# The Frequency of and Reasons for Hospital Readmission Post Percutaneous Coronary Intervention

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***Objectives:*** *The objective of this study was to determine the frequency of and reasons for six months unplanned readmission to hospital post Percutaneous Coronary Intervention (PCI).* ***Background:*** *PCI has become an important and effective way of treating heart disease; however the occurrence of hospital readmission post PCI is not well documented.* ***Methods:*** *The frequency of hospital readmissions were tracked for six months following PCI using the APPROACH registry database. The incidence of and reasons for hospital readmission were determined using the Capital Health Region Administrative Database and the ICD-10 coding for hospital readmission.* ***Results:*** *Of 2641 subjects, it was observed that 4.5% of patients were readmitted to hospital within six months of PCI and 18.6% of patients visited the ED for reasons directly related to PCI. The top reasons for readmission were chest pain (31.2%), atherosclerotic heart disease (24.3%), bleeding/complications with anticoagulation (10.9%), myocardial infarction (7.5%) and procedural complications (3.7%). Factors shown to be independent predictors of hospital readmission were congestive heart failure (p = 0.009), pulmonary disease (p = 0.008), malignancy (p = 0.002), liver disease (p = 0.012) and female gender (p = 0.015).* ***Conclusions:*** *The data indicates that while in-patient six months unplanned hospital readmission post PCI is relatively low, ED visits are substantial. The creation of a post PCI clinic and/or a post PCI hotline may prove to be useful in decreasing hospital visits post PCI. If patients are routinely followed up in the early post PCI period, access to health care may be improved, allowing complications to be observed sooner and care to be given quicker.*

*Keywords: PCI; hospital readmissions; complications; follow-up*

## INTRODUCTION

Percutaneous coronary intervention (PCI) is an umbrella term applied to all techniques used to relieve coronary artery obstruction (Smith, 2001) such as laser angioplasty, rotational atherectomy, and intracoronary stents implantation (Smith, 2001). It is a common modality offered to patients with coronary artery disease (CAD) and is an alternative to coronary artery bypass surgery based on criteria and indications. Procedural PCI complications may include myocardial infarction (MI), emergency coronary artery bypass grafting (CABG), stroke, vascular complications including bleeding, occlusion, dissection, pseudoaneurysm, or arteriovenous fistula at the arterial access site, and contrast agent induced renal failure (Smith, 2001, ACC/AHA Guidelines for Percutaneous Coronary Intervention). Preferably use additional recent sources including related updated guidelines. Mention also some complications that may occur after PCI (post-discharge) such as restenosis that may lead to readmission.

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Unplanned hospital readmissions are viewed as a costly and preventable occurrence and have been associated with a lower quality of inhospital patient care (Ashton, Kuykendall, Johnson, Wray, & Wu, 1995; Weinberger, Oddone, & Henderson, 1996). Moretti et al. reported data from an observational cohort of 1,193 patients, of whom 71 (6.0%) patients had unplanned 60-day readmissions after PCI (Hannan et al., 2011; Kwok et al., 2018; Moretti et al., 2015; Wasfy et al., 2013; Yeh et al., 2012; Yost et al., 2013). Previous studies have concluded that between 8% and 16% of patients undergoing PCI are readmitted to hospitals within 30 days of discharge (Khawaja et al., 2012; Kwok et al., 2018). Hospital readmissions are reported to account for up to half of all hospital admissions and be responsible for 60% of total hospital costs. Reducing readmissions provides a potential opportunity to enhance clinical outcomes and reduce hospital costs. Aside from the financial implications, hospital readmissions have a detrimental effect on individual patients' lives such as time lost from work, family, and other life commitments (Kwok et al., 2018; Olsen & Coleman, 2001).

Researchers have found that an increase in teaching and support post PCI leads to a decrease in complications and an increase in patient satisfaction and quality of life, thus decreasing post PCI hospital readmissions, and ultimately decreasing overall health costs (Healy, 2004; Linsay, Sherrard, Adam, & Wicha, 2000). Therefore, if patients are routinely followed up in the early post PCI period, access to healthcare and information may be improved, allowing complications to be observed sooner and care to be given quicker.

## OBJECTIVE

This study aimed to examine the 6 months unplanned ER visit and hospital readmissions rate, predictors, and causes of readmissions after PCI.

## METHODS

### *Study Design*

A quantitative descriptive cross-sectional study design was used for this study.

### *Study Population*

All subjects were enrolled in the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) registry. The APPROACH registry is an ongoing prospective data collection initiative that began in January 1995 (Ghali, 2001). The registry captures data on the cohort of patients undergoing cardiac catheterization in the province of Alberta, Canada. A purposive sampling was used for this study. Eligible subjects included patients over the age of 18 years who underwent PCI at a Cardiac Catheterization Laboratory in the Capital Health Region within the time periods of January 2002 to December 2004, who were residents in the Capital Health Region and who consented to be enrolled in the APPROACH cohort.

### *Data Collection*

Data collection was designed and training was provided to cardiac catheterization laboratory staff. These forms were completed at the time of cardiac catheterization by the referring cardiologist and were entered into the on-site computers by cardiac catheterization laboratory staff. The computers are linked to a server located at the University of Alberta. Data collected at the time of cardiac catheterization included sociodemographic data, presence or absence of comorbidities, disease specific variables, and coronary angiography results. Results of interventional procedures were also recorded. Subsequent interventions and cardiac catheterizations were also captured by the APPROACH database. Priority of the cardiac catheterization was recorded, along with any procedural complications that may have occurred (Ghali, 2001).

Patients who had a PCI during cardiac catheterization between the time periods of January 2002 to December 2004 were identified by the

APPROACH database. Patient data was then examined for a period of 6 months following the initial PCI. Incidences of hospital readmission or ED visits were determined using the Capital Health Region Administrative database. For this study, The International Classification of Disease, 10th version (ICD-10) code assigned to each admission was used to determine reasons for readmission as well as reasons for ED visits. The ICD-10 code is assigned by trained medical coders who were trained to read through the patient's medical chart to determine the diagnoses and comorbidities that best describe a patient's hospitalization (Quan, Parsons, & Ghali, 2002). Every discharge record contains a unique identification number for each admission, a patient chart number, up to 16 diagnoses, up to 10 procedures, and an indicator flagging the occurrence of death during hospitalization (Quan et al., 2002).

### *Ethical Considerations*

All patients included in the APPROACH database were approached for consent at the time of their cardiac catheterization and consented to follow-up studies post procedure. Once the APPROACH registry data was merged with the administrative data all identifiers were removed and the data was anonymized before analyses.

**Statistical Analysis.** The first phase of analysis involved the creation of descriptive summaries of the data collected. Frequency tables were created and measures of central tendency including means, medians, and modes were determined.

A comparison of baseline demographic and clinical variables was then done between all of the subjects. Chi-squared tests of association were used for categorical variables and the Student's *t* test was used for continuous variables. Significance was set at $p \leq .05$.

The final phase included a logistic regression analysis to determine the independent association between the patient variables and hospital readmission. Using an enter method, the model was built by including all independent variables and determining crude odds ratios for each variable. Those variables with a significance of $p \leq .20$ were then included into the final logistic regression model and an adjusted odds ratio was determined. Predictive variables were identified as those with $p \leq .05$. All analyses were performed using the SPSS version 14.0 statistical package.

## RESULTS

Patients who underwent a PCI, registered in the APPROACH registry were included as part of this study. APPROACH registry data was merged with discharge abstract data and all identifying data were removed from the dataset prior to analyses. The baseline characteristics of the 2,641 patients are reported in Table 1. The sample consisted of 684 females (25.9%) and 1,957 males (74.1%), ranging in age from 27.9 to 93.6 years (median 63.0, mean 63.0 ± 12.1) (Table 1). The mean age of the males was 61.4 ± 11.7 and the mean age of the females was 67.7 ± 11.9 ($p \leq .001$). The mean BMI for the sample group was 27.2 ± 10.3. Comorbidities were common, with hyperlipidemia noted in 78.3%, hypertension in 58.1%, noninsulin dependent diabetes mellitus (NIDDM) in 20.7%, and those who had experienced a previous MI accounted for 16.8% of the sample. In total, 1,840 (69.7%) PCIs were done on an urgent inhospital basis, 511 (19.3%) were planned, 237 (9%) PCIs were done on an urgent out of hospital basis, and 53 (2%) were unknown. Inhospital mortality for patients was 4.7% ($n = 125$).

### *Hospital Readmissions*

Of the 2,641 subjects included in the study, 870 (32.9%) visited the ED and 222 (8.4%) were readmitted to hospital within 6 months of the index PCI. The mean time to repeat visit was 1.9 months (median 1.3 months). The mean number of visits was 2.5 (median 2.0) with 19% having 1 visit and 23% having >1 visit. Unfortunately, the data did not differentiate between those visits that were planned and unplanned; however, it can be assumed that the ED visits were not planned visits to the hospital. Age was noted to be significantly related to the number of times a patient sought medical attention at a hospital ($p = .012$).

**TABLE 1. Baseline Characteristics**

| Variable | *N* | % |
|---|---|---|
| Males | 1,957 | 74.1 |
| Hypertension | 1,531 | 58 |
| Hyperlipidemia | 2,068 | 78.3 |
| IDDM | 37 | 1.4 |
| NIDDM | 546 | 20.7 |
| Priority of PCI | | |
| Urgent inhospital | 1,840 | 69.7 |
| Urgent out-of hospital | 53 | 2 |
| Planned | 511 | 9 |
| Smoking status | | |
| Current | 747 | 29.9 |
| Previous | 967 | 38.7 |
| Never | 610 | 24.4 |
| Unknown | 176 | 7.0 |
| Previous MI | 444 | 16.8 |
| Prior PCI | 94 | 3.6 |
| Prior CABG | 200 | 7.6 |
| Heart failure | 140 | 5.3 |
| Peripheral vascular disease | 134 | 5.1 |
| Cerebrovascular disease | 117 | 4.4 |
| Renal failure requiring dialysis | 38 | 1.4 |
| Pulmonary disease | 214 | 8.1 |
| Malignancy | 74 | 2.8 |
| Liver disease | 15 | 0.6 |
| GI disease | 147 | 5.6 |

*Note.* IDDM = insulin dependent diabetes mellitus; NIDDM = noninsulin dependent diabetes mellitus; PCI = percutaneous coronary intervention; MI = myocardial infarction; CABG = coronary artery bypass grafting; GI= gastrointestinal.

As the patient's age increased, they had more hospital visits (ED visits and in-patient hospitalizations included). The 21-to-30 age group had a mean of 2.0 visits, the 31-to-40 age group had a mean of 1.9 visits, the 41-to-50 age group had a mean of 2.1 visits, the 51-to-60 age group had a mean of 2.2 visits, the 61-to-70 age group had a mean of 2.4 visits, the 71-to-80 age group had a meant of 2.8 visits, the 81-to-90 age group had a mean of 2.9 visits, and there was a mean of 4.5 visits in the 91-to-100 age group. Age was not noted to be significantly related to the time to repeat hospitalization ($p$ = .459). Additionally, the number of visits were not noted to be statistically related to the whether the patient visited the ED or was admitted as an in-patient ($p$ = .842).

**Reasons for Readmission.** Numerous reasons for readmission to hospital were apparent when reviewing the ICD-10 data. The diagnosis descriptions were independently reviewed by an expert in the Interventional Cardiology field (M.G.) and the ICD-10 diagnoses that were deemed to be related to PCI were categorized into 21 separate categories (Table 2). Of the 1,092 subjects that had a repeat hospital visit following their PCI, 610 (56%) visited the hospital for reasons that were related to PCI. Of these 610 patients, 491 (80%) visited the ED and then were discharged home and 119 (20%) were subsequently admitted as in-patients. The most common reason for the ED visit was chest pain (32%), followed by atherosclerotic heart disease (13.3%), MI (5.9%), congestive heart failure (3.7%), and bleeding complications (3.6%).

The most common reasons for being admitted as an in-patient were chest pain (17.1%), atherosclerotic heart disease (13.1%), bleeding (5.9%), MI (4.1%), procedural complications (3.6%), congestive heart failure (2.3%), and phlebitis (1.4%). Time of readmission was noted to be significantly related to the type of readmission to hospital ($p \leq .001$). Patients who were admitted as in-patients took longer to return to hospital with a mean readmit time of 2.3 months (70.1 days). Patients who visited the ED returned to hospital earlier with a mean readmit time of 1.8 months (54.6 days).

**Predicting Hospital Readmission.** By logistic regression analysis, female gender, congestive heart failure, pulmonary disease, malignancy, and liver disease were all independent predictors of repeat hospital visits (either in-patient admissions or ED visits). The Hosmer–Lemeshow statistic for the model was 5.967 ($p$ = .113), indicating good fit for the model (Table 3).

## DISCUSSION

The present study was undertaken to explore and describe the frequency of and reasons for 6

**TABLE 2. ICD-10 Codes used to Identify Reasons for Readmission**

| Reasons for Readmission | ICD-10 Code |
|---|---|
| Bleeding/complications with anticoagulation | 2859, 79092, D649, D683, I620, K290, K625, K920, K921, K922, R040, R310, R318, R58, T810, Y442 |
| MI | 41011, 41091, 4111, I210, I211, I213, I2141, I2149, I219, I221, I249 |
| Renal failure | N179, N19, N990 |
| Cerebrovascular disease/complications | 4359, 436, G459, I64 |
| Procedural complications | I978, M7983, M7986, R098, T812, T8188, T828, T888, Y840, Z480 |
| Chest pain | 4139, 78650, 78659, I200, I2088, I209, I2382, R073, R074 |
| Atherosclerotic heart disease | 4149, I251, I2510, I2511, I2519, I259, I702 |
| Arterial aneurysm | I724 |
| Cardiac arrest | I460, I469 |
| CHF | 4280, I500 |
| Dehydration | E860 |
| Pericardial disease | I319 |
| Ventricular tachycardia | I472 |
| Shortness of breath | R060 |
| Infection | A419, T814 |
| Orthostatic hypotension | I951 |
| Pulmonary embolism | I269 |
| Embolism and thrombosis of arteries of lower extremities | I743 |
| Pain | M545, M7960, M7961 |
| Phlebitis | I802 |
| Syncope | R55 |

*Note.* MI = myocardial infarction; CHF = congestive heart failure.

months unplanned hospital readmission post PCI and to determine the independent clinical predictors of post PCI readmission. The demographic characteristics for this study were those typically found in patients with CAD. Patients who are older and are of the male gender have been shown to be at increased risk of developing CAD (Linton & Fazio, 2003; Velders et al., 2014). In this study, 74% of subjects were male and 26% were female with the mean age being 68 years.

Previous studies have reported a repeat hospitalization rate post PCI of 15% to 50% (Halon, Rennert, Flugelman, Jaffe, & Lewis, 2002; Kwok et al., 2018; Laskey et al., 2005; Lubitz, Gornick, Mentnech, & Loop, 1993) which is similar

**TABLE 3. Predictors of Readmission to Hospital Post PCI**

| Variable | Crude Odds Ratio (95% Confidence Interval) | *p* Value | Adjusted Odds Ratio (95% Confidence Interval) | *p* Value |
|---|---|---|---|---|
| Age | 1.005 (0.997–1.012) | 0.207 | | |
| Female | 1.194 (0.992–1.436) | 0.061 | 1.247 (1.044–1.490) | 0.015 |
| Hypertension | 1.041 (0.881–1.229) | 0.638 | | |
| Hyperlipidemia | 0.915 (0.755–1.108) | 0.362 | | |
| IDDM | 1.110 (0.565–2.178) | 0.763 | | |
| NIDDM | 1.188 (0.974–1.450) | 0.090 | 1.204 (0.991–1.462) | 0.062 |
| Prior MI | 1.022 (0.819–1.277) | 0.845 | | |
| Prior CABG | 0.916 (0.673–1.247) | 0.576 | | |
| Congestive heart failure | 1.534 (1.067–2.205) | 0.021 | 1.616 (1.130–2.311) | 0.009 |
| Prior PCI | 0.780 (0.500–1.216) | 0.273 | | |
| Peripheral vascular disease | 1.295 (0.897–1.868) | 0.167 | 1.335 (0.930–1.917) | 0.117 |
| Cerebrovascular disease | 1.097 (0.747–1.612) | 0.637 | | |
| Renal failure requiring dialysis | 1.509 (0.764–2.981) | 0.236 | | |
| Pulmonary disease | 1.420 (1.060–1.902) | 0.019 | 1.474 (1.105–1.967) | 0.008 |
| Malignancy | 2.057 (1.269–3.335) | 0.003 | 2.153 (1.335–3.471) | 0.002 |
| Liver disease | 4.832 (1.334–17.499) | 0.016 | 5.097 (1.420–18.294) | 0.012 |
| GI disease | 1.172 (0.830–1.655) | 0.368 | | |

*Note.* IDDM = insulin dependent diabetes mellitus; GI = Gastrointestinal; NIDDM = noninsulin dependent diabetes mellitus; PCI = percutaneous coronary intervention; MI = myocardial infarction; CABG = coronary artery bypass grafting.

to the findings of this study where 41% of patients returned to hospital (either having an ED visit, or an in-patient admission) within 6 months of the index PCI. However, this study showed that only 4.5% of patients had in-patient readmissions that were directly related to PCI, significantly less than reported by Lubitz et al. who suggested that 34.6% of hospital readmissions within 1 year were directly related to PCI (Lubitz et al., 1993). This drop in readmissions may be attributed to the improved techniques in performing angioplasty since 1993 when Lubitz et al. completed their

study. The difference may also be due to the differing time periods that hospital readmissions were observed for (6 months versus 1 year), keeping in mind that a greater time following patients may lead to a greater number of "false positives" or unrelated admissions (Heggestad & Lilleeng, 2003). Additionally, different criteria may have been used to determine whether an admission was or was not related to the index PCI.

Although no previous study differentiated between ED visits and in-patient admissions, it is interesting to note that the majority of repeat hospital visits were ED visits (80%) while only 20% of repeat hospital visits were actually in-patient admissions. It is unknown if previous studies that examined hospital readmission looked only at in-patient visits or if they looked at ED visits as well. If only in-patient visits were looked at, the readmissions observed in this study were significantly lower than that of previous studies accounting for 4.5%, while ED visits accounted for 18.6%. This difference in in-patient admissions, if real, could be explained by differing techniques, improved technologies, and/or the type of patient teaching provided by the healthcare professionals at the time of PCI. Additionally, as stated previously, different criteria may have been used to determine if a hospital readmission was actually related to PCI.

Another interesting finding of this study was that patients who had ED visits returned to hospital in a mean time of 1.8 months, whereas patients who were readmitted as in-patients returned to hospital in a mean time of 2.3 months, a statistically significant difference. This could be explained by an elevated anxiety level among recent PCI patients, causing them to visit the ED sooner. It is also possible that the reason for this difference is that those patients requiring admission to hospital may have been experiencing symptoms for a longer period of time prior to seeking medical attention than those who visited the ER. This increase in time may have made their complication more severe, thus requiring closer medical attention. The reasons for returning to hospital were distributed in a similar manner for both ED visits and in-patient admission with the top two reasons for readmission both being chest pain (32% and 31%, respectively) and atherosclerotic heart disease (24% of patients in each category). These findings are consistent with a prior study, where the authors established that the reasons for readmission were diverse but not frequently associated to procedural complications. More than half of readmissions were for evaluation of recurrent chest pain or other anginal symptoms (56.1%). Surprisingly, in spite of the fact that these patients had recently experienced PCI, only 11% of readmitted patients were diagnosed with MI, though more than 40% of patients consequently went on to have further PCI (Wasfy et al., 2014).

It is important for healthcare professionals to realize that the impact of hospital readmission may be very much underestimated as it appears the majority of patients are not actually admitted as in-patients, but are seeking medical care in EDs. The reasons for these visits may be due to actual complications post PCI, or may be prompted by patients who are anxious and have questions or concerns after PCI. It is also unknown how many of these patients visited their family physicians or cardiologists with questions and concerns post PCI and how many complications were managed by these physicians, without the patient ever visiting a hospital, creating a further underestimation of post PCI complications.

Readmissions are frequently caused by persistence of preexisting problems or acute exacerbations of unconnected chronic disease. It is likely that the risk of these occurrences might be reduced by spending more time in delivering patient education, conducting high-quality medication reconciliation, and following up with patients post discharge (Krumholz, 2013; Kwok et al., 2018). Post PCI follow-up clinics have been shown to be successful in reducing the incidence of post procedural complications as well as encouraging patients to engage in more lifestyle changes and risk factor modification (Dendale

et al., 2005; Linsay et al., 2000). Additionally, hospital based follow-up clinics have been observed to decrease the number rehospitalizations, compared to the standard follow up by community physicians (Van Walraven, Mamdani, Fang, & Austin, 2004).

A telephone "hotline" provided to patients after PCI where a health professional could be reached who is knowledgeable about PCI and the potential ensuing complications could possibly reduce ED visits, outpatient clinic visits, and in-patient admissions substantially. Additionally, patients following up in a post PCI follow-up clinic could potentially have complications detected sooner, thus reducing further hospital visits. These follow-up clinics could also provide further teaching on CAD and risk factor reduction, possibly helping to lower the incidence of further disease progression.

Age was noted to be related to the number of repeat hospitalizations with an increasing age resulting in an increased number of hospitalizations. The mean number of repeat visits increased from 2.0 visits in the 21 to 30 age group to 4.5 visits in the 91 to 100 age group. Elderly patients may be more likely to have a hospital visit due to an increase in anxiety or a decreased ability to retain health teaching while at the hospital. Another factor contributing to older patients having more hospitalizations may be that older patients are more likely to have comorbidities that may put them at higher risk of developing complications post PCI. For example, patients in the 61- to 70-year-old age group were more likely to have had prior PCI and CABG, congestive heart failure, peripheral vascular disease, cerebrovascular disease, renal failure requiring dialysis, pulmonary disease, and malignancies. However, these findings are not consistent with the prospective analysis of one the studies, which revealed a cardiac readmission rate of 1 in 22 PCI procedures (4.6%) with no significant difference between those 65 or older and those under 65 years of age (Ricciardi et al., 2012).

***Reasons for Readmission***

Unfortunately, other studies that have examined repeat hospitalization post PCI have not reported the reasons for readmission. In this study, the top five reasons for in-patient readmission to hospital were noted to be chest pain (31.2%), atherosclerotic heart disease (24.3%), bleeding/complications with anticoagulation (10.9%), MI (7.5%), and procedural complications (3.7%). However, as chest pain has been reported to occur in patients as frequently as 23% to 30% of the time post PCI (Galan, Gruentzig, & Hollman, 1985; Rashid et al., 2016; Tan, SULE, Taub, & Sowton, 1995; Versaci et al., 2002), it is not surprising that chest pain is the number one reason for repeat visits to hospital. Additionally, as chest pain continues to be the hallmark symptom of MI, it seems likely that patients would return to hospital when experiencing this symptom in fear of an infarction. It is also interesting to note that chest pain continued to be the number one reason when patients sought medical attention in the ER. Unfortunately, it could not be ascertained whether the severity of chest pain, or ST segment changes differed between the two groups justifying those who were admitted as in-patients and those who were discharged home from the ER.

Previous studies examining vascular complications reported a complication rate of 0.77% to 10.3% (Dendale et al., 2005; Fransson & Nylander, 1994; Kuchulakanti et al., 2004; Ricci, Trevisani, & Pilcher, 1994; Sherev, Shaw, & Brent, 2005). This study found similar results with 0.2% of patients experiencing arterial aneurysm and 0.5% of patients experiencing phlebitis. Those patients that experienced post PCI bleeding accounted for 4% of the sample, however, this variable accounted for all bleeding complications, not just bleeding at the insertion site.

***Predicting Readmission to Hospital Post PCI***

After creating a logistic regression model, five variables were noted to independently predict a repeat hospital visit post PCI (either ED visit or in-patient admission). Patients with liver

disease, malignancies, congestive heart failure, pulmonary disease female patients were all independent predictors of repeat hospital visits. These predictors have only one similarity to those reported by Halon et al. whose model identified hypertension, incomplete revascularization, and female gender as predictors of readmission (Halon et al., 2002). This study did not examine the completeness of revascularization, however, hypertension was not found to be predictive of hospital readmission. On the contrary, female patients were found to be 1.2 times more likely to either have an ED visit or be readmitted to the hospital as an in-patient, similar to the study done by Halon et al. where it was found that female patients were 2.2 times more likely to be readmitted to hospital post PCI (Halon et al., 2002).

***Limitations of the Study***

This study may not capture all patients readmitted to hospitals. Patients who were readmitted to a hospital outside of the Capital Health Region were not included in the study in order to capture all hospital readmissions. Patients living in other health regions could be readmitted to a multitude of other institutions, rendering the tracking of readmissions nearly impossible. However, it is felt that by creating this limitation, the majority of hospital readmissions among the study subjects were captured.

Another limitation of this study is that the ICD-10 coding may not have accurately captured the reasons for readmission with all patients. A study done on the accuracy of the ICD-9 coding system found that although not all comorbidities were captured, the ICD-9 coding system appeared to be accurate in describing the primary diagnosis (8). It is therefore likely that the primary reason for hospital readmission was captured by the ICD-10 code.

One more limitation is that the ICD-10 reason for admission of "atherosclerotic heart disease" is vague and it was unclear exactly what this diagnosis encompassed. Although it was viewed that this diagnosis was related to the PCI, the vagueness of the term may have contributed to a higher estimation.

A forth limitation is that it is unknown how many patients visited their family physician post PCI for problems and concerns related to the PCI, potentially underestimating the number of patients who had problems post PCI.

One final limitation is that it is uncertain how many in-patient admissions were planned. Unfortunately the data collected did not differentiate between planned and unplanned admissions, therefore the number of in-patient readmissions reported may be slightly elevated.

## CONCLUSION

Rehospitalization post PCI can have an enormous impact on both the healthcare system as well as patients' lives. Previously, this issue had not been thoroughly examined, although it was thought that the incidence of readmission post PCI may be significantly underestimated. The information from this study can be used to help focus post PCI teaching to those patients that may have a higher incidence of readmission post PCI, potentially reducing their need for readmission. Moreover, it is possible that many of the hospital visits, specifically, the ED visits, were not necessary and may have been a result of patient anxiety and uncertainty. For these instances, the creation of a post PCI clinic and/or a post PCI hotline may prove to be useful in decreasing the number of hospital visits post PCI by giving patients a place to go for PCI follow-up as well as to call with any questions or concerns.

As it seems that returning to hospital post PCI is a relatively frequent occurrence, it is imperative that current procedures and practices be examined and reevaluated in order to better assist patients post PCI. These actions my help to reduce the occurrence of hospital readmissions post PCI decreasing the effect it may have on the healthcare system as well as patient's lives.

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