than previously reported, the calculator does not account for follow-up costs or productivity losses and therefore underestimates the true economic burden of a campus meningococcal outbreak. This outbreak response cost calculator can be used to aid in response planning and highlights the need to shift the public health response from outbreak control to prevention by proactive, pre-emptive vaccination using available licensed meningococcal vaccines.

Figure 1. Timeline of vaccination clinics

Table 1. Actual vs Potential/Expected Direct Costs by Resource Category for Providence College

| Outcome                                      | Actual            | Potential/Expected |
|----------------------------------------------|-------------------|--------------------|
| Coverage outcomes                            |                   |                    |
| People vaccinated with any doses, n          | 4,418             | 4,705              |
| People vaccinated with all 3 doses, n        | 2,124             | 4,705              |
| Completed full course, % of target population| 44.3              | 100.0             |
| Cost outcomes (college/university paid), $    |                   |                    |
| Labor resource costs                         | 91,418            | 153,702            |
| Nondurable resource costs                    | 845,642           | 1,621,905          |
| Cost outcomes (other entities paid), $       |                   |                    |
| Medical supplies (CDC covered vaccine costs) | 391,600           | 0                  |
| Case identification (local/state health departments paid) | 21,158         | 21,158             |
| Vaccines-related adverse events              | 1,145             | 1,635              |
| Total costs, $                               | 1,350,963         | 1,798,399          |
| College/university paid                      | 957,069           | 1,775,907          |
| Other entities paid                          | 413,903           | 22,793             |
| Total costs per person ever vaccinated       | 305.79            | 375.06             |
| Total costs per person fully vaccinated      | 636.05            | 375.06             |

Disclosures. E. M. La, RTI Health Solutions (RTI-HS): Employee and RTI-HS is an independent scientific research organization which was retained pursuant to a contract with Pfizer to conduct the research services which are the subject of this presentation/abstract. Salary and The RTI-HS employees who worked on this project did not receive compensation from Pfizer or any other organization, other than RTI-HS salaries. S. E. Tahir, RTI Health Solutions (RTI-HS): Employee and RTI-HS is an independent scientific research organization which was retained pursuant to a contract with Pfizer to conduct the research services which are the subject of this presentation/abstract. Salary and The RTI-HS employees who worked on this project did not receive compensation from Pfizer or any other organization, other than RTI-HS salaries. J. Fain, Pfizer Inc.: Employee at time of Study and Employee, Salary. L. Huang, Pfizer Employee and Shareholder. Salary and Stocks. A. Srivastava, Pfizer: Employee and Shareholder, Salary and Stocks.

684. Risk Stacking for Pneumococcal Disease in Costa Rica
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Session: 66. Public Health: Epidemiology and Outbreaks
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Background. The value of nontraditional high-risk factor stacking is not known in the Costa Rican population. We aim to describe risk factor stacking for pneumococcal disease (PD) in patients seeking care at Social Security Hospitals in Costa Rica.

Methods. Descriptive study of adult patients with microbiological culture-positive Streptococcus pneumoniae disease seeking care at two tertiary hospitals in Costa Rica between years 2014 and 2016. Information on underlying comorbidities (nontraditional) and other risk factors for PD were analyzed and stacked for each age group (G1: <50 y/o, G2: 50–64 y/o, and G3: ≥65 y/o).

Results. We included 181 culture-positive patients. We found that patients in G1 predominately stacked ≥2 risk factors (63%), the proportion of patients with ≥2 risk factor was similar to high-risk patients in G2 (33% vs. 38%). In G3, 18% didn’t stacked any other risk factor and 46% was on high-risk. Most frequent risk factors in G1/G2 were smoking and alcoholism, and in G3 chronic pulmonary and heart diseases.

Conclusion. We conclude that risk factor stacking is more relevant than high-risk conditions and PD also occurs in persons <50 y/o. We recommend that risk factor stacking should be considered in prevention strategies for PD.

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685. Correlation Between Hospitalized Influenza and Group A Streptococcus Infections in Minnesota, 2010–2016
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Background. Outbreaks of influenza can result in significant morbidity, including secondary bacterial infections. Invasive group A streptococcal (iGAS) infections are associated with a 12% case fatality rate. We used surveillance data to examine if there was a correlation between hospitalized influenza and GAS cases.

Methods. Minnesota Department of Health conducts population-based surveillance for hospitalized lab-confirmed influenza and iGAS (sterile site isolation) cases in the Minneapolis–St. Paul area as part of the CDC Emerging Infections Program. Cases were categorized by week during October–April of each year for 2010–2016, based on specimen collection date. Using STATA (v15), the correlation between the number of influenza (N = 11,768), and overall iGAS (N = 687), iGAS septic shock (n = 104), and iGAS pneumonia cases (n = 59) was assessed in weekly time periods using the Granger causality test.

Results. The number of hospitalized influenza cases was associated with an increase in the overall number of iGAS cases (Wald χ² = 10.22, P = 0.04). Hospitalized influenza cases were associated with an increase in iGAS septic shock cases; every 1,000 increase in case counts were associated with one case of iGAS septic shock 1 week later (P = 0.02). Similarly, every 1,000 increase in hospitalized influenza cases were associated with one case of iGAS pneumonia 1 week later (P < 0.01). While the effect of Granger causality is cumulative when describing the causal relationship between hospitalized influenza and total iGAS, the correlation between influenza and the iGAS subgroups is best described with a 1-week lag.

Figure 1. Pneumococcal disease by age group

Figure 2. Risk Factor Stacking By Age Group

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Conclusion. Granger causality tests are commonly used in economic modeling but have not been routinely applied to infectious diseases. Using this test, we found a strong correlation between weekly cases of hospitalized influenza and iGAS septic shock or pneumonia. This approach can provide insight into the potential impact of developing prevention interventions for infections with strong correlation. Further exploration of Granger tests in infectious disease modeling should be considered.

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686. Use of an Influenza-Like Illness School Absenteeism Monitoring System to Identify Seasonal Influenza Outbreaks in the Community: ORCHARDS (Wisconsin, September 2014–June 2017)

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Background. Schools are purported to be primary venues of influenza transmission and amplification with secondary spread to communities. We assessed K–12 schools' sentinel monitoring as a means for early detection of influenza activity in the community.

Methods. We conducted a 3-year, prospective observational study of all-cause (a-TOT), illness-associated (a-I), and influenza-like illness-associated (a-ILI) absenteeism within the Oregon School District. Oregon, WI (OSD enrollment = 3,900 students). Absenteeism reporting was facilitated by automated processes within OSD's electronic student information system. Students were screened for ILI, and, if eligible, visited at home, where pharyngeal specimens were collected for influenza RT-PCR (IVD CDC Human Influenza Virus RT-PCR Diagnostic Panel) and multipathogen testing (Luminex NxTAG RPP). The study definition of a-ILI was validated for 700 children with acute respiratory infections using binomial logistic regression. Surveillance of medically attended laboratory-confirmed influenza (MAI) occurred in five primary care clinics in and adjoining OSD as part of the Wisconsin Influenza Sentinel Surveillance Project using the same laboratory testing. Poisson general additive log linear regression models of daily counts of absenteeism and MAI were compared using correlation analysis.

Results. Influenza A and B were detected in 54 and 51 of the 700 visited students, respectively. Influenza was significantly associated with a-ILI absenteeism (OR = 4.74; 95% CI: 2.78 – 8.18; P < 0.001) with a 1-day lead time. a-ILI was significantly correlated with MAI in the community (r = 0.66; CI: 0.480; P < 0.001) with a 1-day lead time. a-TOT performed poorly (r = 0.278; P < 0.001), following MAI by 9 days (Figure 1).

Conclusion. Surveillance using case-specific absenteeism was feasible to implement in OSD and performed well over a 3-year period marked by diverse presentations of influenza. Monitoring a 1 and a-ILI can detect influenza outbreaks in the community, providing early warning in time for community mitigation efforts for seasonal and pandemic influenza.

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687. Modeling the Impact of Introduction of Influenza Vaccination on ILI Cumulative Case Count in Cameroon

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Background. Influenza illness can range from mild to severe, with serious outcomes occurring in children and the elderly. Flu has been studied extensively in geographies where vaccine is often plentiful. The burden of influenza is not well known in tropical regions where vaccine coverage is scant. Our study examines the impact of introducing influenza vaccination campaigns in Cameroon and compares this with a scenario of passive incidence in a Cameroonian population with <0.2% influenza vaccine utilization.

Methods. The data consists of 1 year of flu surveillance from patients presenting with influenza-like-illness at clinics in Cameroon. Samples underwent RT-PCR influenza screening. Analysis was performed in Berkeley, California. We developed ordinary differential equations (ODEs) under the SEIR compartmental model and calculated R0. We estimated the proportion of cases the clinics observed to make inferences to the catchment population of these health facilities. We developed a new set of ODEs to introduce vaccination using a pulse function with a 50% efficacy and 45% vaccination coverage.

Results. We observed 1,429 cases of influenza-like illness in a 1-year period utilizing this surveillance system. We projected that the introduction of annual influenza vaccination campaigns into a Cameroonian population would reduce cases from 1,429 to 662, while reducing the number of cases by only 5% in the baseline scenario.

Conclusion. Cameroon could reduce influenza cases substantially even with only a small proportion of the population vaccinated. Flu vaccination campaigns should be strongly considered as they can reduce case count which may reduce the likelihood of transmitting flu to those who are at risk of severe outcome.

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688. Impact of Expanded Influenza Post-exposure Prophylaxis on Healthcare Worker Absenteeism at a Tertiary Care Center During the 2017–2018 Season

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Background. A severe 2017–2018 influenza season was expected for the United States. We hypothesized that a surge in influenza cases paired with decreased vaccine effectiveness could increase healthcare worker (HCW) absenteeism. Because of a potential public health emergency during the 2017–2018 season, we offered oseltamivir post-exposure prophylaxis (PEP) to exposed HCWs regardless of vaccination status. We describe PEP uptake, cost, and impact on absenteeism at the University of Iowa Hospital and Clinics (UIHC).

Methods. UIHC serves as a referral and safety net health system for Eastern Iowa. Influenza seasons were defined as the period between Week 40 from 1 year to Week 13 of the following year. During the 2016–2017 season, PEP (75 mg/day for 7 days) was offered free of charge to unvaccinated exposed HCWs. Exposure was defined as proximity within 3 ft of a confirmed influenza-infected person for ≥ 15 minutes without mask protection, or direct contact with respiratory secretions. During the 2017–2018 season, PEP was expanded to all exposed HCWs regardless of vaccination status. We reviewed surveillance, employee health, pharmacy, and human resources records for the 2016–2017 and 2017–2018 seasons. We defined PEP uptake as prescriptions picked up/all referrals and absenteeism rate as sick-leave requests/scheduled hours.

Results. During the 2016–2017 and 2017–2018 seasons, we detected 373 and 427 confirmed influenza cases among patients at UIHC. HCW vaccination rates were similar: 89.7% and 90.9%. PEP was recommended in 49 exposures during 2016–2017 and 280 exposures during 2017–2018. A total of 22 (44.9%) and 133 (47.5%) HCWs picked up oseltamivir from the pharmacy during the 2016–2017 and 2017–2018 seasons. The estimated cost of oseltamivir was $1,791 and $10,828, respectively. Overall, 1,187 sick-leave requests (median = 12 hours, absenteeism rate = 3.2%), and 6,174 sick-leave requests (median = 12 hours, absenteeism rate = 3.4%) were reported during the 2016–2017 and 2017–2018 seasons.

Conclusion. Influenza case counts mildly increased from the 2016–2017 to the 2017–2018 season. Expanding PEP to all exposed HCWs, regardless of vaccination status, had moderate uptake and was costly. Absenteeism rates remained similar during both seasons.

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689. Narcolepsy During the 2009–2010 H1N1 Pandemic

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Background. The 2009–2010 H1N1 pandemic led to a surge of influenza cases throughout the world. A surge in cases of narcolepsy during the 2009–2010 pandemic was reported. The peak of the pandemic season occurred in the spring of 2010, approximately 1 year before the peak of narcolepsy cases. This analysis demonstrates the introduction of vaccination in Cameroon would reduce influenza cases substantially even with only a small proportion of the population vaccinated. Flu vaccination campaigns should be strongly considered as they can reduce case count which may reduce the likelihood of transmitting flu to those who are at risk of severe outcome.

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