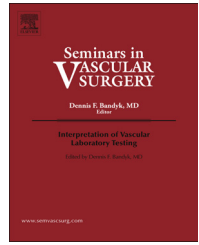


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# Measures to reduce unplanned readmissions after vascular surgery



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## ARTICLE INFO

## ABSTRACT

Hospital readmissions are increasingly utilized as a measure of health care quality. Unplanned readmissions in surgical patients are viewed as a marker of poor care quality, and are associated with significant expense both to the health care system and to the patient. Interventions aimed at reducing readmissions have been the focus of several prospective randomized trials addressing medical conditions like congestive heart failure, but few data exist on efforts to reduce readmissions in surgical patients. Vascular surgery patients have been found to be at a particularly high risk for readmission, and a number of groups have reported on the risk factors for readmission in these patients. However, measures to reduce unplanned readmissions after vascular surgery have not been thoroughly investigated. Here, we summarize the existing data on risk factors for readmission in vascular surgery patients, review interventional studies in medical patients aimed at reducing readmissions, and suggest interventions that may be helpful in reducing readmissions in vascular patients. Further investigative work is needed to ascertain practical approaches to reducing unplanned readmissions in vascular surgery patients and thus improve the quality of care they receive.

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## 1. Introduction

Among metrics used to evaluate health care quality, readmissions are increasingly scrutinized as penalties are levied on hospitals for excess readmissions under the Patient Protection and Affordable Care Act of 2010 [1]. This law established the Hospital Readmissions Reduction Program, which requires the Centers for Medicare and Medicaid Services (CMS) to penalize hospitals for excessive readmissions. CMS started with penalties for three medical conditions (ie, acute myocardial infarction, heart failure, and pneumonia), and has now moved to penalize rehospitalizations for chronic

obstructive pulmonary disease, as well as readmissions in surgical patients after total knee and hip arthroplasties in 2015 [2]. In 2017, CMS plans to target readmissions after coronary artery bypass surgery [3]. This penalty list now includes five of the seven conditions associated with the most frequent and highest cost readmissions reported to the US Congress by the Medicare Payment Advisory Commission in 2007 [4]. The remaining two conditions not yet penalized are percutaneous transluminal coronary angioplasty and a category labeled “other vascular” procedures [4].

In the Medicare population, the overall 30-day readmission rate for vascular surgical patients is quite high at 24% [5], and

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these readmissions cost more on a per-readmission basis than any other condition studied, including coronary artery bypass surgery [4]. These statistics, based on administrative data, might not tell the whole story of vascular readmissions, as they do not account for planned rehospitalizations and readmissions not related to the index procedure [6]. Some have argued that readmission rates may not be indicative of hospital care quality [7], but other data suggest that readmissions in surgical patients are indeed reflective of inferior care quality [8]. Rehospitalizations in vascular patients may thus provide an area for quality improvement. Several groups have examined risk factors for readmissions in vascular patients, but prospective studies of interventions aimed at reducing such readmissions are lacking. Here, we discuss what is known about readmissions in vascular surgery patients, describe measures that have been implemented in studies to reduce readmissions in medical patients, and propose ways to reduce readmissions in vascular surgery patients.

## 2. Risk factors for readmissions in vascular surgery patients

Several groups have examined procedure-specific risks for readmissions in vascular surgery patients, as well as risk factors for vascular patients in general. Studies on readmissions after vascular surgery have reported widely variable data on both rates of, and risk factors for, readmission (Table 1).

### 2.1. Carotid interventions

Patients who undergo carotid artery interventions have some of the lowest readmission rates among vascular surgery patients. Overall reported readmission rates after carotid endarterectomy (CEA) are in the range of 6.5% [9,10], but can be as high as 8.8% [11]. Risk factors for readmissions after CEA include older age and preoperative patient comorbidities, such as congestive heart failure (CHF), prior coronary artery bypass grafting, diabetes, renal failure, and history of stroke [9–12]. Postoperative complications such as stroke, bleeding, cardiac events, and reoperation have also been implicated as risk factors for readmission [9,10]. Discharge to a skilled nursing facility (SNF) is a risk factor for readmission after CEA as well [10]. Interestingly, readmission rates after carotid artery stenting have been shown to be higher than those after CEA: 11% for carotid artery stenting versus 9% for CEA at 30 days; 18% versus 13% at 60 days; and 23% versus 17% at 90 days [11]. Even after adjusting for confounding factors, readmissions after carotid artery stenting were 1.5 times more frequent than after CEA in this study, with the most common reason for readmission being coronary artery disease [11].

### 2.2. Aortic aneurysm repair

Thirty-day readmission rates after thoracic (TAA) and thoracoabdominal aortic aneurysm (TAAA) repair range from 16% to 22% for endovascular repair and from 19% to 21% for open repair [13], with one study reporting a 29% overall early readmission rate after TAAA repair [14]. Risk factors for readmission include older age, poor socioeconomic status,

open repair, and postoperative complications, such as pneumonia and wound occurrences [13,14]. Patient comorbidities have been shown to be a risk factor for readmission in one study [13], but not in another [14]. Notably, early discharge after complex TAA repair in patients without postoperative complications was associated with fewer readmissions as compared with late discharge [13], and most patients readmitted after TAAA repair were rehospitalized at a non-index hospital [14].

More data exist regarding readmissions after abdominal aortic aneurysm (AAA) repair. Some groups have reported similar readmission rates for both endovascular aneurysm repair (EVAR) and open AAA repair, ranging from 7.6% to 13% for EVAR and from 8% to 13% for open AAA repair [10,15]. One study revealed a higher 30-day readmission rate for open repair (20% v 17% for EVAR) [16]. However, after 1 year, readmissions after EVAR were more frequent than open repair (55% v 52%), with the crossover occurring at 4 months postoperatively [16]. Another group reported a higher readmission rate after EVAR as compared with open repair during a 6-year period (7.6 v 7.0 per 100 person years) [17].

Reported risk factors for readmission after EVAR include older age; female sex; preoperative comorbidities, such as history of stroke and smoking; and postoperative complications, such as cardiac arrest, venous thromboembolism, renal failure, longer hospital length of stay (LOS), and discharge to SNF [10,15–17]. For open repair, readmission risk factors include older age; female sex; preoperative comorbidities; postoperative complications, such as venous thromboembolism, renal failure, wound infection, graft complication, blood transfusion, longer LOS, and discharge to SNF [10,15–17]. In one study, postoperative complications were found to have a much stronger association with 30-day readmission as compared with patient comorbidities [15]. Patients who had open AAA repair were readmitted for failure to thrive and other postoperative medical complications, while those who had EVAR were more likely to be readmitted for a device or aneurysm complication [16].

### 2.3. Lower extremity arterial intervention

Interventions for lower extremity arterial occlusive disease are associated with higher 30-day readmission rates than many other vascular operations. Readmissions after infringuinal bypass occur at rates of 14% to 24% [10,18–20]. Rates of readmissions after open versus endovascular interventions have been reported to be similar by one group [18], although another study found readmissions to be more frequent after open procedures [21]. Patient factors predominate as risk factors for readmission after infrainguinal bypass, and include African-American race, female sex, renal failure, diabetes, CHF, chronic obstructive pulmonary disease, smoking, functional dependence, critical limb ischemia, and tissue loss [10,18,19,21,22]. Operative factors including infrapopliteal bypass target, longer operative time and LOS, admission to a nonteaching hospital, discharge to SNF, in-hospital loss of graft patency, and, most significantly, any return to the operating room also significantly predict readmission in these patients [18,19,21,22]. Postoperative infection tends to be the most common cause of readmission [10].

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