doi: 10.1371/journal.pone.0250898. PMID: 33930091; PMCID: PMC8087006.
18. Sud M, Yu B, Wijeyesundera HC, Austin PC, Ko DT, Braga J, Cram P, Spertus JA, Domanski M, Lee DS. Associations Between Short or Long Length of Stay and 30-Day Readmission and Mortality in Hospitalized Patients With Heart Failure. *JACC Heart Fail.* 2017 Aug;5(8):578-588. doi: 10.1016/j.jchf.2017.03.012. Epub 2017 May 10. PMID: 28501521.
19. Masoudi FA, Baillie CA, Wang Y, et al. The Complexity and Cost of Drug Regimens of Older Patients Hospitalized With Heart Failure in the United States, 1998-2001. *Arch Intern Med.* 2005;165(18):2069-2076. doi:10.1001/archinte.165.18.2069
20. Haynes KT, Oberne A, Cawthon C, Kripalani S. Pharmacists' recommendations to improve care transitions. *Ann Pharmacother.* 2012;46(9):1152-1159. doi:10.1345/aph.1Q641
21. Chamberlain AM, St Sauver JL, Gerber Y, Manemann SM, Boyd CM, Dunlay SM, Rocca WA, Finney Rutten LJ, Jiang R, Weston SA, Roger VL. Multimorbidity in heart failure: a community perspective. *Am J Med.* 2015 Jan;128(1):38-45. doi: 10.1016/j.amjmed.2014.08.024. Epub 2014 Sep 16. PMID: 25220613; PMCID: PMC4282820.

Appendix

Randomization

Primary Outcome

