Using risk models and electronic health records to inform cervical cancer screening guidelines

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Background: We collaborated with Kaiser Permanente Northern California (KPNC) to assemble a cohort of 1.4 million women undergoing cervical cancer screening with human papillomavirus (HPV) and Pap "cotesting" by linking electronic records of patient information, test results, and disease outcomes. To estimate risks, we developed "logistic-Weibull" models for use in screening cohorts assembled from electronic health records. These risks underlie current cervical cancer screening guidelines.

Methods: Using a "logistic-Weibull" model that is a logistic regression for prevalent disease and a Weibull survival regression for interval-censored incident disease, we calculate risks of cervical intraepithelial neoplasia grade 3 and cancer (CIN3+) for each possible abnormal cotesting result. To illustrate how risk estimates can be used to inform screening guidelines, we compare the risks curve for 34,261 women who test Pap negative and HPV positive at enrollment against that of 27,455 women with abnormal Pap and 10,435 women with low-grade Pap. We further examine the effect of age on CIN3+ risk in women testing Pap negative and HPV positive.

Results: The 1.87% prevalent risk and 2.56% 1-year cumulative risk of CIN3+ among women who tested Pap-negative/HPV-positive at enrollment is close to the 1.90% prevalent risk and 2.37% 1-year risk among women with abnormal Pap. In contrast, women with low-grade Pap have 3.87% prevalent risk and 4.88% 1-year risk. Among women testing Pap-negative/HPV-positive, risks of CIN3+ were significantly lower in older women than in younger women. The 2-year cumulative risk of CIN3+ was 2.38%, 1.75%, and 2.41% among women age 45-49, 50-54, and 55-65, respectively.

Discussion: The prevalent and 1-year risks of CIN3+ for women testing Pap-negative/HPV-positive was similar to that of women with abnormal Pap, suggesting the same 1-year screening interval should be used. The lower risks among older women testing Pap-positive/HPV-negative suggests screening intervals may safely be extended to 2-years.