Background. National Immunization Program (NIP) in Korea provides 17 types of mandatory vaccines for all children free of charge. However, vaccine-hesitant group refusing the NIP are being a major threat to public health. We analyzed the healthcare utilization pattern observed in NIP eligible children and sought to identify those who remain unvaccinated using national population data.

Methods. History of receiving protein conjugate pneumococcal vaccine (PCV) was reviewed to determine the vaccination status of children born between 2013 and 2015. Children who had 3-doses or more out of 3 + 1 schedule were defined vaccinated, while those with no record of vaccination were defined unvaccinated. Their healthcare utilization records, including a number of visits, total duration, type of institution (hospitals, complementary and alternative medicine [CAM]), and purpose of visits (outpatient care, hospitalization), were retrieved from the National Health Insurance (NHI) Review and Assessment Service. Annual healthcare utilization rate and incidence of pneumococcal infections were estimated with Poisson regression and compared between study arm. The proportion of CAM out of total healthcare utilization was also compared.

Results. Among 1,272,685 children, 51% were boys and median age was 29.4-months. Two-percent of the cohort remained unvaccinated until study end. Annual hospital visiting rates were 26.9 times (95% confidence interval [CI] 26.9–27.0) for vaccinated and 3.4 (95% CI 3.4–3.5) for unvaccinated. Average NHI benefit period per year was 28.8 days (95% CI 28.8–29.0) for vaccinated and 3.9 (95% CI 3.8–3.9) for unvaccinated. The discrepancy resulted in under-detection of pneumococcal incidence in unvaccinated with 10.1 cases (95% CI 9.9–10.4) per 1,000 child-months whereas that of vaccinated was 42.5 (95% CI 42.4–42.6). Vaccine hesitant children preferred CAM at least 3-times more than vaccinated children (CAM proportion 3.5% in hesitant group vs. 1.07% in vaccinated group, $P < 0.001$).

Conclusion. Vaccine hesitant group not only refuses vaccination but also tends to opt-out from the entire medical attention and prefer CAM. Active detection considering this different pattern should be implemented in order to ensure the public benefits from the vaccination program.

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1633. Human Co-infection with *Borrelia burgdorferi* and *Babesia microti* Among High-Risk Hispanic/Latino Workers on Eastern Long Island, New York: A Preliminary Cross-Sectional Analysis in 2016

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Background. Lyme disease has serious public health implications and has a high prevalence in Suffolk County, NY. Furthermore, there is a high risk for coinfection with Babesiosis, a potentially life-threatening tick-borne infection in the same area. This population-based cohort study was implemented in 2016 to assess the risk factors for Borreliosis among the Hispanic/Latino work population, which gave us the opportunity to measure clinical and epidemiological features of co-infection.

Methods. Invitation to participate in the study occurred during a Spanish educational lecture about tick-borne diseases. Following signed informed consent, a questionnaire and blood sample were obtained for each participant Borreliosis was defined based on 2-tiered serologic testing. Antibodies to *B. microti* were detected by indirect immunofluorescence assay (IFA). Between June and December 2016, 126/199 (66%) with a completed visit 1 (survey and blood draw) were included in the first analysis.

Results. Sample characteristics include 60% 18–39 years old, 75% male, 79% had elementary school education or less, 86% reported having tick exposure, 79% lived in Eastern North Fork, 65% lived 10 or more years in the United States, and 48% were gardeners and landscapers. The seroprevalence for Borreliosis burgdorferi, Babesiosis microti, and co-infection were $n = 13 (10.3\%)$, $n = 36 (28.6\%)$, and $n = 7 (5.6\%)$, respectively. In the univariate analysis having a fatigue severity score of <4 or having fatigue most of the time or stiff neck or joint pain or facial paralysis, or a previous diagnosis of other tick-borne diseases were associated with co-infection (Pearson chi-square, $P < 0.05$).

Conclusion. However, none of these factors were statistically significant in the multivariate analysis after adjusting for the above variables. In this initial study, a high prevalence of Babesiosis was found. A larger sample size may be needed to better assess the risk of coinfection in this Lyme endemic area.

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1634. A Mobile Application for Management and Surveillance of Vector-borne Diseases in Cali, Colombia: An Evaluation of Usability and Acceptability in a Hospital Setting

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Background. Vector-borne diseases are a public health problem in Colombia, an area that has become hyperendemic for dengue virus. This situation has been aggravated by the introduction of other arboviruses such as chikungunya and Zika in the last 3 years. Mobile health (mHealth) offers new strategies for strengthening healthcare and surveillance systems. A large number of mHealth tools are available; however, very few have been evaluated regarding usability and acceptability. This study aimed to evaluate the usability and acceptability of a mobile application, FeverDX, as a support tool in the management of patients with febrile syndrome and suspected vector-borne infection by general practitioners from Colombia.

Methods. The usability and acceptability of FeverDX were evaluated using the modified version of the Mobile Application Rating Scale (uMARS). The evaluation included aspects of content, user engagement, functionality, user-interface design, impact, and subjective quality.

Results. Between December 2016 and January 2017, a total of 20 general practitioners evaluated FeverDX. Seventy-five percent of the evaluators reported being aware of the Colombian Ministry of Health guidelines for diagnosis and management of arboviruses. 80% of evaluators partially or completely agreed the application information agreed with management guidelines. On uMARS scale, FeverDX excelled regarding impact (median = 5/5, IQR = 5–5); functionality (5/5, 4.8–5); and information and scientific basis (4/5, 4-4). FeverDX scored well regarding user feedback (median = 4/5, IQR = 4–4.5); design and esthetics (4/5, 4–4.3); and subjective assessment of quality (4.5/5, 4.3–4.8).

Conclusion. Despite a large number of mHealth tools available, the literature lacks evaluated and evidence-based mobile technology. Applying Information and Communications Technologies in health areas can strengthen care processes and facilitate the detection and reporting of reportable surveillance diseases. Assess the usability and acceptability of mobile health applications increases the reliability of these technologies. The mobile app, FeverDx, can improve adherence to guidelines for management and prevention of prevalent diseases.

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1635. Analysis of Antibiotic-Related Malpractice Claims, 2007 to 2016

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Background. The threat of medical liability can influence physician behavior and lead to the practice of "defensive medicine." Concern for malpractice liability has been cited as a cause of inappropriate antibiotic prescribing. Data on malpractice claims related to antibiotic use (AU) are lacking. The objectives of this analysis were to describe malpractice claims associated with AU.

Methods. We conducted a retrospective analysis of pooled closed antibiotic-related claims from a malpractice carrier representing 30% of US malpractice cases from January, 2007 to December, 2016. We described antibiotic-related, malpractice claims, patient demographics, amount of indemnity paid, clinical severity, settings, responsible services, initial diagnoses, drug classes, and causes of allegation.

Results. From 2007 to 2016, 767 antibiotic-related claims were identified and represented less than 1% of overall claims. A total of $123 million were paid for antibiotic-related claims. Claims classified as medium to high clinical severity constituted 97% of all claims, with 35% having permanent injury and 24% leading to death. Of all patients, 56% were female, 8% were < 20 years of age, and 32% were ≥ 60 years old. Most claims (51%) were associated with outpatient settings, 37% with inpatient, and 11% with emergency department settings. Responsible services with the highest number of claims were medicine (44%), surgery (27%) and the emergency medicine (9%). The most common infection cited as an initial diagnosis was respiratory (10%), followed by urinary (7%) and skin and soft-tissue infections (6%). The most common class cited was β-lactams (19%), followed by fluoroquinolones (14%) and sulfa-drugs (11%). Allegations associated with antibiotic administration and management constituted 62% of all claims, 19% were related to failure or delay in diagnosis or treatment, and 19% were due to other causes.

Conclusion. Claims related to AU were not a common cause of malpractice claims in these data source. Antibiotic administration and management was more commonly associated with malpractice claims than failure or delay in AU. A better understanding of malpractice claims associated with AU can help guide messaging on improving antibiotic prescribing.

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1636. Antibiotic Treatment of Human Plague: A Systematic Literature Review of Worldwide Cases, 1937–2016

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Background. *Yersinia pestis* remains endemic in countries throughout Africa, Asia, and the Americas and is a tier 1 bioterrorism agent. Antibiotic treatment with aminoglycosides such as streptomycin or gentamicin is effective when initiated early in the course of illness but can have serious side effects. Alternatives such as fluoroquinolones, tetracyclines, and sulfonamides are potentially safer but currently lack robust human data on their efficacy.

Methods. We searched PubMed Central, Medline, Embase, CINAHL, and other databases for articles in any language with terms related to plague, *Yersinia pestis,* and antibiotics. Articles that contained case-level information on antibiotic treatment and patient outcome were included. We abstracted information related to patient demographics, clinical features of plague, treatment, and survival using a standardized form.

Results. Among 4,874 articles identified and screened, we found 723 published cases of treated plague reported between 1937 and 2016. Fifty-two percent of patients were male; median age was 22 years (range: 8 days-80 years). Cases were most commonly reported from the United States (21%), India (13%), China (11%), Vietnam (10%), and Madagascar (10%). Overall, the case fatality rate was 21%. The majority of patients had primary bubonic (64%), pneumonic (21%), or septicemic (4%) plague, of which survival was 83%, 71%, and 55%, respectively. Among those treated with an aminoglycoside ($n = 386$, 53%), survival was 86%. Among those treated with a tetracycline ($n = 145$, 20%), fluoroquinolone ($n = 45$, 6%), or sulfonamide ($n = 311$, 43%), survival was 90%, 84%, and 77%, respectively. Survival rates did not substantially differ between patients treated with one vs. two classes of antibiotics (table).

Conclusion. Published cases of treated plague offer an opportunity to evaluate the treatment efficacy of different antibiotic classes. In addition to aminoglycosides, tetracyclines, fluoroquinolones, and sulfonamides appear to be effective for plague treatment, although publication bias and low numbers in certain treatment groups may limit interpretation.

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1637. Antibiotic Use in Lower Respiratory Tract Infections: Insights From Patient Interviews in Sri Lanka

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Background. Antibiotic resistance is an emerging global public health threat with inappropriate use of antibiotics as one of the major drivers. In Sri Lanka, antibiotic consumption is increasing, while little is known about how patients perceive antibiotics. We conducted a qualitative study to better understand patients' knowledge, perceptions, and attitudes toward antibiotics.

Methods. Semi-structured interviews were conducted in the local language (Sinhala) and audio recorded for 18 patients with lower respiratory tract infections (LRTI) admitted to a large, public tertiary care hospital in southern Sri Lanka. Interviews were transcribed and then translated into English. Translated interviews were analyzed for themes regarding care-seeking behavior, patients' knowledge of disease etiology and treatment of LRTI.

Results. Almost all patients mentioned multiple care visits and polypharmacy prior to admission. When seeking care, patients mainly focused on finding a quick cure, mostly by visiting several different private physicians. However, self-medication was also common. Patients reused prescriptions for antibiotics, kept antibiotics for later use after prematurely stopping their course of treatment and bought antibiotics over-the-counter. Patients' knowledge of disease etiology and antibiotics was poor. Most patients described non-microbial causes such as exposure to dust and cold weather for their illness. Only a few patients were aware of antibiotic resistance. Despite the desire to receive more information regarding disease and treatment, transfer of information between patients and physicians was limited and mainly confined to prescription instructions.

Conclusion. This qualitative study in Sri Lanka suggests inappropriate use of antibiotics is a multifactorial problem. Patients' poor knowledge of disease and treatment, poor information transfer between physicians and patients, high demand for medicines, overprescribing by physicians, and self-medication were found as possible obstructive factors to improve antibiotic usage. To improve antibiotic use, a multifaceted approach is needed with improvement of awareness by patients, public, and physicians regarding antibiotic use and antibiotic resistance.

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1638. Measles Outbreak Risk Assessment for Transplant Candidates and Recipients

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Background. A measles outbreak began in 2018 with ongoing transmission in the New York City (NYC) area, affecting children and vulnerable adults. We developed a systematic 3-part approach to address measles risk in our solid-organ transplant program's adult population by 1) identification of non-immune adults living in at-risk ZIP codes 2) education focused on risk reduction for all at-risk patients and families and 3) vaccination of non-immune waitlisted patients and consideration of prophylactic immunoglobulin G (IgG) for post-transplant non-immune patients at high risk for measles exposure.

Methods. All waitlisted and transplanted patients residing in any of 11 ZIP codes with recent measles cases in the NYC area as of April 4, 2019, were included. We also focused on the 4 ZIP codes in the NYC Health Commissioner's vaccination order from April 9, 2019. We reviewed electronic medical records (EMR) of patients born after 1956 for measles immunity by serology or vaccine documentation. A 1-page measles patient education handout was created, reviewed for health literacy appropriateness and utilized in English and non-English language versions.

Results. 118 waitlisted or previously transplanted patients resided in at-risk ZIP codes. Among the 118 patients, 56 (47.5%) were presumed immune based on birth year before 1957. Among 62 patients born in 1957 or later, 5 (8.1%) had preexisting positive measles IgG in the EMR and 1 patient had documentation of measles vaccination without measles IgG testing. Fifty-seven patients without EMR evidence of measles immunity were called to undergo measles IgG testing. 29 patients agreed to testing and an additional 19 patients had the test added to routine laboratories. Of these 48 patients, 1 was non-immune and 1 had equivocal immunity. Among transplanted patients identified as non-immune or with equivocal immune status, a recommendation for prophylactic IgG was made. All 118 patients received a measles informational handout by mail. Furthermore, we identified 21 patients born after 1956 living in the 4 zip codes targeted by the NYC health Commissioner's order, and among those tested all were found to be immune.

Conclusion. A systematic risk assessment during a large measles outbreak identified at-risk transplant patients and provided timely education and screening for measles immunity.

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1639. Outbreak of Human Bartonellosis Due to *Bartonella bacilliformis* in the Ecuadorian Andes

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Background. Bartonellosis affects small Andean communities in Peru, Colombia, and Ecuador. Research in this area has been limited; our study presents a continuous outbreak of cases that occurred in 2018 in areas near the cloud forest of the Ecuadorian Andes.

Methods. Retrospective review of 101 cases of human bartonellosis managed in Quito - Ecuador, during the last outbreak in our country in the last year (2018). The study focused upon the most recent outbreak in order to look at current manifestations of disease and existing practices in diagnosis and management, and how closely these followed the latest guidelines to manage this disease.

Results. Of the 101 patients reviewed, 52% were male and 48% were female. The mean age of cases was 24.3 years, (mean age of males = 23.7, mean age females = 25.3). The median age of patients was 20 years (min = 4 years, max = 71 years, IQR = 15). There was a peak in acute cases after the rainy season; mainly in moths march to June, chronic cases presented less constantly throughout the year. The sensitivity of blood smear against blood culture in acute disease was 35%. The most commonly used treatment for chronic disease was rifampicin; chloramphenicol and ciprofloxacin was used to treat most acute cases. Complications arose in 16.8% and the most frequent was anemia, and there were 2 deaths.

Conclusion. Recognize the physiopathological and microbiological characteristics of the disease, as well as improve the diagnostic and treatment algorithms for acute and chronic bartonellosis which have been developed without a strong evidence base. Preparation of ready-to-go operational research projects for future outbreaks would strengthen the evidence base for diagnostic and treatment strategies and enhance opportunities for control and prevent deaths.