serum samples collected, 1 sample was positive for DEN-3. To achieve effective Larva survey, equal resource for vector control for both outdoor (importance percentage 51 for district A and 43 for district B) and indoor containers (importance percentage 51 for district A and 43 for district B) are recommended. **Conclusion:** During January to July, Dengue epidemic in Ubon Ratchathani has the highest risk among students age group. Indoor and outdoor water containers were equally important.

### Board 418. Human-tick Encounters as a Surrogate Measure for Disease in Tickborne Disease Intervention Studies

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**Background:** Indices of entomologic risk (e.g., tick density measured by drag, tick pathogen infection rates) have long been used as a proxy for human risk of tickborne diseases (TBDs). In a recent intervention study conducted by the CDC and three Emerging Infections Program sites, tick density on residential properties correlated poorly with the occurrence of TBDs among household members. To determine if human-tick encounters could serve as a more accurate surrogate of disease risk, we conducted a follow-up analysis to assess the strength of association between reported human-tick encounters and TBD diagnoses.

**Methods:** Human-tick encounters (total number of ticks found crawling on or attached to household members) were measured using four monthly online surveys administered to heads of household during 2011 and 2012. Self-reported TBD diagnoses among household members were measured using a single telephone survey at the end of each study year. Self-reported diagnoses were verified by medical chart review. Logistic regression was used to evaluate the association between tick encounters and disease at the household level. **Results:** A total of 2727 households were enrolled in the study over two years: 795 (29%) reported any human-tick encounter; 680 (25%) reported ticks crawling; 434 (16%) reported ticks attached; 319 (12%) reported ticks crawling and attached, and 80 (3%) reported TBD diagnoses. 39 (1%) of which were verified by chart review. Households reporting tick encounters were more likely to have verified TBD diagnoses in the household: for any human-tick encounter, odds ratio (OR)=2.9 (95% confidence interval (CI): 1.5-5.4); for ticks found crawling, OR=2.9 (95% CI: 1.5-5.5); for ticks found attached, OR=4.2 (95% CI: 2.2-8.0); for ticks found crawling and attached, OR=4.9 (95% CI: 2.3-9.4). **Conclusions:** While entomologic outcomes measured via tick drags may not accurately represent risk of acquiring TBDs, use of human TBD occurrence as the outcome measure in interventions requires significant expense. Our findings indicate that self-reported human-tick encounters are a robust surrogate for disease risk at the household level that can be used in future intervention studies. Use of human-tick encounters as a proxy for disease in intervention studies will reduce study costs, time, and sample sizes.

### Board 419. Meteorological Factors Associated with Hand, Foot and Mouth Disease in a Central Highlands Province, Vietnam: An Ecological Study

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**Background:** Over the years, the burden of Hand, foot, and mouth disease (HFMD) remains highly, especially in the Western Pacific Region including Vietnam. The seasonal trend in HFMD cases was reported in many areas. However, the association between HFMD and climate was not well-known/underestimated in Vietnam. This study assessed the effect of meteorological factors on HFMD in Daklak, a Central Highlands province in Vietnam. **Methods:** Monthly data on HFMD cases were collected from all commune health stations in Daklak province (total population: ~1.7 million) during a period of 2012-2013. The average temperature, maximum temperature, minimum temperature, humidity, rainfall, evaporation, duration of sunshine, and wind speed were recorded monthly at 5 meteorological stations throughout the province. The association between weather variables and number of HFMD cases was estimated, using a Poisson regression model. **Results:** In 2012-2013, there were 7128 HFMD patients in Daklak. The number of HFMD cases increased during the rainy season. An increased risk of HFMD was associated with higher average temperature (RR and 95% CI: 1.09; 1.03-1.15 per 1oC increase), higher minimum temperature (RR=1.09; 1.05-1.13 per 1oC increase), higher rainfall (RR=1.10; 1.05-1.15 per 200 mm increase), and higher sunshine duration (RR=1.26; 1.18-1.35 per 60 hours increase). The risk of HFMD was inversely associated with maximum temperature (RR=0.95; 0.92-0.99 per 1oC increase), and wind speed (RR=0.79; 0.75-0.83 per 1 m/s increase). Humidity and evaporation were insignificantly associated with HFMD. **Conclusions:** This study suggests that there is an obvious relationship between HFMD occurrence and climate. Temperature, rainfall, wind speed, and sunshine could be used as ecological indicators of HFMD cases in Daklak.

### Board 420. Spatial Epidemiology of Lyme Disease in an Endemic County

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**Background:** Although Lyme disease (LD) is the most common vector-borne disease in the US, risk factors for human infection remain poorly defined. In the northeastern US, LD is thought to be acquired primarily in the home environment. We used data from one endemic county to evaluate associations of environmental and socio-demographic factors with risk of human LD according to residence. **Methods:** All households in Howard County, Maryland, were classified as a Lyme/Non-Lyme household based on surveillance reports for 2001-2011. Land use and land cover type were assessed at the geocoded household location; other environmental and socio-demographic factors were assessed at the census block group. Multilevel logistic regression models were used to describe spatial variation in risk and to examine associations of LD risk with factors ascertained at both the household and census block group. **Results:** Nearly 2% (n=1,672) of 94,303 households had at least one case of reported LD during 2001-2011; LD occurrence was spatially non-uniform. Household LD risk was primarily associated with low density residential development (adjusted odds ratio [aOR]: 1.7; 95% confidence interval [CI]: 1.4-2.1), a dominant vegetation type of red and white oak forest (aOR: 1.3; 95% CI: 1.1-1.6), and a higher amount of the census block group composed of forest (aOR per interquartile range [IQR] increase: 1.3; 95% CI: 1.1-1.6). Compared to houses without reported LD, case households were located in census block groups of higher average home value (aOR per IQR increase: 1.5; 95% CI: 1.3-1.8). Use of median odds ratios demonstrated that census block group factors accounted for more spatial variation in risk than household factors. **Conclusions:** Using a large cohort of all households in a single county, several fixed effect associations reiterated findings from earlier case-control studies. To our knowledge, this is the first analysis to associate human LD risk with a specific forest type. Variables measured at both the household