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Influenza-Like Symptom Incidence, Illness-Associated Expenses, and Economic Impact Among Healthcare Personnel in Thailand: A Prospective Observational Cohort Study (2020–2021)

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Abstract

Objectives: We estimated influenza-like symptom (ILS) incidence among healthcare personnel (HCP) in four hospitals and the economic impact due to ILS in the Thai HCP population during

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Contributions

W.K., P.P., J.A.M., and S.C. conceptualized and designed the study. W.K., P.P., and S.C. designed data collection instrument. C.K. and A.R.J. provided laboratory support. W.K., T.W., S.P., P.P., A.V., P.Y., C.T., and S.C. managed overall administrative requirement and supervised data collection. W.K. carried out all data analyses, drafted, and revised the manuscript. All reviewed and approved the final manuscript as submitted.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention or the U.S. Government. Material has been reviewed by the Walter Reed Army Institute of Research. There is no objection to its presentation and/or publication. The opinions or assertions contained herein are the private views of the authors, and are not to be construed as official, or as reflecting true views of the Department of the Army or the Department of Defense. The investigators have adhered to the policies for protection of human subjects as prescribed in AR 70–25.

Supplementary data

Supplementary data are available at *Annals of Work Exposures and Health* online.

July 2020–June 2021 (Thailand’s expected 2020 influenza season), which also coincided with the novel coronavirus disease 2019 pandemic.

Methods: We followed HCP, in a prospective observational cohort, weekly for ≥ 1 of: muscle pain, cough, runny nose/nasal congestion, sore throat, or difficulty breathing. We fitted population-averaged Poisson regression models to identify factors associated with acquiring ILS and to calculate ILS incidence. We applied epidemiologic parameters to Thailand’s HCP population (227 349 persons) to estimate economic impact.

Results: Of 2184 participants, adjusted all-cause ILS incidence was 6.1 episodes per 100 person-years (95% confidence interval 3.4–10.9). Among Thailand’s HCP population, 13 909 ILS episodes were estimated to occur annually and would result in US\$235 135 economic loss. Controlling for study site and calendar month, factors associated with acquiring ≥ 1 ILS versus no ILS included being female, having asthma, and using personal protective equipment ‘frequently, but not always’.

Conclusions: All-cause ILS resulted in considerable economic loss among Thai HCP workforce. These findings underscore the importance of public health interventions to reduce the risk of acquiring ILS.

Keywords

COVID-19; economic impact; healthcare personnel; incidence; influenza-like symptom; Thailand

Introduction

When there are suboptimal infection control practices, the potential for healthcare personnel (HCP) to develop work-associated infections due to influenza and other respiratory viruses, or to play a role as a vector for spreading these viruses to patients is well-recognized (Jones and Xia, 2016; Amer et al., 2018). HCP are a vulnerable and important target group for intervention, due to frequent and close contact with patients and their colleagues (Piyaraj et al., 2022). HCP in many settings, including industrialized countries, often work while experiencing influenza-like symptom (ILS), increasing the likelihood of pathogen transmission to others (Yassi et al., 1993; Vanhems et al., 2011; Huttunen and Syrjänen, 2014; Edwards et al., 2016; Piyaraj et al., 2022). Such transmission may result in morbidity and mortality in HCP and their patients, and economic loss for healthcare institutions and communities. For example, a cross-sectional study among HCP in Mexico’s hospital reported that influenza virus infection caused significant morbidity and work absenteeism in their workforce; for an illness episode, an average of 2.5 days absent from their work was documented (Laris González et al., 2018). In a pandemic scenario when a critical number of HCP is absent from work due to illness as evident during the early phase of the novel coronavirus disease of 2019 (COVID-19) pandemic, healthcare service disruption may occur (Schoch-Spana, 2000; Laris González et al., 2018; Davis et al., 2022; World Health Organization, 2022).

Respiratory illness among HCP (e.g. COVID-19, seasonal influenza including ILS) is a major economic burden (Gianino et al., 2019; Faramarzi et al., 2021) as it can lead to increased usage of medical resources and worker absenteeism. In a previous study during

seasonal influenza outbreaks of medium intensity in Italy, over 11 100 of lost working days per year were reported among approximately 5400 HCP, with the economic costs due to sickness absenteeism estimated at US\$1.8 million (Gianino et al., 2019). Furthermore, a recent study among approximately 2000 HCP in Iran during the COVID-19 pandemic reported remarkable absenteeism cost alone of US\$1.3 million (Faramarzi et al., 2021).

Although there is literature on influenza virus infection burden data and its potential economic impact on work productivity and work presenteeism when ill or absenteeism among HCP (Ablah et al., 2008; Edwards et al., 2016; Al Nuhait et al., 2017; Chiu et al., 2017; Laris González et al., 2018; Kuster et al., 2020; Daniels et al., 2021), information is lacking among the Thai HCP population. The intent of the study was to examine incidence of ILS and illness-associated expenses among Thai HCP followed for laboratory-confirmed influenza virus and respiratory syncytial virus (RSV) infection and all-cause ILS, cost of illness, and work presenteeism and absenteeism related to ILS. We also estimated the economic impact due to ILS among Thai HCP population. The follow-up of study participants started 6 months into the COVID-19 pandemic with a total of 2867 COVID-19 cases officially reported in Thailand at the time (Department of Disease Control, 2022). During which time, non-pharmaceutical and pharmaceutical interventions were implemented countrywide (Davis et al., 2022). Data from this study might provide evidence about the potential utility to estimate possible health and economic benefits of prevention resource allocation and are critical to HCP surge capacity modeling for pandemic planning.

Methods

Study setting

From February to March 2020, we enrolled 2200 HCP, based on convenience sampling, in Thai hospitals: Bamrasnaradura Infectious Diseases Institute (BIDI, 300 beds referral hospital specializing in infectious diseases, total 819 HCP); Phaholpolpayuhasena hospital (PH, 540 beds tertiary hospital, total 1400 HCP); Phramongkutklao hospital (PMK, 1200 beds super tertiary and academic hospital, total 1428 HCP); and Rayong hospital (RY, 567 beds tertiary hospital, total 1600 HCP) for 1-year follow-up. We defined HCP as individuals providing services in a healthcare setting, and enrolled those aged ≥ 18 years, who had contact with ≥ 1 patient/day and worked ≥ 30 h/week. HCP employed < 1 year, anticipated leaving the jobs in 1 year, or who did not have a telephone number for study contact were ineligible for enrollment. For recruitment, posters detailing briefed study information (including enrollment criteria, enrollment venues, and times) were posted in areas frequented by the HCP. Interested HCP were free to come forward for screening and enrolling during the scheduled dates; appointments were not needed. At enrollment, study staff interviewed participants using a structured questionnaire for work and health history, gross income information, frequency of appropriate personal protective equipment (PPE) use (defined as donning the PPE suitable for the procedure), and seasonal influenza vaccination history. Participants self-graded their risk from 0 (no risk) to 10 (highest possible risk) in different scenarios: (i) becoming infected with any respiratory virus; (ii) developing an acute respiratory illness (ARI); (iii) developing ARI and having to take leave from work; (iv) developing severe ARI; and (v) transmitting respiratory viruses to patients. Study staff

taught participants how to self-collect midturbinate nasal specimens for laboratory testing (Suntarattiwong et al., 2021).

During the COVID-19 pandemic, non-pharmaceutical and pharmaceutical measures were implemented across all hospitals countrywide (e.g. triage of patients with ARI, installation of physical barriers or partitions between patients and the HCP, encouraging the use of face mask when caring for all patients and the use of respirator and other PPE when caring for patients suspected/confirmed of SARS-CoV-2 infection, isolation of SARS-CoV-2-infected HCP and quarantine of HCP with potential exposure to SARS-CoV-2 and COVID-19 vaccination among HCP). Furthermore, the HCP from non-critical departments (e.g. dental, ophthalmology) were transferred to the newly established COVID-19 wards or ARI clinics to meet the significant demand in services.

Symptom surveillance

From July 2020 to June 2021 (Thailand's expected 2020 influenza season), study staff called/texted participants weekly to ascertain an ILS (defined as new onset or sudden worsening of ≥ 1 of: muscle pain, cough, runny nose/nasal congestion, sore throat, and difficulty breathing) during the preceding 7 days. Participants were asked to contact the study staff if an ILS developed between weekly contacts. Symptomatic participants self-collected nasal specimens using a free of charge prelabeled study-provided kit (sterile polyester-tipped swab [MacroPur Swab P® regular size with plastic applicator, AMD Ritmed, China] and 3-ml cryovial tube of Universal Transport Medium [COPAN ITALIA SpA, Italy]), and kept them in a refrigerator (4–8°C). Specimens were transported to Armed Forces Research Institute of Medical Sciences for respiratory virus real-time reverse transcription-polymerase chain reaction (rRT-PCR) testing free of charge to participants.

Contact with ill participants was ceased upon participants' reporting of an ILS and re-started at 7 days post-illness onsets to determine illness resolution. Participants returned to weekly contact at illness resolution defined as 48 h symptom-free of all five symptoms, or ≥ 13 days after ILS onset, whichever came first. Participants missing four consecutive weekly contacts were considered lost to follow-up. A re-enrollment was possible if a contact to study staff was made by the lost participants.

Illness interview

Study staff called ill participants every other day starting at 7 days after symptom onsets until they were no longer ill (or ≥ 13 days after illness onsets, whichever came first) for an illness interview. The interview was conducted using a structured questionnaire for illness management information and resolution date; all out-of-pocket and subsidized expenses associated with ILS (laboratory and examination tests, clinician fee, hospital fee, prescribed and over-the-counter medication fees, and transportation fee); monetary income loss due to ILS; and number of hour(s) participants and/or family members (who took care of the participants while ill) were absent from work, as well as family members' income information.

All participants were compensated US\$16 for the enrollment interview and US\$0.3 for each successful weekly contact, but not for nasal specimen collection or illness interviews.

Laboratory testing

The quality of collected specimens was assessed by testing for human Ribonuclease P (RNase P) prior to laboratory testing. Influenza virus detection was performed using the U.S. Centers for Disease Control and Prevention's (U.S. CDC's) rRT-PCR protocol (WHO Collaborating Centre for Influenza, 2009). When additional funding became available, RSV detection was performed on specimens with remaining aliquots using commercial rRT-PCR assay (QIAstat-Dx Respiratory 2019-nCoV Panel, Qiagen, Germany). All participants had access to free-of-charge SARS-CoV-2 testing by rRT-PCR at their hospitals and were encouraged to share positive results with the study team.

Data analysis

We included only participants with ≥ 1 weekly contact for analysis. We used the Chi-square tests (categorical variables) or Student's *T*-tests (log-transformed continuous variables) as appropriate to compare characteristics of (i) ILS cases (individuals meeting the ILS case definition) and non-cases (individuals who did not experience any ILS while in study) and (ii) ILS cases with and without hospitalization.

To calculate illness-associated expenses using the societal perspective, we summed all reported fees and monetary income loss (if any). We accounted for time lost due to missed work by multiplying the number of hours absent from work by self-reported hourly wages and added this calculated time lost to the overall expenses. Exchange rate used was 31 Thai Baht to US\$1 (XE, 2022).

To calculate ILS incidence, the outcome was time to ILS onset (the number of days from 1 July 2020 to illness onset). The follow-up time of participants who did not experience any ILS ended on 30 June 2021. Participants who dropped out ($n = 102$; 4.7%) contributed follow-up time until their last successful contacts. Re-enrolled participants ($n = 29$; 1.3%) contributed a full follow-up time with the time not under observation deducted. We fitted population-averaged Poisson regression models (Neuhaus et al., 1991; Neuhaus, 1992) for the number of ILS events with person-time entered into the models as an offset. Adjusted ILS incidence per 100 person-years was calculated from Poisson parameters using least-squares means methods (Cameron and Trivedi, 2013). The 95% Poisson confidence intervals (95% CIs) were calculated using the exact method.

We calculated the economic impact due to ILS by applying number of days missed work, illness-associated expenses, etc. to Thailand's HCP population (227 349 persons) (Strategy and Planning Division, 2020) and reported annual burden adjusted for sex, medical condition, frequency of PPE use, study site, and calendar month. We used a two-sided *P*-value of < 0.05 to indicate statistical significance and performed analysis using Stata software version 16.0 (StataCorp LP, College Station, TX, USA).

Ethical approval

This study was approved by the Institutional Review Boards (IRBs) of: BIDI; PH; PMK; RY; Department of Disease Control of the Thai Ministry of Public Health (Thailand); and Walter Reed Army Institute of Research (USA). The U.S. CDC's IRB (USA) issued

a reliance on the determination of PMK. All participants had provided written informed consent to participate.

Results

Participants' baseline characteristics

From February to March 2020, we enrolled 2200 participants (BIDI = 306, PH = 548, PMK = 900, and RY = 446). Of these, 2184 (99.3%) had ≥ 1 weekly contact with a median weekly response rate to symptom surveillance of 99.5% (interquartile range [IQR], 99.4–99.7%), and 2005 (91.8%) completed a 1-year follow-up. The median enrollment age was 38 years (IQR 29–47.5); most were female (1906; 87.3%; Table 1). All were salaried employees with paid sick leave (30 days) and covered by a health insurance provided by the government for both in- and out-patient expenditures. Nurses comprised the majority of the participants (1277; 58.5%), followed by administrative staff (572; 26%), and other professions involving patient contact including seven physicians (335; 15.3%). Three hundred and ninety-seven participants (18%) self-reported that they had ≥ 1 underlying medical condition (Supplementary Table 1, available at *Annals of Work Exposures and Health* online).

ILS cases and non-cases were similar at baseline with regards to age; sex; profession; career and service lengths; work location and associated department; numbers of working hours, patients encountered, and times handling potentially infectious materials; and self-reported medical condition (Table 1). However, non-cases were statistically more likely than cases to report always using PPE (P -value = 0.042), to receive annual seasonal influenza vaccination in the past 5 years (P -value = 0.004), to not experience an ARI in the past 12 months prior to study enrollment (P -value = 0.015), and to work at hospitals other than PMK (P -value < 0.001). Using a 10-point scale, perceived risks in various scenarios were comparable between ILS cases and non-cases except perceived risk of becoming infected with any respiratory virus which was higher among cases (median 7 points; IQR 5–8) than non-cases (median 6 points; IQR 5–8; P -value = 0.022).

Influenza vaccination

Most participants (1911; 87.5%) self-reported a history of ever receiving seasonal influenza vaccination, 199 (9.1%) self-reported no history of vaccination, and 74 (3.4%) were unsure of their history. Among those with seasonal influenza vaccination history, 777 (40.7%) received an influenza vaccine annually during the past 5 years prior to study enrollment (Table 1).

Respiratory virus identification

Of 242 ILS episodes identified during the course of this study, 232 (95.9%) had nasal specimens collected. The median time from ILS onset to specimen collection was 3 days (IQR 2–4). All collected specimens were of good quality as indicated by RNaseP, but none tested positive for influenza viruses. Three (2.3%; 95% CI 0.4%–6.7%) of 128 specimens with remaining aliquots tested positive for RSV. Seven participants (0.3%; 95% CI 0.1%–0.6%) self-reported testing positive for SARS-CoV-2.

ILS and illness-associated expenses

One hundred and ninety-nine participants (9.1%) reported 242 ILS episodes; 167 (83.9%) reported one, 24 (12.1%) reported two, and 8 (4.0%) reported ≥ 3 episodes. Of 242 episodes, 86 (35.5%) were associated with two symptoms. Of the five symptoms constituting the ILS case definition, runny nose/nasal congestion (174; 71.9%) was the most commonly reported symptom, followed by sore throat (163; 67.4%) and cough (138; 57.0%; Supplementary Table 2, available at *Annals of Work Exposures and Health* online). Additionally, 82 ILS episodes (33.9%) presented with fever, 40 (16.5%) with headache, and 29 (12.0%) with sputum production. Most ILS episodes (233; 96.3%) did not require hospitalization, and 200 (82.6%) resolved before illness interviews. Among 200 ILS with known resolution dates, illness durations were not statistically different between ILS episodes with and without hospitalization (median 5.5 days [IQR 4–7] versus median 5 days [IQR 3–6]; P -value = 0.407).

Among the nine hospitalized ILS cases, one tested negative for influenza, but positive for RSV, three tested negative for both influenza and RSV, and five self-reported SARS-CoV-2 infection. The median hospitalized duration was 7 days (IQR 3.5–12). All had missed work (median 7 days, IQR 5–9) and incurred illness-associated expenses (median US\$271 [58.5% of median monthly income], IQR US\$148–US\$402). The highest proportion of the expenses was healthcare-related cost (61%), followed by indirect cost of self and family's lost time (39%). There was no non-healthcare-related cost (e.g. travel expense) incurred. Seven (77.8%) reported presenting at work while ill (median 3 days, IQR 2–6).

Among the 233 non-hospitalized ILS cases, 43 (18.5%) had missed work (median 2 days, IQR 1–2) and 118 (51.0%) incurred illness-associated expenses (median US\$14 [3.0% of median monthly income], IQR US\$5–US\$42). The highest proportion of the expenses was indirect cost of self and family's lost time (60%), followed by healthcare-related cost (40%), and non-healthcare-related cost, e.g. travel expense (<1%). Two hundred and twenty-five (96.5%) reported presenting at work while ill (median 6 days, IQR 4–9). Numbers of days presenting at work while ill were not significantly different between ILS episodes with and without hospitalization (median 3 days [IQR 2–6] versus median 6 days [IQR 4–9]; P -value = 0.779); however, numbers of days of missed work (median 7 days [IQR 5–9] versus median 2 days [IQR 1–2]; P -value < 0.001), and illness-associated expenses (median US\$271 [IQR US\$148–US\$402] versus median US\$14 [IQR US\$5–US\$42]; P -value < 0.001) were greater among hospitalized ILS cases.

Factors associated with acquiring ILS

Factors independently associated with acquiring ≥ 1 ILS episodes included female sex, self-reported asthma as a medical condition, lower frequency of PPE use, study site, and calendar month (Table 2). Controlling for covariates, females were 2.1 times more likely than males to acquire ILS (95% CI 1.1–4.0). Those with asthma were 2.4 times more likely than those without the condition to acquire ILS (95% CI 1.1–5.2). Those who used PPE frequently but not always were 1.6 times more likely than those who always used PPE to acquire ILS (95% CI 1.2–2.3). Compared to BIDI, ILS episodes were 1.6 times more likely to be reported from PMK participants (95% CI 1.0–2.6) and 0.3 times less likely to be

reported from RY participants (95% CI 0.2–0.7). Lastly, ILS episodes were 0.14 times less likely to be reported during month of June compared to January (95% CI 0.1–0.9).

Incidence and economic impact due to ILS in Thai HCP population

Study participants contributed 2142 person-years of observation time during Thailand's expected 2020 influenza season. The adjusted all-cause ILS incidence was 6.1 episodes per 100 person-years (95% CI 3.4–10.9; Table 3). With Thailand's HCP population of 227 349 persons, 13 909 ILS episodes (95% CI 7798–24 781) were estimated to occur annually, resulting in 78 800 days of HCP presenting at work while ill (95% CI 44 178–140 392), 8823 days of HCP missed work (95% CI 4946–15 719), and 3621 days of hospital beds occupied (95% CI 2030–6451). In terms of economic burden, these episodes would result in US\$235 135 economic loss when all fees, monetary income loss, and time loss were accounted for (95% CI US\$131 826–US\$418 922; Table 4).

Discussion

In a cohort of 2184 HCP who were generally healthy, we demonstrated that while influenza virus circulation was not detected among cohort participants, the burden of all-cause ILS was estimated at 6.1 episodes per 100 person-years during July 2020 through June 2021 (which coincided with the COVID-19 pandemic). ILS cases self-reported presenting at work while ill for a few days per episode while cases requiring hospitalization incurred illness-associated expenses per episode equaling to 58% of their monthly income. Although there were certainly community exposures among HCP, we found that 100% use of PPE that was appropriate to the procedure was associated with not acquiring ILS. We estimated yearly economic loss of nearly US\$240 000 among Thai HCP workforce.

Influenza virus infections were undetected among study participants, likely in part because of the implementation of countrywide infection prevention measures to control COVID-19 pandemic, resulting in very low circulation of respiratory viruses overall (Cowling et al., 2020; Sun et al., 2020; Feng et al., 2021; Li et al., 2021; Wang et al., 2022). At the time of writing, we were not aware of any study reporting ILS incidence among the HCP population during the same time period as our study. However, an estimated influenza-like illness rate of 1.3 episodes per 100 person-years was reported among adults aged 25–59 years in Beijing during China's expected 2020 influenza season (Wang et al., 2022).

Similar to other studies, we found that ILS was reported more frequently by females than males (Restivo et al., 2016; Laris González et al., 2018). This might be explained by difference in health-seeking behavior and reporting between sexes rather than the intrinsic biological or immunological factors (Thompson et al., 2016). Furthermore, unmeasured characteristics linked to study sites and calendar months e.g. patient caseload and local pathogen circulation, practices regarding case management and infection prevention and control, or climate factor may explain the significant association between these variables and ILS (Suntronwong et al., 2020). In this study, self-reported compliance with PPE use may have been influenced by the COVID-19 pandemic (e.g. the need to wear PPE while caring for suspected or confirmed COVID-19 patients), resulting in 60% and 20% of participants reporting always and frequent usage, respectively. Nonetheless, the finding that ILS occurred

more commonly among frequent (i.e. very often) PPE users than habitual (i.e. always) users could possibly highlight the importance of 100% compliance with PPE usage for reducing transmission in the healthcare setting.

High proportions of HCP in this and other studies reported working while ill (Ablah et al., 2008; Turnberg et al., 2010; Chiu et al., 2017; Laris González et al., 2018; Homrich et al., 2020). A recent substudy at the PMK (a study site of this study) documented most important reasons for such action including: (i) feeling of professional obligation to colleagues; (ii) not feeling ill enough to miss work; (iii) difficulty to find replacement to cover their duties; (iv) thinking that they were non-contagious; and (v) perception that employer expected them to continue working (Piyaraj et al., 2022). Low HCP's awareness of hospital sick leave policies was also reported. Studies have found associations between presenteeism and profession (Chiu et al., 2017; Daniels et al., 2021). For example, pharmacists and physicians were most likely to work when ill in one study (Chiu et al., 2017). We, however, did not find any particular profession linking to work presenteeism while ill because most of our participants were nurses. The high proportion of work presenteeism when ill in this study, which may have been driven by the need for non-severely ill HCP to continue working during the pandemic, is of concern as patients exposed to ≥ 1 contagious HCP were shown to have 5.5 times increased risk of developing hospital-acquired ILS than those without documented exposure (Vanhems et al., 2011).

Study suggested that on average 16% of influenza virus transmission occurred in the workplace (Edwards et al., 2016). The long duration of work presenteeism while ill in our study coupled with the high prevalence of runny nose/nasal congestion and cough which may further amplify respiratory virus transmission than when such symptoms were not present highlight the public health necessity to encourage HCP workforce to take sick leave even when they feel they could still perform their duties, especially during the non-pandemic periods when healthcare services are not in significant demand.

In this study, missed work due to ILS was reported by both study participants and family members. Duration of work absenteeism in this study (2 days and 7.5 days/episode for non-hospitalized and hospitalized cases, respectively) was similar to other reports (Restivo et al., 2016; Laris González et al., 2018). In two Mexican studies, missed work of 1 and 2.5 days/episode was reported among non-hospitalized cases (Restivo et al., 2016; Laris González et al., 2018). Extrapolating to the nation, the economic loss was considerable among Thailand's HCP population (approximately US\$240 000). For comparison, Thailand's per capita gross domestic products for years 2020 and 2021 (during the years the study was conducted) were US\$7159 and US\$7233, respectively (The World Bank, 2022). Much of this cost could be avoided by clarifying expectation from employer and defining policy pertaining sick leave including encouraging its use.

The method for ascertaining ILS cases is a strength of this study. Although we followed a relatively large cohort of busy HCP, the weekly response rate was high, and the dropout rate was low. Most ILS cases self-collected nasal swabs. We used the most sensitive and specific test (rRT-PCR) and assessed for specimen quality prior to laboratory testing. However, some of the limitations were that follow-up was only for a single influenza

season, and the fact that there were no influenza virus infections detected, perhaps due to pandemic interventions, made it impossible to estimate influenza virus infection incidence. We did not test for other respiratory viruses but although all participants had access to free-of-charge SARS-CoV-2 testing, they reported positive results infrequently. At the time the study ended, Thailand had yet to experience a large wave of COVID-19. PPE use was self-reported, and while we clarified the definition of ‘appropriate PPE use’ to all participants, non-differential misclassification might have occurred based on personal judgment, hospital policy, and PPE availability. The study was conducted during the COVID-19 pandemic for which infection prevention and control measures (e.g. face mask wearing, hand hygiene, limited patients’ access to healthcare services, and physical distancing) were implemented, resulting in no influenza circulation and zero influenza virus infection incidence. The all-cause ILS incidence of 6% reported here was therefore likely not a true estimate of the ILS incidence and could only be used as a proxy of the incidence among the HCP who were generally healthy. In this study, there were only a few ILS episodes that resulted in hospitalization, limiting the robustness of the cost estimate. Lastly, the impact of ILS on the economic assumed that characteristics of nationwide HCP population such as health status, susceptibility to ILS, and exposure risk were similar to those of the study participants. The estimated incidence and economic burden may be imprecise should the population comprise individuals with differing characteristics e.g. higher/lower risk of infection, more/less severe health outcomes, varying practice regarding the PPE use, or having different work environment and work presenteeism/absenteeism during the non-pandemic times.

Conclusions

This study found an annual ILS burden of 6% among study participants and showed that 100% compliance in PPE usage was associated with reduced risk of acquiring ILS. HCP should be encouraged to take sick leave when possible and to have 100% PPE compliance to limit potential transmission of respiratory viruses in healthcare setting and in public health in general. Given these circulation patterns, we estimated an economic loss due to ILS of approximately US\$240 000 would have occurred during the early COVID-19 pandemic year in Thailand. These data have the potential to inform policy decisions regarding possible health and economic benefits of prevention resource allocation related to HCP workforce management. They are also critical to HCP surge capacity modeling for future pandemic planning.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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What's important about this paper?

This study reports, for the first time, the burden of influenza-like symptom (ILS) among Thai healthcare personnel (HCP). Between July 2020 and June 2021, the incidence of ILS was estimated to be 6.1 episodes per 100 person-years, and may be lower than in other periods owing to the adoption of COVID-19 prevention and control measures. All-cause ILS resulted in considerable economic losses among Thai HCP workforce. Preventing ILS among HCP benefits workers and patients.

Table 1.

Characteristics at enrollment of 2184 healthcare personnel stratified by whether or not an influenza-like symptom was reported during the course of the study, Thailand, 2020–2021.

	HCP who did not report any ILS episode during follow-up (n = 1985)	HCP who report ≥1 ILS episode during follow-up (n = 199)	Total HCP (n = 2184)	P-value ^a
Median age in years (IQR)	38 (29–48)	37 (29–44)	38 (29–47.5)	0.188
Sex				0.063
Male	261	17	278	13%
Female	1724	182	1906	87%
Occupation				0.510
Registered nurse	541	63	604	28%
Non-registered nurse	619	54	673	31%
Admin and service staff	519	53	572	26%
Others	306	29	335	15%
Career length in years				0.702
1 to <3	280	26	306	14%
3 to <5	235	20	255	12%
5 to <7	173	19	192	9%
7 to <9	125	17	142	7%
≥9	1172	117	1289	59%
Service length at study site in years				0.815
1 to <3	323	30	353	16%
3 to <5	247	22	269	12%
5 to <7	164	21	185	8%
7 to <9	128	13	141	6%
≥9	1123	113	1236	57%
Main work location in a typical workday				0.677
Out-patient department	762	71	833	38%
In-patient department	738	72	810	37%
Both out- and in-patient departments	336	40	376	17%
Others ^b	149	16	165	8%
Number of working hours in a typical week				0.843

	HCP who did not report any ILS episode during follow-up (n = 1985)	HCP who report ≥1 ILS episode during follow-up (n = 199)	Total HCP (n = 2184)	P-value ^d
30–56 h ^c	1568	156	1724	79%
>56 h ^c	417	43	460	21%
Number of patients encountered in a typical workday				0.881
≤20 patients ^c	1557	157	1714	78%
>20 patients ^c	428	42	470	22%
Number of times handling potentially infectious materials in a typical workday				0.250
None	310	30	340	15%
1–5 times	661	69	730	33%
6–10 times	364	26	390	13%
11–15 times	148	22	170	11%
>15 times	469	50	519	25%
Not sure	33	2	35	1%
Self-reported personal protective equipment use				0.042
Always	986	91	1077	54%
Frequently	312	47	359	28%
Sometimes	286	22	308	13%
Rarely	31	5	36	3%
Never	28	2	30	1%
Main department worked in				0.365
Medicine	406	47	453	24%
Surgery	403	27	430	14%
Pediatric	121	10	131	5%
Eye, ear, nose, and throat	138	20	158	10%
Emergency	94	6	100	3%
Rehabilitation	86	10	96	5%
Orthopedic	83	9	92	5%
Obstetrics and gynecology	135	15	150	8%
Laboratory	101	9	110	5%
Others ^d	418	46	464	23%

	HCP who did not report any ILS episode during follow-up (n = 1985)	HCP who report ≥1 ILS episode during follow-up (n = 199)	Total HCP (n = 2184)	P-value ^a
Self-reported medical condition				0.595
None	1531	146	1677	77%
1 condition	319	35	354	16%
> 1 condition	38	5	43	2%
Not sure	97	13	110	5%
Self-reported number of years receipt of seasonal influenza vaccination in the past 5 years				0.004
0	35	2	37	2%
1	329	31	360	16%
2	274	14	288	13%
3	229	29	258	12%
4	162	29	191	9%
5	711	66	777	36%
Self-reported history of acute respiratory illness in the past 12 months				0.015
No	1737	162	1899	87%
Yes	248	37	285	13%
Study site				<0.001
Banrasaradura Infectious Diseases Institute	266	34	300	14%
Phramongkutklao hospital	794	104	898	41%
Rayong hospital	428	15	443	20%
Paholpolpayuhasena hospital	497	46	543	25%
Median perceived risk (IQR)				
Becoming infected with any respiratory virus	6 (5–8)	7 (5–8)	6 (5–8)	0.022
Developing an acute respiratory illness	5 (3–8)	5 (3–8)	5 (3–8)	0.799
Developing an acute respiratory illness and having to take leave from work	4 (1–6)	5 (2–7)	4 (1–6)	0.080
Developing severe acute respiratory illness	3 (0–5)	4 (1–6)	3 (0–5)	0.503
Transmitting respiratory viruses to patients	3 (0–5)	3 (1–5)	3 (0–5)	0.565

HCP, healthcare personnel; ILS, influenza-like symptom, IQR, interquartile range.

^aChi-square or Student's *T*-test comparing healthcare personnel who did not report and who reported ≥1 ILS episode during the course of the study.

^bPhysician, staff at emergency or operating room, triage staff, pharmacist, nutritionist, laboratory technician, dentist, assistant, x-ray staff.

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C_{cutoff} was $\leq 75^{\text{th}}$ or $> 75^{\text{th}}$ percentile.
 p Community, emergency department, operating room, laboratory, specific departments.

Table 2.

Bivariate and multivariate analyses examining factors associated with acquiring an influenza-like symptom among study participants in the healthcare personnel cohort, Thailand, 2020–2021.

	Unadjusted IRR ^a		95% confidence interval		P-value	Adjusted IRR ^a		95% confidence interval		P-value
	Lower bound	Upper bound	Lower bound	Upper bound		Lower bound	Upper bound	Lower bound	Upper bound	
Sex										
Male	Reference					Reference				
Female	1.93		0.96	3.89	0.066	2.14		1.14	4.00	0.018
Occupation										
Registered nurse	Reference									
Non-registered nurse	0.71		0.46	1.09	0.121					
Admin and service staff	0.83		0.51	1.37	0.472					
Others	0.89		0.52	1.52	0.679					
Self-reported asthma as medical condition										
No	Reference					Reference				
Yes	2.42		1.03	5.68	0.042	2.44		1.14	5.19	0.021
Self-reported personal protective equipment use										
Always	Reference					Reference				
Frequently	1.55		1.04	2.31	0.031	1.64		1.16	2.33	0.006
Sometimes	0.75		0.43	1.30	0.302	0.77		0.47	1.26	0.299
Rarely	1.81		0.69	4.77	0.231	1.99		0.85	4.62	0.111
Never	1.13		0.29	4.45	0.857	1.02		0.30	3.53	0.972
Number of times handling potentially infectious materials in a typical workday										
1–5 times	Reference									
6–10 times	0.62		0.36	1.05	0.075					
11–15 times	1.16		0.65	2.06	0.616					
>15 times	1.01		0.67	1.53	0.944					
Perceived risk of becoming infected with any respiratory virus ^b	1.06		0.99	1.14	0.075	1.07		1.01	1.13	0.033
Calendar month										
January	Reference									
February	0.62		0.28	1.40	0.250	0.63		0.29	1.38	0.250

	Unadjusted IRR ^a		95% confidence interval		P-value	Adjusted IRR ^a		95% confidence interval		P-value
	Lower bound	Upper bound	Lower bound	Upper bound		Lower bound	Upper bound			
March	0.65	0.30	1.40	0.268	0.66	0.32	1.38	0.266		
April	1.66	0.89	3.10	0.109	1.63	0.90	2.98	0.109		
May	0.73	0.34	1.57	0.419	0.74	0.35	1.54	0.416		
June	0.34	0.13	0.89	0.028	0.36	0.14	0.89	0.026		
July	0.63	0.29	1.36	0.238	0.64	0.31	1.34	0.240		
August	1.22	0.63	2.37	0.555	1.21	0.64	2.30	0.554		
September	0.99	0.50	1.98	0.982	1.00	0.51	1.94	0.995		
October	0.83	0.40	1.71	0.617	0.84	0.42	1.67	0.614		
November	1.17	0.60	2.30	0.641	1.16	0.61	2.22	0.644		
December	1.01	0.51	1.99	0.986	1.01	0.52	1.95	0.974		
Study site										
Bamrasnaradura Infectious Diseases Institute	Reference				Reference					
Phramongkutkiao hospital	1.50	0.90	2.51	0.116	1.63	1.01	2.65	0.048		
Rayong hospital	0.33	0.15	0.75	0.008	0.34	0.16	0.73	0.005		
Paholpolpayuhasena hospital	0.84	0.46	1.51	0.552	0.81	0.47	1.42	0.470		

IRR, incidence rate ratio.

^aPopulation-averaged Poisson models with those with missing information of self-reported appropriate personal protective equipment use or number of times handling potentially infectious materials in a typical workday excluded; variables significant at P -value ≤ 0.200 in bivariate models were entered into a saturated model, stepwise backward elimination approach was used to fit the final model with variables significant at P -value < 0.050 retained in the model.

^bContinuous variable.

Table 3.
Incidence of influenza-like symptom among study participants in the healthcare personnel cohort, Thailand, 2020–2021.

Study site	Person-years	Cases with influenza-like symptoms	Adjusted influenza-like symptom incidence per 100 person-years ^{a,b}		
			Estimate	Lower bound	Upper bound
Bamrasnaradura Infectious	297	36	7.0	3.5	14.1
Bamrasnaradura Infectious	297	36	7.0	3.5	14.1
Diseases Institute					
Phramongkutkiao hospital	881	137	10.5	5.9	18.8
Rayong hospital	433	15	2.2	0.9	5.0
Paholpolpayuhasena hospital	531	54	5.2	2.7	10.0
All study sites	2142	242	6.1	3.4	10.9

^a Population-averaged Poisson model adjusted for calendar month, healthcare personnel's sex, self-reported frequency of appropriate personal protective equipment use, and whether the healthcare provider self-reported asthma as medical condition; those with missing information of self-reported frequency of personal protective equipment use or number of times handling potentially infectious materials were excluded.

^b Adjusted for sex, medical condition, frequency of appropriate personal protective equipment use, and calendar month.

Table 4.

Estimated annual economic loss due to influenza-like symptom among Thailand’s healthcare personnel population, Thailand, 2020–2021.

	Estimate ^{a,b}	95% confidence interval	
		Lower bound	Upper bound
<i>Hospitalized episodes</i>	517	290	922
Days present at work when ill	1207	677	2150
Days HCP missed work	3880	2175	6912
Days occupying hospital beds	3621	2030	6451
Days family members missed work	632	354	1126
Illness-associated expenses	\$140 184	\$78 593	\$249 756
<i>Non-hospitalized episodes</i>	13 392	7508	23 859
Days present at work when ill	77 593	43 502	138 241
Days HCP missed work	4943	2771	8806
Days family members missed work	230	129	410
Illness-associated expenses	\$94 950	\$53 233	\$169 166
<i>All episodes</i>	13 909	7798	24 781
Days present at work when ill	78 800	44 178	140 392
Days HCP missed work	8823	4946	15 719
Days occupying hospital beds	3621	2030	6451
Days family members missed work	862	483	1536
Illness-associated expenses	\$235 135	\$131 826	\$418 922

HCP, healthcare personnel.

^a Calculated based on a population of 227 349 persons as reported by Strategy and Planning Division, Permanent Secretary Office, Ministry of Public Health, Thailand, 2020.

^b Adjusted for sex, medical condition, frequency of appropriate personal protective equipment use, study site, and calendar month.