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Automated Immunization Surveillance: Using Business Intelligence to Improve Up-to-Date Rates

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Objective

To describe a business intelligence system designed to reprocess and utilize an immunization information system's (IIS) data to visualize, and track population trends in immunization coverage in an urban population.

Introduction

IIS have effectively increased vaccination rates through targeted engagement and outreach, often with clinicians and patients. Little has been published around IIS use for generating meaningful population health measures. To leverage IIS data for sub-county population health measures, new tools are required to make IIS data easily accessed for this distinct use case.

Human papillomavirus (HPV), the most common sexually transmitted infection in the United States, has a highly effective (97%) vaccine to prevent infection when administered to individuals 9-26 years old. According to the National Immunization Survey, only 47% of Colorado females 13-17 years had completed the HPV vaccine series in 2011. In 2012, Denver metropolitan health departments were awarded a three year grant to support the Alliance for HPV Free Colorado, where media and clinic coaching were used to improve HPV vaccination coverage among adolescents (11-17 years) in Adams, Arapahoe, Denver, Douglas, and Jefferson counties. Recent HPV vaccination schedule changes from three to two required doses highlighted further challenges in monitoring vaccination UTD rates.

Description

We describe a Denver metropolitan area HPV case study where IIS data were used to inform and evaluate the impact of Alliance for HPV Free Colorado activities. IIS data were processed through the Immunization Calculation Engine (ICE)^{TM}, a state-of-the-art open-source web application that provides immunization evaluation and forecasting, typically for patients and providers at the point of care. With the IIS data, the goal of ICE processing was to identify communities of low adolescent HPV coverage (11-17 years) for targeted media placement and track HPV trends over time at the clinic and population level. The Immunization Business Intelligence System (IBIS), processed IIS data from the Colorado Department of Public Health and Environment; using ICE, the validity of each vaccine was evaluated. Each HPV vaccine was evaluated for validity and an assessment made for each individual regarding HPV series initiation and completion (i.e., percent of individuals receiving 1, 2 or 3 valid HPV doses) depending on interval between vaccine and age at first dose. IBIS components and functionality were developed through collaborative design with a goal of developing lessons relevant for future surveillance efforts. Tableau dashboards were constructed to calculate rates of HPV initiation and completion for each participating county and healthcare practice.

IBIS contained data on 33 million vaccines administered to 2.5 million adults and children residing in metro counties. In 2017, IBIS received approximately 2 million vaccines administered to 959,000 adults and children, representing roughly 35% of the 2.7 million metro residents estimated by the American Community Survey (2016). Specific to HPV vaccines, IBIS received over 900,000 HPV vaccines administered to roughly 400,000 individuals by over 1100 clinics; 2017 data included 91,951 HPV vaccines administered to 81,795 patients.

Between 2015 and 2017, 186,489 HPV vaccines were administered to 116,901 adolescents 11 to 17 years residing in the Denver metro area. Using ICE, 85% of HPV vaccines were valid, 10% were accepted as extra doses not needed to complete the HPV series, 4% were invalid because the dose was given too soon after the previous dose, and less than 1% as invalid because the dose was administered too early (under nine years).

As of 12/31/2017, 65,447 or 56% of adolescents 11 to 17 years had completed the HPV vaccine series, among those receiving any HPV vaccines. County specific completion rates varied from 53% to 60%, among adolescents receiving any HPV vaccines.

Completion increased with age from 7% at 11 years, 34% at 12 years, 70% at 14 years, 76% at 15 years and then declined to 68% at 17 years of age. Among adolescents receiving any vaccines in the past decade, HPV completion rates were lower but increased with age from 2% at 11 years to 39% at 14 years and down to 22% at 17 years.

Tableau reports displayed monthly age and county specific HPV completion rates, tracking trends over time. As ICE implemented modifications aligned with 2016 HPV schedule changes (from 3 doses to 2), IBIS was updated and trend data were reprocessed to accurately reflect current ACIP rules. IBIS was indexed to optimize direct query using Tableau for stratified dashboard reporting by demographic and/or geographic populations.

IIS-based vaccination surveillance and reporting provided important guidance for public health program direction. IBIS repurposed a knowledge management system for a population-focused HPV surveillance use case applies across the metro area of Colorado. IBIS was built on a scalable platform, allowing for expansion of data capture and reporting across broader geographies and demographic groups, as well as different vaccines, vaccine groups and vaccine schedules.

Collaboration across public health entities was important to construct appropriate infrastructure to build and maintain IBIS for broader public health use. Future development of IBIS includes expanding reporting to 10 additional Colorado counties and vaccines in 2018.