Conclusion. No local or disseminated HSV infections were encountered in the study cohort. Bacterial skin and soft-tissue infection were uncommon. Most other infections were unrelated to TVEC therapy. Real-world review of the use of an HSV-derived oncolytic viral vector therapy mimics reported infectious complications from clinical trials.

Disclosures. **All authors:** No reported disclosures.

2299. A London Hospital's Experience of Confirmed Measles Infections and Re-Infections Between 2009 and 2019

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Background. 2018 to 2019 has seen a global resurgence in measles cases, with the UK seeing an over 3-fold increase in cases in 2018 compared with 2017. In this context, our center saw a cluster of geographically linked measles cases presenting in the first quarter of 2019. We present this with comparative data of confirmed measles cases from our center over the preceding 10 years. Given the growing recognition of measles "re-infection" in fully vaccinated individuals, we also present our first confirmed cases of reinfection within this cohort.

Methods. Retrospective analysis of confirmed measles cases (positive Measles IgM or detectable Measles RNA) between 2009 and 2019. Laboratory and demographic data were obtained from electronic patient records.

Results. 18 cases (of which 14 were adults) of measles (all genotype D8 of those tested) were confirmed in the first 4 months of 2019. 12 presented within a 14 day period from a geographically linked part of North London. There were 4 confirmed measles re-infections (detectable measles RNA on a buccal swab with either a high Measles IgG avidity or previous documented measles immunity). From the 10 year data, cases peaked in 2011 and 2016 consistent with national trends. Of the 89 cases identified, 60 (67%) were adults, who were over twice as likely to be admitted as children, had a longer median length of stay in hospital (2 days vs. 1.5 days) and were more likely to develop a hepatitis (1/10 pediatric cases vs. 26/48 adults, $p \leq 0.01$)or other complications. The majority of adults (68%) were unsure of their vaccination status.

Conclusion. 4 cases of 18 in the first 4 months of 2019 were confirmed re-infections. Re-infections in fully vaccinated individuals are described in the literature, typically presenting with a milder course; however, these are the first cases we have identified at our center. Overall, adult cases were more likely to be admitted to hospital and to have a complicated course compared with children. Vaccination history in adults was of limited clinical utility due to lack of reliable documentation and the potential for reinfection.

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2300. Incidence, Complications, and Recurrence of Herpes Zoster in Unvaccinated Adults ≥50 Years of Age

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Background. More recent baseline epidemiological data for Herpes Zoster (HZ) in adults ≥ 50 years of age, obtained before the introduction of the adjuvanted Recombinant Zoster Vaccine (RZV), are needed for future evaluations of the impact of RZV on HZ epidemiology.

Methods. The study comprised five elements: (1) The incidence of HZ was estimated from immunocompetent adults ≥ 50 years of age not vaccinated with Zoster Vaccine Live who had incident HZ between 2011–2015. HZ was identified by International Classification of Diseases (ICD) codes from electronic health records (EHR) of 4.6 million Kaiser Permanente Southern California members; (2) Postherpetic neuralgia (PHN) was identified by validated survey and medical record review of laboratory-confirmed incident HZ cases recruited during 2012–2015 for HZ-related pain ≥ 90 days after initial HZ diagnosis; (3) HZ Ophthalmicus (HZO) with ocular complications was identified by ICD codes and keyword search in EHR among patients identified with HZO using a validated natural language processing algorithm; (4) The proportion of HZ-related non-PHN and non-HZO cutaneous, neurological or other complications was assessed by double abstraction of EHRs from a sample of 600 incident HZ cases; (5) Recurrent HZ was identified by having an HZ diagnosis with HZ antiviral medication ≥ 6 months after the most recent HZ diagnosis with HZ antiviral medication in a cohort initially diagnosed with HZ between 2007 and 2008 and followed through 2016.

Results. We identified 40,893 incident HZ cases with an overall incidence of 9.92 (95% confidence interval [CI]: 9.82–10.01) per 1000 person-years. The proportion of incident HZ cases with PHN and HZO with ocular involvement was 18.37% (95% CI: 14.90–21.84%) and 8.06% (95% CI: 7.80–8.32%), respectively. The proportion of cutaneous, neurological, and other complications was 7.20% (95% CI: 5.44–8.96%), 0.87% (95% CI: 0.79–0.95%), and 1.24% (95% CI: 1.15–1.33%), respectively. The incidence of recurrent HZ was 10.96/1000 person-years (95% CI: 10.18–11.79).

Conclusion. HZ is common among unvaccinated US adults ≥ 50 years of age, with PHN and HZO occurring most frequently among incident HZ cases.

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2301. Increased Risk of Varicella-Associated Hospitalizations Among Adult Immigrants From Temperate and Tropical Countries After the Introduction of a Childhood Varicella Vaccination Program in Quebec, Canada

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Background. Varicella zoster virus (VZV) hospitalizations are an uncommon, severe and costly consequence of VZV. Childhood VZV vaccination leads to decreased VZV rates across all age groups through herd immunity but increases the age of VZV acquisition and the potential risk of severe VZV in non-immune adults. A large proportion (~15%) of young adult immigrants from tropical regions are susceptible to VZV due to different transmission dynamics in their countries of origin and lack of vaccination. We aimed to describe the impact of the childhood VZV program introduced in 2006 in Quebec on VZV hospitalizations in immigrants and nonimmigrants.

Methods. A population-based cohort of all medically-attended VZV cases in Quebec, Canada (1996–2014) were identified in administrative health databases and linked to immigration data. VZV-attributable hospitalizations included those with primary or secondary ICD-9 or ICD-10 codes for VZV. Overall age-standardized and age-specific rates of hospitalizations were calculated during pre- (1996–98), private (1999–2005) and public vaccination (2006–14) periods and by immigrant status and pregnancy. Relative risk ($RR_{I\text{-}NI}$) and 95% CI for immigrants vs. nonimmigrants were estimated.

Results. 5873 hospitalizations occurred among 230,052 VZV cases. Hospitalization rates decreased dramatically in the pre to public vaccination period (6.6 to 1.3/100,000 population); however, the proportion of hospitalized varicella cases increased from 1.7% to 3.9% ($P < 0.01$). Immigrants only accounted for 3.6% of hospitalizations ($N = 213$) however, the proportion of all hospitalizations among immigrants increased in the pre- vs. public-vaccination periods in those aged 10–19 years (2.9% to 13.7%) and 20–39 years (8.8% to 22.7%). The RR was higher in these age groups in the public vaccination period [$RR_{I\text{-}NI}$ 1.96 and $RR_{I\text{-}NI}$ 1.67] (Table 1). Adults (>20 years) accounted for 52% (CI: 45–59%) and pregnant women 18% (13–25%) of all hospitalizations among immigrants compared with only 14% (13–15%) and 1.6% (1.3–2.0%) in nonimmigrants, respectively.

Conclusion. Young adult and pregnant immigrants bore a disproportionate burden of VZV hospitalizations after the introduction of childhood VZV vaccination. Susceptible immigrant adults would benefit from targeted VZV vaccination.

Table 1: Overall age-standardized and age-specific rates of varicella attributable hospitalizations and proportion of cases by immigrant status in Quebec, Canada (1996-2014)

		Immigrants			Non-Immigrants			Immigrants vs non-Immigrants
Age-group	Vaccination Period	Cases N	% cases [row] (95% CI)	Rate per 100,000	cases	% cases [row] (95% CI)	Rate per 100,000	Rate Ratio$_{I\text{-}NI}$ (95%CI)
0-9 years	1996-1998	16	1.2 (0.6-1.8)	23.0 (14.1 - 37.6)	1322	98.8 (98.2-99.4)	50.7 (48.0 - 53.5)	0.45 (0.28 - 0.74)
	1999-2005	49	1.8 (1.3-2.3)	26.2 (19.8 - 34.7)	2665	98.2 (97.7-98.7)	48.0 (46.2 - 49.8)	0.55 (0.41 - 0.72)
	2006-2014	20	2.9 (1.6-4.1)	6.1 (4.0 - 9.5)	678	97.1 (95.9-98.4)	9.6 (8.9 - 10.3)	0.64 (0.41 - 1.00)
10-19 years	1996-1998	2	2.9 (0.0-7.0)	1.3 (0.3 - 5.3)	66	97.1 (93.0-100.0)	2.5 (1.9 - 3.1)	0.53 (0.13 - 2.17)
	1999-2005	8	9.6 (3.3-16.0)	2.1 (1.0 - 4.2)	75	90.4 (84.0-96.7)	1.2 (1.0 - 1.5)	1.70 (0.82 - 3.53)
	2006-2014	7	13.7 (4.3-23.2)	1.1 (0.5 - 2.4)	44	86.3 (76.8-95.7)	0.6 (0.4 - 0.8)	1.96 (0.88 - 4.34)
20-39 years	1996-1998	18	8.8 (4.9-12.7)	2.8 (1.8 - 4.5)	187	91.2 (87.3-95.1)	3.3 (2.8 - 3.8)	0.87 (0.54 - 1.42)
	1999-2005	44	13.3 (9.7-17.0)	2.8 (2.1 - 3.7)	286	86.7 (83.0-90.3)	2.3 (2.1 - 2.6)	1.18 (0.86 - 1.62)
	2006-2014	20	22.7 (14.0-31.5)	0.8 (0.5 - 1.2)	68	77.3 (68.5-86.0)	0.5 (0.4 - 0.6)	1.67 (1.02 - 2.76)
40+ years	1996-1998	5	9.3 (1.5-17.0)	0.4 (0.2 - 1.0)	49	90.7 (83.0-98.5)	0.6 (0.5 - 0.8)	0.70 (0.28 - 1.76)
	1999-2005	13	10.5 (5.1-15.9)	0.4 (0.2 - 0.7)	111	89.5 (84.1-94.9)	0.5 (0.4 - 0.6)	0.81 (0.45 - 1.44)
	2006-2014	11	9.2 (4.0-14.3)	0.2 (0.1 - 0.4)	109	90.8 (85.7-96.0)	0.4 (0.3 - 0.4)	0.61 (0.33 - 1.14)
Total (ASR)	1996-1998	41	2.5 (1.7-3.2)	4.2 (2.5 - 5.8)	1624	97.5 (96.8-98.3)	6.7 (6.4 - 7.0)	0.63 (0.42 - 0.93)
	1999-2005	114	3.5 (2.9-4.1)	4.9 (3.8 - 6.0)	3137	96.5 (95.9-97.1)	6.1 (5.9 - 6.4)	0.79 (0.63 - 0.99)
	2006-2014	58	6.1 (4.6-7.6)	1.0 (0.7 - 1.4)	899	93.9 (92.4-95.5)	1.3 (1.3 - 1.4)	0.78 (0.57 - 1.06)

* 1996-1998 = pre-vaccination, 1999-2005 = private vaccination, 2006-2014 = public vaccination, ASR=age-standardized rate

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2302. A Meta-Analysis of Risk Factors for Herpes Zoster Infection

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Background. The burden of herpes zoster (HZ) is significant worldwide, with millions affected and the incidence rising. Current literature has identified some risk factors for this disease; however, there is yet to be a comprehensive study that pools

all evidence to provide estimates of risk. Therefore, The purpose of this study was to identify various risk factors, excluding immunosuppressive medication, that may predispose an individual to developing herpes zoster.

Methods. The literature search was conducted in MEDLINE, EMBASE, Cochrane Central, Cochrane Systematic Reviews, Web of Science, CAB Direct, yielding case–control, cohort and cross-sectional studies that were pooled from January 1966 to September 2018. Search terms included: *zoster* OR *herpe**OR *postherpe**OR *shingle**AND *risk*OR *immunosupp**OR *stress* OR *trauma* OR *gender OR ethnicity* OR *race* OR *age* OR *diabetes* OR *asthma* OR *chronic obstructive pulmonary disease* OR *diabetes*. Risk ratios for key risk factors were calculated via natural logarithms and pooled using random effects modeling.

Results. From a total of 4417 identified studies, 93 were included in analysis (n = 3826134 HZ cases). Immunosuppression through HIV/AIDS (RR 3.25; 95% CI 2.47–4.27) or malignancy (RR 2.17; 95% CI 1.86–2.53) significantly increased the risk of HZ compared with controls. Family history was also associated with a greater risk (RR 2.48; 95% CI 1.70–3.60), followed by physical trauma (RR 2.01; 95% CI 1.39–2.91) and older age (RR 1.68; 95% CI 1.41–2.01). A slightly smaller risk was seen those with psychological stress, females, and comorbidities such as diabetes, rheumatoid arthritis, cardiovascular diseases, renal disease, SLE, and IBD compared with controls (RR range: 2.08 to 1.25). We found that black race had lower rates of HZ development RR 0.69 (95% CI 0.56–0.85).

Conclusion. This study demonstrated patients with family history of HZ, older age, female sex, have particular comorbidities or are immunosuppressed have an elevated risk of herpes zoster. Patients with these characteristics are prime candidates for vaccination.

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2303. Chronic Hepatitis B Virus Infection and Risk of Herpes Zoster: A Cohort Study

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Background. No cohort studies have evaluated the effect of hepatitis B virus (HBV) infection on the risk of herpes zoster. We investigated the association of HBV infection with the development of herpes zoster.

Methods. We performed a cohort study of 224,691 non-cirrhotic adult men and women free of herpes zoster at baseline who underwent serologic testing for hepatitis B surface antigen (HBsAg) and were followed annually or biennially for a median of 4.2 years. Incident cases of herpes zoster were ascertained using the Korean Health Insurance and Review Agency (HIRA) database. A Cox proportional hazard model was used to estimate the adjusted hazard ratio (aHR) with 95% confidence interval (CI) for incident herpes zoster according to HBsAg seropositivity status.

Results. During 830,073.4 person-years of follow-up, 11,061 cases of incident herpes zoster were identified. HBsAg seropositivity was inversely associated with the development of herpes zoster. After adjustment for possible confounders, the multivariable-adjusted hazard ratios (95% CI) for herpes zoster comparing HBsAg-positive to HBsAg-negative participants was 0.83 (0.75–0.93).

Conclusion. In a large cohort of Korean adults, HBsAg seropositivity was associated with lower risk of herpes zoster, suggesting that HBV seems to inhibit the reactivation of varicella-zoster virus.

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2304. Incidence and Risk Factors for Herpes Zoster among Diabetes Patients at Siriraj Hospital; Results from a 10-year Cohort

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Background. Herpes Zoster (HZ) is the reactivation of latent varicella-zoster virus. Diabetes Mellitus (DM) is one of well-known risk factors for HZ. Nowsday, the knowledge on the incidence of and risk factors for HZ among Thai DM patients is limited.

Methods. We conducted a nested case–control study of DM patients who attended the Siriraj DM clinic for ≥6 consecutive months during 2005–2014. Eligible subjects were identified through the DM clinic registry database (n = 1,427). Cases were those who had ≥1 episode of HZ while controls were those without evidence of HZ during the study period. We captured 40 cases and randomly sampled 175 controls (1 case: 4 controls). All data were obtained via chart-review, the ICD-10, pharmacy and laboratory databases

Results. During the 10-year study period, the cumulative incidence and the incidence rate of HZ were 0.28% [95% CI: 0.20–0.38%] and 3.96 [95% CI: 2.90–5.28] per 1,000 person-years. The most common sites were trunk (27.5%), followed by herpes opthalmicus (22.5%). Thirty-five percent had post-herpetic neuralgia and only 1 case required hospitalization. Independent risk factors for HZ [adjusted odd ratio; 95% CI; P-value] identified from multivariate analysis included underlying hypertension [3.48; 1.28–9.43; P = 0.01], number of hypoglycemic drug used [1.46; 1.03–2.08; P = 0.04] and previous use of herbal remedies [3.83; 1.06–13.84; P = 0.04]. Furthermore, higher body mass index was an independent protective factor [0.89;0.81–0.98; P = 0.02].

Conclusion. The incidence rate of HZ among DM patients at our institute was comparable to other Asian countries. Risk factors for HZ can be used to identify patients who would benefit the most from preventive interventions.

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2305. Incidence of Active Cytomegalovirus Infection and Its Influence on Outcome Among Non-Immunosuppressed Cirrhotic Adults Requiring Critical Care in Liver-ICU

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Background. Cytomegalovirus (CMV) infection is not very uncommon in critically ill patients as per the studies in past decade. However, the incidence of active CMV infection and its association with clinical outcomes have not been studied for critically ill non-immunosuppressed cirrhotic adults.

Methods. We prospectively evaluated active CMV infection (CMV-plasma-DNAemia; > 500 IU/mL) by real-time polymerase chain reaction and clinical outcome in sero-positive (anti CMV IgG-positive) critically ill non-immunosuppressed adults with chronic liver diseases (all cirrhotics) at day 0, 7, 14 and 21 in Liver-ICU. Patients with prior CMV infection (on day 0) were excluded.

Results. A total of 166 blood samples were collected from 84 enrolled Liver-ICU patients [73 men, median age: 49.5 years, interquartile range (IQR): 40–57.5]. Of 84, 29 died/discharged before day 7, leaving 55 patients in study. Cumulative incidence of active CMV infection was 30.9% (95% confidence interval, CI: 19.1–44.80) at 7-day follow-up. The incidence rate (or density) of active CMV infection was 2.75% per person-day (95% CI: 1.68–4.26% person-day) during 21-day follow-up. Acute on chronic liver failure (n = 12, 63.16%; P = 0.003) was the most common clinical presentation among patients with active CMV infection. On multivariate analysis, significant factors for active CMV infection were bacterial infections (P = 0.031, odds ratio (OR): 0.07, 95% CI: 0.01- 0.78) and leucocytosis (P = 0.047, OR: 1.15, 95% CI: 1.00–1.32). ICU-Mortality did not differ between patients with and without active CMV infection (90% vs. 88.57%, P = 1.00). In Cox-regression analysis, active CMV infection was not independently associated with time to death [Hazard Ratio (HR) = 1.18, 95% CI: 0.65 to 2.15, P = 0.58] as well as length of stay (LOS) in ICU (9.50, IQR 8–16.50 vs. 12, IQR 8–18 days; HR: 1.12; 95% CI: 0.64–1.97, P = 0.68).

Conclusion. Incidence rate of active CMV infection is considerable in critically ill non-immunosuppressed cirrhotic adults. This study did not find significant association of active CMV infection with ICU-mortality and LOS in ICU among critically ill cirrhotic patients. Further studies with optimum frequency for monitoring of active CMV infection are needed to clarify its impact on clinical outcomes.

Figure: 1
Patient population (at risk) for monitoring of active CMV infection in Liver-ICU

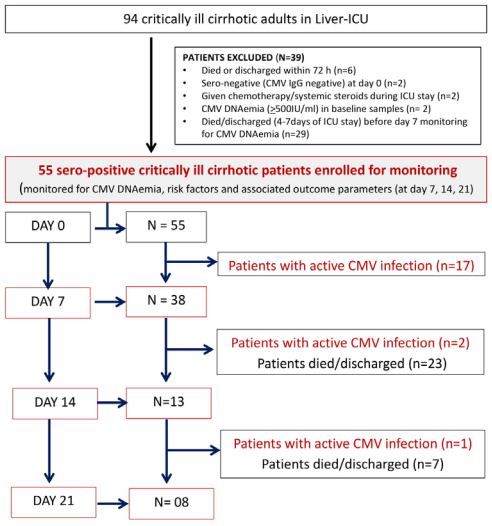

Table -1 Incidence density (or rate) of active CMV infection during Liver-ICU stay

Day('t')	Patients with active CMV infection (n) by 't'	Total patient follow-up days up to 't'	Incidence rate (or density) at 't'
7	17	359.5	0.047
14	19	599.5	0.031
21	20	726	0.027