

# Risk Stratification for Patient Care Model and General Surgery Service

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## Description

Annually, more than 2 million patients are admitted with emergency general surgery (EGS) conditions. Emergency general surgery cases comprise 11% of all general surgery operations, yet account for 47% of mortalities and 28% of complications. Using the statewide general surgery Michigan Surgical Quality Collaborative (MSQC) data, we previously confirmed that wide variations in EGS outcomes were unrelated to case volume/complexity. We assessed whether Patient Care Model (PCM) affected EGS outcomes.

## Patient Care Model

There were 34 hospitals that provided data for PCM, resources, surgeon practice patterns, and comprehensive MSQC patient data from January 1, 2008 to December 31, 2016 (general surgery cases = 126,494; EGS cases = 39,023). Risk and reliability adjusted outcomes were determined using hierarchical multivariable logistic regression analysis with multiple clinical covariates and PCM.

Postoperative Pancreatic Fistula (POPF) is one of the major factors for morbidity and mortality in pancreatic surgery. The International Study Group for Pancreatic Surgery (ISGPS) published in 2005 a definition and a classification of POPF, which have been widely accepted and used. According to this definition, a pancreatic fistula is defined as any amylase-rich drainage fluid (>3 times the upper limit of institutional normal serum amylase activity) starting from the third day after surgery. POPF are then classified in grade A, grade B and grade C, according to the extent of the clinical impact.

Grade A POPF have no impact on the postoperative course, grade B POPF alter the normal postoperative course, while the condition of the patient stays stable, and grade C POPF lead to severe complications such as organ failure with the need of intensive care or surgical intervention. In 2016, the ISGPS narrowed the definition of POPF to the clinically relevant POPF. While POPF B does not lead to higher mortality, the in-hospital death rate among patients with POPF C is as high as 35% and over one third of in-hospital deaths after pancreatoduodenectomy are contributed to POPF. Thus,

assessing risk for POPF has a pivotal role when estimating overall risk in pancreatic surgery.

There has been considerable effort to develop a measurement tool for risk of POPF. In a recent review, Sandini et al. described 10 clinical risk scores for POPF, published between 2008 and 2016. The most common parameters used in the development of predictive scores for POPF are the consistency of the pancreatic parenchyma and the diameter of the Main Pancreatic Duct (MPD). While usually the consistency of the pancreatic parenchyma is subjectively assessed by the surgeon as soft or hard, the MPD is either used as a continuous or as a multicategorical parameter, measured at the resection plane of the pancreas. Since measurements of the MPD intraoperative, especially when the pancreatic duct is small, might be impractical and imprecise, in the pancreatic surgery registry of the German Society for General and Visceral Surgery MPD has been recorded as a binary variable <3 mm versus ≥3 mm. Furthermore, there is an association of soft pancreatic parenchyma and small MPD that might cause the problem of multicollinearity in the regression models used to develop the prediction scores, and thus lead to instability of the models.

## General Surgery Service

The General Surgery Service (GSS) model was more common (73%) than acute care surgery (ACS, 27%). Emergency general surgery 30-day mortality was 4.1%. The ACS model was associated with a reduction of 31% in mortality for EGS cases, related to decreased mortality in the intestinal resection cohort. Morbidity in EGS was 17.4% (9.7% elective); highest (40%) in intestinal resection, and PCM did not affect morbidity. We identified specific variables for an optimal EGS risk adjustment model.

This is the first multi-institutional study to identify that an ACS model is associated with a significant 31% mortality reduction in EGS using prospectively collected, clinically obtained, research-quality collaborative data. We identified that new risk adjustment models are necessary for EGS outcomes evaluations. Postoperative pancreatic fistula (POPF) is a major factor for morbidity and mortality after pancreatic resection. Risk stratification for POPF is important for adjustment of treatment, selection of target groups in trials and quality assessment in

pancreatic surgery. In this study, we built a risk-prediction model for POPF based on a large number of predictor variables from the German pancreatic surgery registry Pancreas. Pancreas was searched for patients, who underwent pancreatoduodenectomy from 2014 to 2016. A multivariable logistic regression model with elastic net regularization was built including 66 preoperative and intraoperative parameters. Cross-validation was used to select the optimal model. The model was assessed via area under the ROC curve and calibration slope and intercept.

The model we present is a valid measurement instrument for POPF risk based on four predictor variables. It can be applied in

clinical practice as well as for risk-adjustment in research studies and quality assurance in surgery. Another issue, when developing a predictive model for POPF, is the parameter selection, which usually has been based on univariable testing for significance or some prior knowledge, which might lead to selection bias and potentiating of uncertainties due to multiple testing. In this study, we address the problems of parameter selection and multi collinearity using multivariable logistic regression with elastic net regularization to develop a predictive model for POPF, using a large sample from the German pancreatic surgery registry pancreas.