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Predicting Radical Prostatectomy Pathologic Outcomes in the Michigan Urological Surgery Improvement Collaborative

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INTRODUCTION AND OBJECTIVES: Prediction of pathologic outcomes of radical prostatectomy (RP) is a potentially important source of information to assist therapeutic counseling and decision-making, and potentially guide operative planning. Predictive models such as the Memorial Sloan Kettering Cancer Center (MSKCC) pre-operative nomograms are commonly utilized but have not been well validated in broad community cohorts. We sought to create and validate a pre-RP predictive model based on a population of men drawn from a diverse group of urology practices in the state of Michigan.

METHODS: The Michigan Urological Surgery Improvement Collaborative (MUSIC) is a consortium of 44 diverse urology practices that maintains a prospective registry of men with prostate cancer (CaP) with high-quality, validated data abstraction. We identified over 5,400 men from this registry between 2012 and 2017 who had received RP as primary therapy for CaP and had a PSA within 180 days, available data on number of positive and total cores at time of biopsy and pathologic outcomes--non-organ confined disease (NOCD), extraprostatic extension (EPE), seminal vesicle invasion (SVI), or lymph node involvement (LNI)--at the time of surgery. We divided the men randomly into a training (70%) and test (30%) set. We developed binary logistic regression models to predict each of the 4 endpoints (MUSIC model). We evaluated models on the basis of discrimination using area-under-the-curve (AUC) and calibration. We further compared the models to the well-known MSKCC pre-RP models.

RESULTS: The MUSIC and MSKCC models had comparable discrimination for all 4 endpoints based on the MUSIC test set (Figure 1A). The discrimination of the MSKCC model on the MUSIC test set was better than the published discrimination of this same model on MSKCC data for NOCD and EPE. However, NOCD and EPE exhibited poor calibration when evaluated on the MUSIC data, overestimating the probability of these outcomes significantly (Figure 1B).

CONCLUSIONS: The MUSIC model exhibited excellent out-of-sample calibration in the MUSIC population, whereas the MSKCC model significantly overestimated the risk of NOCD and EPE when applied to the MUSIC population. This may be related to the quaternary referral practice of MSKCC, which may limit the generalizability of these pre-RP models.

Figure 1. A) Comparison of MSKCC and MUSIC model discrimination, **B)** Comparison of calibration for MSKCC and MUSIC models on the MUSIC test set.

Outcome	MSKCC model MSKCC data AUC*	MSKCC model, MUSIC test set AUC	MUSIC model, MUSIC test set AUC
Not Organ Confined	0.71	0.77	0.78
Extracapsular Extension	0.70	0.76	0.77
Lymph Node Involvement	0.86	0.82	0.82
Seminal Vesicle Invasion	0.85	0.82	0.86

* Source: https://www.mskcc.org/nomograms/prostate/pre_op/coefficients