Estimating influenza-related sick leave in Norway: Was work absenteeism higher during the 2009 A(H1N1) pandemic compared to seasonal epidemics?

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The impact of influenza on work absenteeism is poorly documented. We used data from the national registry and Norway Post AS (>14,000 employees) to explore sickness absence patterns from 2005/06 through 2009/10 in Norway. Annually, an estimated 2.868% (mean 95% confidence interval (CI): 2.405–4.820%) of the working population obtained sick leave for influenza, of whom 0.915% (mean 95% CI: 0.453–1.590%) had diagnoses for other respiratory illnesses with influenza as underlying cause. In the 2009/10 pandemic season, the absence rate increased 1.5-fold, mainly due to a 73% increase in influenza-diagnosed sick leaves. At Norway Post AS, absence related to seasonal influenza accounted for 0.351% (mean 95% CI: 0.126–0.704%) of total person-days annually (excluding parental care absence), of which 32–43% were estimated to be self-certified. Medically certified sick leave increased 1.3-fold in the pandemic season to 0.458% (95% CI: 0.176–0.856), while self-certified sick leave remained at a level typical for seasonal influenza. We found a significant four-fold increase in work loss to care for sick children, 0.048% (95% CI: 0.031–0.070%) of person-days, compared with 0.012% (95% CI: 0.004–0.028%) in 2008/09. In conclusion, GP-certified and parental care work absence were higher in the pandemic season. More studies are needed to quantify the burden of self-certified sick leave.

Introduction

Influenza is a highly contagious disease that affects people of all ages and imposes substantial burdens to the healthcare system. In addition, influenza epidemics result in considerable work absenteeism, and the associated cost of lost productivity is a major component of the financial burden of the disease to society [1-4]. In Europe, the major pandemic in 2009 wave arrived in October to December; in several European countries including Norway it was preceded by a smaller summer wave occurring from July to September. The pandemic was less severe than initially feared: there was immunity among the elderly and the large majority of illnesses were mild and self-limiting [5]. Estimation of influenza-related sick leave is challenging, partly because influenza is rarely laboratory-confirmed and partly because the disease may lead to secondary infection or worsening of underlying chronic illness. Mortality related to influenza is routinely studied, and the most common methods used to study influenza-attributable mortality are: the Serfling method [6], which measures the excess mortality above an expected winter baseline, cyclical regression [7], and Poisson regression informed by influenza surveillance data [8-10]. These approaches have been adopted to estimate excess hospitalisations [11], and more recently to estimate influenza-associated sick leaves [12]. In this study we used Poisson regression because the method can accommodate additional factors, such as accounting for co-circulation of other viruses and adjusting for the unusual timing of the pandemic that occurred in Norway outside the winter period.

We quantified work absence related to the 2009 pandemic in Norway and compared it with work absence for seasonal influenza epidemics, using data from the national registry on general practitioner (GP)-certified sick leave. In Norway, approximately 50% of the work force has a so-called 'Inclusive Working Life' (IWL) agreement allowing employees the right to full salary during sickness for up to eight calendar days of work absence without a GP certificate. Approximately 40% of the Norwegian work force has a non-IWL agreement allowing for up to three days of work absence with full salary without a doctor's certificate; the remaining 10% are self-employed, and this group is not compensated during illness. A considerable part of sickness absence due to influenza is therefore 'self-certified' and unknown to Norwegian public health authorities. In addition, work absence related to caring for sick children is not centrally registered. Previous international studies have found higher influenza-attributable work

absence among employees living in households with children [2,13]

To explore influenza-related work absences for self-certified sickness and parental care, we further analysed data from the Norwegian postal service (Norway Post AS), a government-owned company and one of the largest firms in Norway with more than 14,000 employees. Because of a monopoly on mail distribution, Norway Post AS is represented in all geographic regions of Norway. The present results provide new insights into the disease burden of influenza, and may serve as reference data in health economic evaluations of influenza.

Methods

Data

Weekly influenza-like illness (ILI) data were obtained from the Norwegian Institute of Public Health for the period January 2005 to December 2010. The Norwegian GP sentinel network consists of approximately 200 GPs throughout the country and covers approximately 15% of the population. The influenza surveillance is normally active in the winter season from week 40 to week 20, but was extended in 2009 to year-round reporting due to the on-going pandemic. Sentinel ILI rates are expressed per total number of consultations. The missing ILI levels during the summers of 2005 to 2008 were imputed from the ILI levels in week 20 and week 40 when influenza surveillance ended and started. We assumed that these ILI levels were representative of the baseline ILI activity in periods without influenza epidemics; the levels were all small and comparable (range: 0.47–0.73%). In each year separately, weekly ILI levels were found from a linear interpolation between the ILI levels in week 20 and 40.

We used monthly data on all Norwegian laboratory-confirmed respiratory syncytial virus (RSV) cases and norovirus cases from the Department of Virology, Division of Infectious Disease Control, at the Norwegian Institute of Public Health. The data do not convey information on the age of the reported cases. For RSV, smears of secretions from the nasopharynx were collected primarily from hospitalised children with acute respiratory diseases, and the samples analysed using PCR or immunofluorescence. Both the PCR method and the primers varied between laboratories. For norovirus, stool samples were collected mainly from adults during outbreaks in institutions and hospitals (G. Ånestad, personal communication, March 2012) and tested, primarily using in-house PCR, but the PCR method and the primers varied between laboratories.Like influenza, both RSV and norovirus are mainly active during the winter months and cause outbreaks involving a substantial proportion of the population, and similar to influenza virus, RSV and norovirus infect the respiratory tract and gastrointestinal epithelial cells, respectively [14,15] Weekly data on the number of individuals who went on sick leave (i.e. counts of new sick leaves) with International Classification of Primary Care (ICPC)-2 diagnoses [16] influenza (R80) and other respiratory diseases (all R diagnoses except R80) were obtained from the Norwegian Labour and Welfare Service (NAV) for the period January 2005 to December 2010. A robust locally weighted regression smoothing (robust LOESS) was applied to the data to eliminate large variations around the New Year and Easter vacations. Monthly employment data during the study period for individuals aged 16 to 74 years were obtained from Statistics Norway [17].

At Norway Post AS, work absence is registered as number of working days lost, whereas the number of employees absent from work is not recorded. We used monthly data on working days lost due to self-certified and GP-certified sick leave from February 2005 to November 2010; data on work absence related to caring for sick children were only available from February 2008 to December 2010.

Regression analyses

We used log-linear Poisson regression modelling to estimate counts of respiratory sick leaves attributable to influenza in the national sick leave registry data. In the model, weekly numbers of respiratory sick leaves (ICPC-2 all R codes, excluding influenza R80) were explained by ILI rates among 15 to 64 year-olds as a proxy for influenza activity, laboratory-confirmed RSV cases, short- and long-term temporal variables accounting for weekly and seasonal patterns not related to the respiratory infections included, and an interaction term between ILI reporting and the pandemic to account for the fact that the pandemic occurred outside the normal influenza season in Norway:

$$\hat{S}_{j,s} = \exp[\log(S_{j,s}^{tot}) + \beta_0 + \beta_1 ILI_{j,s}^{15-64y} + \sum_j \beta_{2,j}^{week} +$$

$$\sum_s \beta_{3,s}^{season} + \beta_4 RSV_{j,s} + \sum_k \beta_{5,k}(ILI_{j,s}^{15-64y} \times I_k^{pan}) + error_{j,s}]$$

$$(1.1)$$

Here, $\hat{S}_{j,s}$ is the predicted count of new sick leaves in week $j=\{1,2,\ldots 52\}$ and season s=$\{2004/05,\ldots 2010/11\}$, $\log(S_{j,s}^{tot})$ is an offset term of the total number of employed persons, $ILI_{j,s}^{15-64y}$ is the ILI rate in the working population, $\beta_{2,j}^{week}$, $\beta_{3,s}^{season}$ describe the variation within the seasons and between the seasons , respectively, and $RSV_{j,s}$ represents monthly numbers of laboratory-confirmed RSV infections. Lastly, the term $\beta_{5,1}$ describes the interaction between reported ILI activity and the pandemic summer wave using an indicator variable I_1^{pan} that was set equal to one from July to September 2009, and zero otherwise. Similarly the term $\beta_{5,2}$ describes the interaction between ILI activity and the major pandemic wave using an indicator variable I_2^{pan} that was set equal to one from October to December 2009, and zero otherwise. Because the RSV cases were reported on a monthly basis, we created a dummy variable to assign a month-to-week indicator. To account for over-dispersion, we used a quasi-Poisson approach by including a dispersion parameter λ. We used a similar model to estimate monthly GP-certified and

FIGURE 1

Surveillance data for influenza-like illness, respiratory syncytial virus and norovirus, Norway 2005/06–2009/10
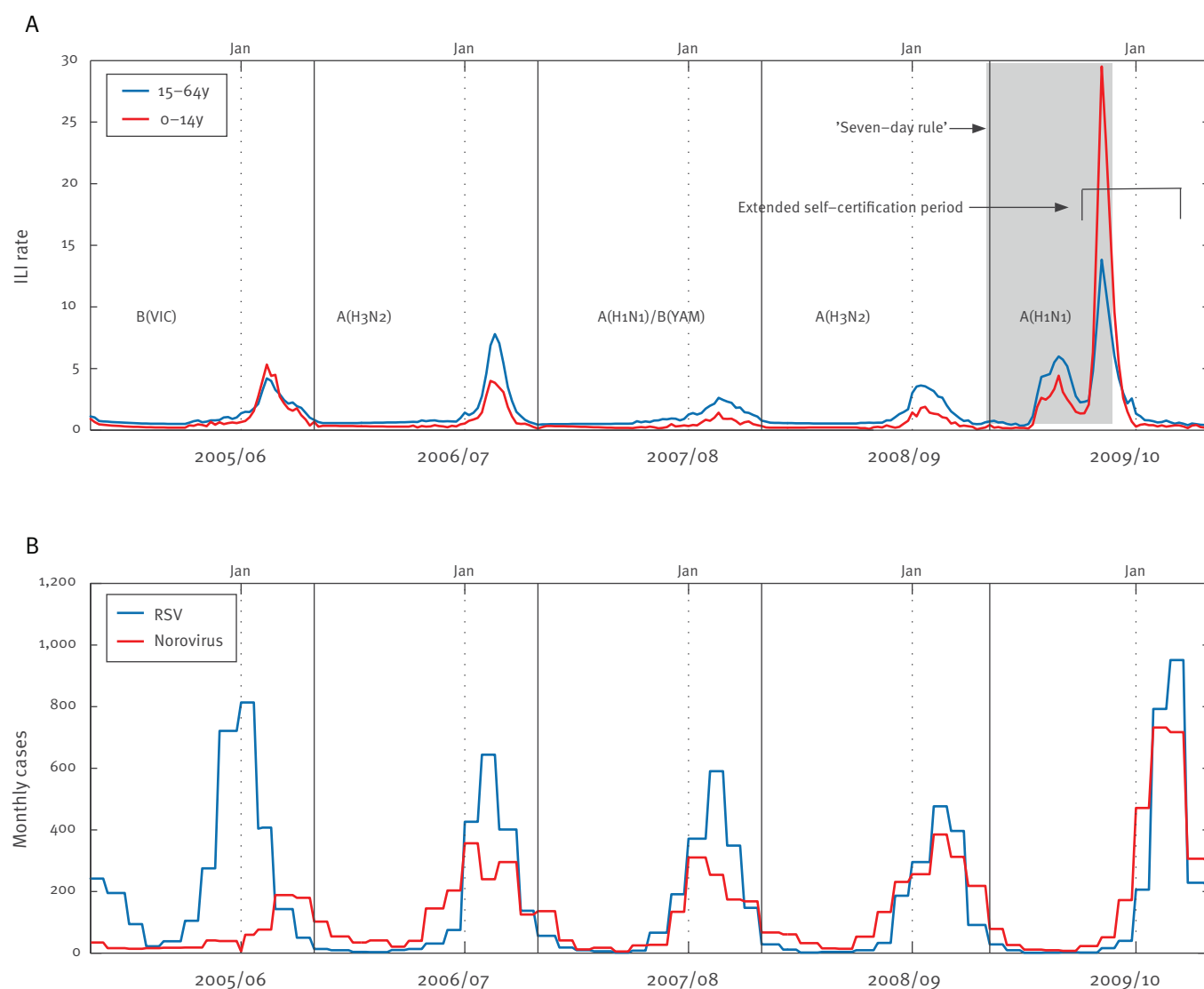
ILI: influenza-like illness; RSV: respiratory syncytial virus.

A: Weekly ILI rates expressed in percentage of total consultations among children and adults. Dominating influenza strains are listed for each season. The time period of extended self-certification from three to eight days is indicated, and the time period during which people e with influenza-like symptoms were recommended to stay at home: seven days after onset of symptoms (gray shaded area).

B: Monthly number of laboratory-confirmed cases of RSV and norovirus infections.

self-certified working days lost at Norway Post AS, except that we included monthly laboratory-confirmed norovirus cases $Noro_{j,s}$, and weekly variables were substituted with monthly predictors $j=\{1,2,...12\}$. In these models the offset $\log(S_{j,s}^{tot})$ comprised monthly totals of working days.

Norway Post AS started to record data about work absence to care for sick child in 2008. Because observations were sparse, we used a modified Poisson model with few predictor variables to estimate influenza-attributable loss of working days for parents caring for sick children:

$$\hat{S}_i = \exp[\log(S_i^{tot}) + \beta_0 + \beta_1 ILI_i^{0-14y} + \beta_2 Cos(2\pi i / 12) + \beta_3 Sin(2\pi i / 12) + \beta_4 i^2 + \beta_5 I^{July} + error_i]$$

(1.2)

Here $\hat{S}_i$ is the predicted number of working days lost due to caring for sick children in month i={1,2,..34} starting from February 2008, $\log(S_i^{tot})$ is the offset term of total monthly working days, and $ILI_{j,s}^{0-14y}$ is the ILI rate in children. The terms $Cos(2\mu i/12)$ and $Sin(2\mu i/12)$ describe yearly fluctuations in lost working days and i^2 accounts for the time trend in lost working days (a linear predictor variable was also tested, but it was not significant) and I^{July} is an indicator variable set equal

TABLE 1

General practitioner-certified sick leaves with influenza and estimated sick leaves with respiratory illness attributable to influenza, and corresponding sick leave rates per 100,000 employees Norway, 2005/06–2009/10 (312 weeks)

| Area/Season	Influenza R80				Other respiratory diseases (R/not R80) Poisson regression					Total			
	Reported	Rate	Estimated	95% CI[a]	Estimated	95% CI[a]	%[b]	Rate	95% CI[a]	Estimated	95% CI[a]	Rate	95% CI[a]
National													
2005/06	41,901	1,815	19,904	9,129–34,891		9.2		862	395–1,512	61,805	51,030–76,792	2,677	2,211–4,493
2006/07	62,064	2,607	29,322	17,800–45,192		11.8		1,232	748–1,898	91,386	79,864–107,256	3,839	3,355–6,445
2007/08	39,426	1,595	19,144	7,018–36,015		7.9		774	284–1,457	58,570	46,444–75,441	2,369	1,878–3,963
2008/09	45,592	1,811	20,231	9,882–38,789		8.0		804	393–1,541	65,823	55,474–84,381	2,615	2,204–4,426
Mean 2005/06–2008/09	47,246	1,952	22,150	10,957–38,463		9.2		915	453–1,590	69,396	58,203–85,709	2,868	2,405–4,820
2009/10	84,359	3,376	24,371	13,531–37,427		11.7		975	542–1,498	108,730	97,890–121,786	4,352	3,918–7,728
Health Region East													
Mean 2005/06–2008/09	9,720	1,086	4,611	1,802–12,025		8.3		515	201–1,343	14,331	11,522–21,745	1,600	1,287–2,686
2009/10	18,449	1,991	4,769	3,377–12,003		9.5		515	364–1,295	23,218	21,826–30,452	2,505	2,355–4,496
Health Region South													
Mean 2005/06–2008/09	16,155	3,519	7,481	1,207–19,624		8.3		1,630	263–4,275	23,636	17,362–35,779	5,149	3,783–8,669
2009/10	30,304	6,472	7,563	2,602–18,604		10.0		1,615	556–3,973	37,867	32,906–48,908	8,087	7,028–14,559
Health Region West													
Mean 2005/06–2008/09	11,078	2,154	3,524	1,535–9,861		7.2		685	299–1,917	14,603	12,614–20,939	2,839	2,453–4,993
2009/10	19,580	3,668	3,331	1,743–9,530		7.7		624	327–1,786	22,911	21,323–29,110	4,293	3,995–7,961
Health Region Mid													
Mean 2005/06–2008/09	5,956	1,771	3,149	943–6,704		11.7		937	280–1,994	9,105	6,899–12,660	2,708	2,052–4,479
2009/10	9,778	2,845	2,437	821–5,881		10.3		709	239–1,711	12,215	10,599–15,659	3,553	3,083–6,398
Health Region North													
Mean 2005/06–2008/09	4,337	1,892	1,903	943–3,601		5.3		830	411–1,571	6,240	5,280–7,938	2,722	2,303–4,614
2009/10	6,248	2,740	1,554	821–4,178		10.1		682	360–1,832	7,802	7,069–10,426	3,422	3,100–6,162

CI: confidence interval.

[a] In rows reporting the mean 2005/06–2008/09, the mean values of the lower and upper 95% CI are shown; in columns reporting totals , the mean values are summed with the mean number of influenza-diagnosed sick leaves.

[b] Percentage of total number of registered sick leaves with respiratory illness (ICPC-2 R) excluding influenza (R80).

Estimated weekly excess of influenza-attributable general practitioner-certified sick leaves with respiratory illness, Norway, 2005/06–2009/10
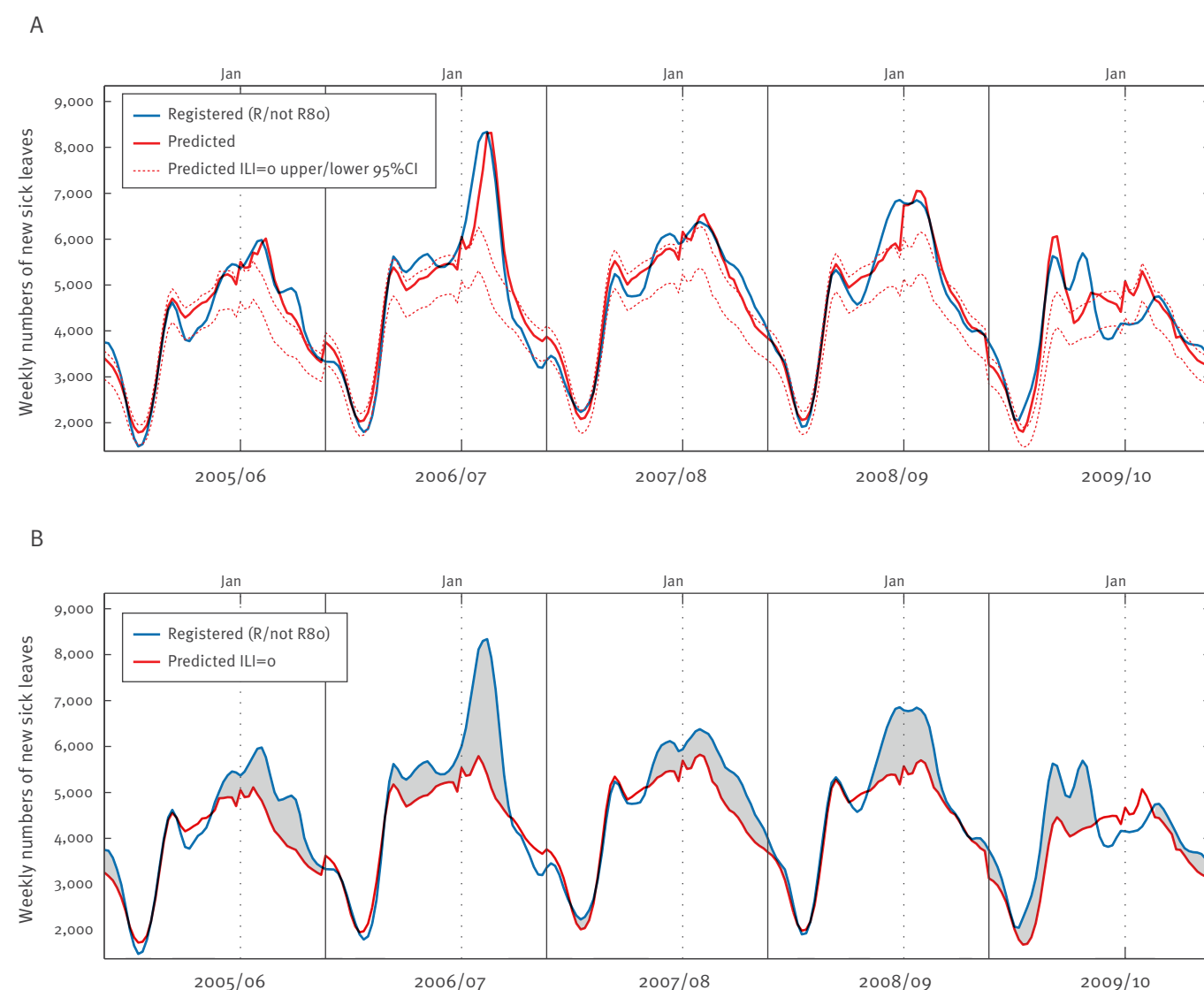
CI: confidence interval; ILI: influenza-like illness.

A: Observed (blue) and predicted (red) weekly numbers of respiratory sick leaves; upper and lower 95% confidence interval of prediction with ILI=0 (dotted red lines).

B: Crude estimation calculated as the difference between observed and predicted (ILI=0); only positive contributions are summed (gray areas).

to 1 in the month of July and zero elsewhere to adjust for low levels of work absence during the main summer holiday period. As above, we adopted a quasi-Poisson approach by fitting a dispersion parameter.

The Poisson regression was conducted using the GLM package in the open source statistical software R version 2.13.0 [18]; data smoothing and graphical plots were done using Matlab version R2011a.

Estimating influenza-associated work absence
For each outcome, only significant variables were included in the final models that were used to estimate

the sick leave burden. We estimated a *Poisson baseline* from the number of sick leaves/working days lost for each week/month predicted by the models equation 1.1 and equation 1.2 when influenza activity was set to zero.

A *crude estimate* of the influenza-associated sick leaves/working days lost for each season was made by subtracting the Poisson baseline at each point in time from the observed values and summing the positive contributions. We considered the uncertainty in the parameter estimates by subtracting the upper and lower 95% confidence intervals (CI) of the models from

Estimated self-certified work absence and certified work absence at Norway Post AS due to influenza from 2005/06 through 2009/10 (71 months), work absence due to care of sick children from 2008/09 to 2009/10 (34 months)

A

Season	Est.	95% CI[a]	%[b]	Rate[c]	95% CI[b]
Self-reported					
2005/06	4,459	2,473−6,434	10.2	131	72−188
2006/07	5,208	3,175−7,146	12.3	157	96−215
2007/08	3,627	2,147−5,452	8.4	107	64−161
2008/09	4,157	2,203−5,919	10.1	131	70−187
Mean 2005/06−2008/09	4,363	2,500−6,238	10.3	132	75−188
2009/10	3,695	1,841−5,273	9.8	127	63−181
GP-certified					
2005/06	9,442	2,855−19,427	3.2	277	84−569
2006/07	6,877	1,221−17,761	2.6	207	37−536
2007/08	7,059	1,712−16,139	2.8	209	51−478
2008/09	5,802	1,019−15,488	2.3	183	32−489
Mean 2005/06−2008/09	7,295	1,702−17,204	2.7	219	51−514
2009/10	9,640	3,286−19,643	4.1	331	113−675
Total Self+GP					
Mean 2005/06−2008/09	11,658	4,202−23,442	-	351	126−704
2009/10	13,335	5,126−24,916	-	458	176−856

B

Season	Est.	95% CI[a]	%[b]	Rate[c]	95% CI[b]
Sick children men					
2008/09	228	112−502	4.8	13	6−29
2009/10	870	547−1,251	17.1	52	33−75
Sick children women					
2008/09	141	26−382	4.0	10	2−27
2009/10	539	366−774	16.6	44	30−63
total 2008/09	369	138−884	4.5	12	4−28
2009/10	1,409	913−2,025	16.9	48	31−70
Total Self+GP+children					
2008/09	10,328	4,339−24,326	-	362	131−732
2009/10	14,743	6,040−26,941	-	507	208−926

CI: confidence interval; GP: general practitioner.

[a] In rows reporting the mean 2005/06−2008/09, the mean values of the lower and upper 95% CI are shown;

[b] Percentage of total number of lost working days (self-certified/GP-certified/sick children).

[c] Rates of lost working days per 100,000 working days.

the observed values. Again, only those weeks/months with a positive contribution were summed. For consistency between models using weekly and monthly variables, the influenza seasons were defined to last from May to April, although the influenza surveillance (except in 2009/10) ended in week 20 (approximately mid-May).

Results
Figure 1 shows weekly ILI rates among adults and children, and monthly laboratory-confirmed cases of RSV and norovirus in Norway from 2005/06 through 2009/10. In this period, seasonal influenza epidemics occurred during the months December to April. In 2009, high ILI rates occurred in two separate time periods: a minor summer wave (July to September) and a major wave (October to December). Both RSV and norovirus infections displayed clear seasonal patterns with a peak appearing during the late winter months.

General practitioner-certified sick leaves in national registries associated with influenza
The number of GP-certified sick leaves with influenza diagnoses was on average 47,246 in the seasons from

FIGURE 3

Estimated monthly excess of self-certified influenza-attributable working days lost at Norway Post AS, 2005/06–2009/10
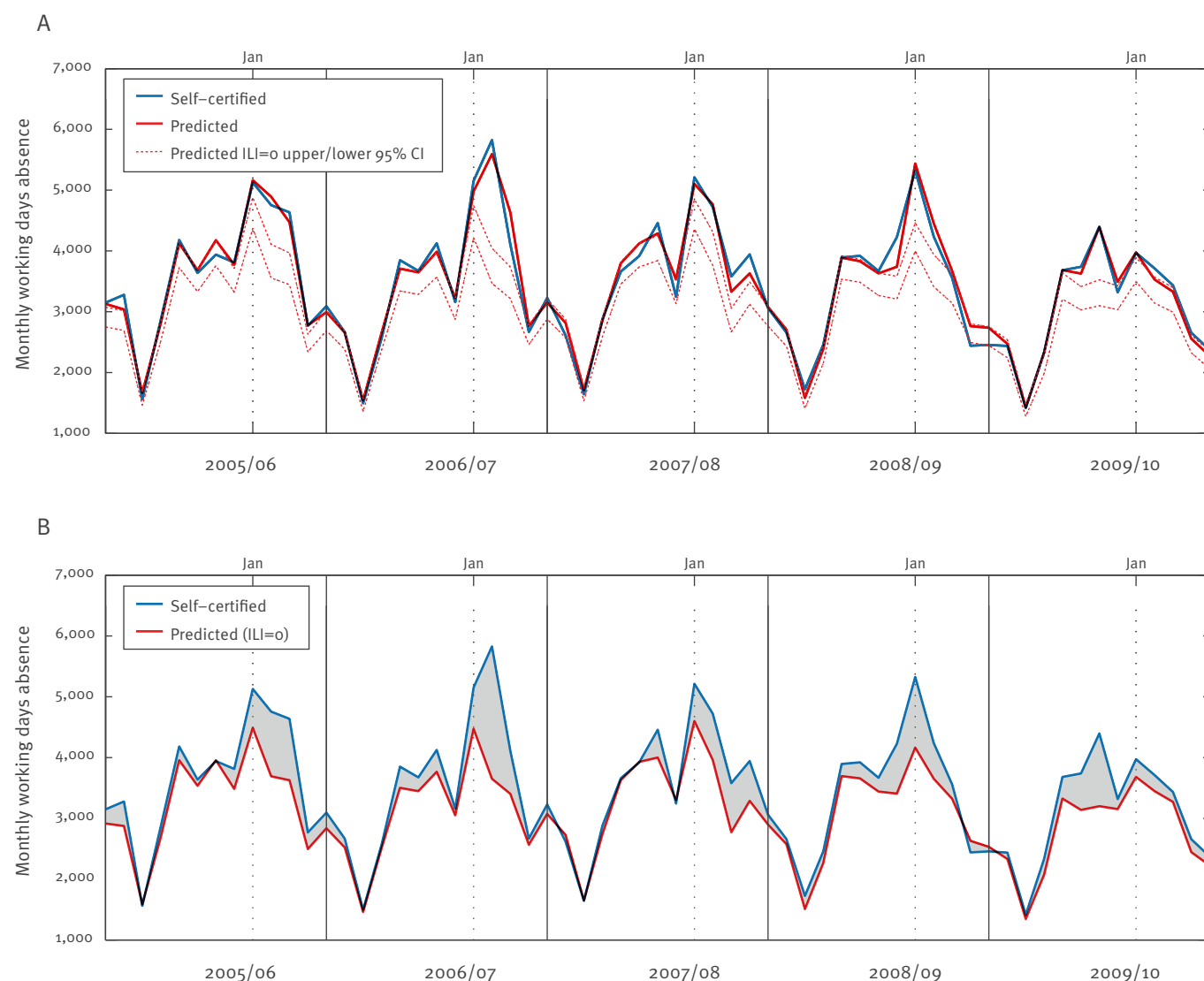
CI: confidence interval; ILI: influenza-like illness.

A: Observed (blue) and predicted (red) monthly numbers of self-certified working days lost; upper and lower 95% confidence interval of prediction with ILI=0 (dotted red lines).

B: Crude estimation calculated as the difference between observed and predicted (ILI=0); only positive contributions are summed (gray areas).

2005/06 through 2008/09 (Table 1), representing a sick leave rate of 1,952 (range: 1,595–2,607) per 100,000 persons employed. In the pandemic season, 84,359 GP-certified sick leaves with influenza were registered, an increase of 79% compared with the mean level in the previous seasons. The corresponding sick leave rate was 3,376 per 100,000 employed, a 73% increase compared to the average level in the non-pandemic seasons.

We estimated the number of sick leaves for other respiratory diseases with influenza as underlying cause using Poisson regression. In the model, ILI^{15-64y} (p<0.001) and RSV (p<0.05) were significant predictor variables. We found an averxage of 22,150 (mean 95% CI: 10,957–38,463) annual sick leaves associated with seasonal influenza (Table 1, Figure 2), corresponding to an average rate of 915 (mean 95% CI: 453–1,590) sick leaves per 100,000 persons employed. The data suggest that influenza-related complications account for 9.2% (range: 7.9–11.8%) of sick leaves with other respiratory disease diagnoses. In the pandemic season, 24,371 (95% CI: 13,531–37,427) sick leaves were found associated with influenza, indicating a slight increase

FIGURE 4

Estimated monthly excess of GP-certified influenza-attributable working days lost at Norway Post AS, 2005/06–2009/10
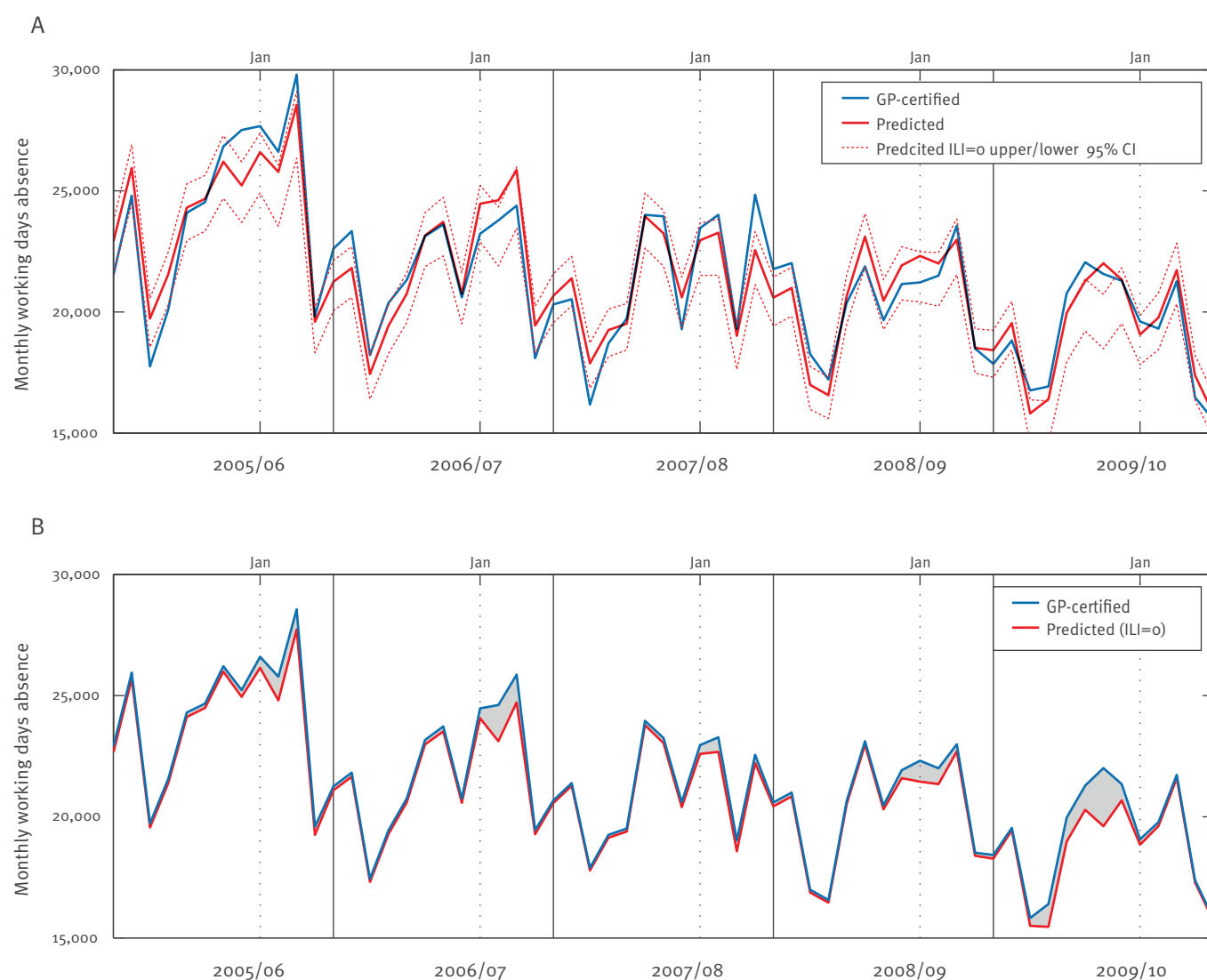
CI: confidence interval; GP: general practitioner; ILI: influenza-like illness.

A: Observed (blue) and predicted (red) monthly numbers of self-certified working days lost; upper and lower 95% confidence interval of prediction with ILI=0 (dotted red lines).

B: Crude estimation calculated as the difference between observed and predicted (ILI=0), summing only positive contributions (gray areas).

of 10% compared with the level typical for seasonal influenza. The sick leave rate was 975 (95% CI: 542–1,498) per 100,000 employees and showed a similar trend, increasing by 7% compared with prior seasons.

Overall, we estimated a seasonal average of 69,396 (mean 95% CI: 58,203–85,709) influenza-associated sick leaves, indicating that 2,868 (mean 95% CI: 2,405–4,820) per 100,000 persons employed obtain sick leave due to influenza annually. In the pandemic season the number of influenza-associated sick leaves was estimated at 108,730 (95% CI: 97,890–121,780)

and was significantly increased compared with the previous years, while an estimated 4,352 (95% CI: 3,918–7,728) per 100,000 persons employed went on sick leave with influenza-related illness.

We found large differences in the sick leave rates for seasonal influenza across the country: Health Region South had the highest sick leave rate with an average of 5,149 (mean 95% CI: 3,783-8,669) per 100,000 persons employed in 2005/06–2008/09, 3.2 times the level of Health Region East, which had the lowest level estimated at 1,600 (mean 95% CI: 1,287–2,686).

During the pandemic season, influenza-diagnosed sick leaves increased by 70–90% in Health Regions East, South and West compared with the levels typical for seasonal influenza. After adjusting for RSV, other respiratory sick leaves associated with influenza rose by factors of 10–20% in those regions. In Health Regions Mid and North, influenza sick leaves increased by 50–60%, while respiratory sick leaves decreased by 15–20% compared with the seasonal mean.

We also tested a model on all short-term sick leaves (excluding all ICPC-2 R diagnoses), but no influenza-attributable excess sick leave was discovered, and these results are not presented.

Self-certified and general practitioner-certified sick leave at Norway Post AS associated with influenza

The total number of working days at Norway Post AS, i.e. the number of person-days after deduction of leaves (except sick leaves) and holidays, declined by 15% from 3.41 million in the 2005/06 season to 2.91 million in the 2009/10 season. In the study period, self-certified and GP-certified work loss comprised 1.3% and 8.0%, respectively, of the total working days in the company.

Influenza-attributable work loss at Norway Post AS was estimated using Poisson regression. In the model for self-certified work absence, ILI^{15-64y} (p<0.0001) was found a significant predictor variable, whereas $Noro$ and RSV were left out as neither was significant. The average estimated work loss due to seasonal influenza was 4,363 (mean 95% CI: 3,500–6,238) working days annually, 10.3% of the total load of self-certified absence in the company (Table 2A; Figure 3). The corresponding mean absence rate was 132 (mean 95% CI: 75–188) per 100,000 working days which was similar to the level obtained in the pandemic season of 127 (95% CI: 63–181) per 100,000 working days.

In the model for GP-certified sick leave, ILI^{15-64y} was found significant (p=0.01) when excluding $RSV, Noro$ and the interaction terms between ILI and the pandemic waves . The estimated influenza-associated work loss averaged at 7,295 (mean 95% CI: 1,702–17,204) working days per season, representing 2.7% of the total number of GP-certified working days lost (Table 2A, Figure 4). The corresponding rate of GP-certified absence was 219 (mean 95% CI: 51–514) per 100,000 working days for seasonal influenza. In the pandemic season, the estimated absence rate increased 1.5-fold to 331 (95% CI: 113–675) per 100,000 working days.

Influenza-attributable work absence to care for sick children at Norway Post AS

Between February 2008 and November 2010, female employees accounted for 43.3% of the total working days. The average age of the women was 47 years, versus 44 years among the men, and 54% of the women were aged 20–49 years compared to 61% of the men. The overall work absence to care for sick children comprised 0.27% of potential working days and was comparable among women (0.26%) and men (0.29%).

In the models predicting work absence of women and men due to parental care, ILI^{0-14y} (p<0.0001) was significant, while both RSV and $Noro$ were non-significant and were left out. In the 2008/09 season, influenza-attributable work loss for sick children was estimated at 10 (95% CI: 2–27) and 13 (95% CI: 6–29) days per 100,000 working days for women and men, respectively. The results indicate that seasonal influenza accounts for approximately 4–5% of work absence related to care for sick children (Table 2B). Work absence increased significantly among women to 44 (95% CI: 30–63) per 100,000 working days and among men to 52 (95% CI: 33–75) per 100,000 working days during the pandemic season. Pandemic influenza accounted for 16–17% of the total work loss due to caring for sick children in the 2009/10 season.

Total sick leave at Norway Post AS in 2008/09-2009/10 associated with influenza

Overall, the work absence rate rose by a factor of 1.4 in the pandemic season, from an estimated 10,328 (95% CI: 4,339–24,326) working days lost in the 2008/09 season to 14,743 (95% CI: 6,046–26,941) working days lost in the 2009/10 season. In the pandemic season, self-certified work absence accounted for 25% of influenza-associated work loss, while 65% was GP–certified, and 10% was related to sick children. The corresponding figures for the 2008/09 season were 36%, 61% and 3%, respectively.

Discussion

This study presents estimates of influenza-associated work absenteeism between 2005/06 and 2009/10 in Norway using both national and company-based data. Our results show that during an influenza season there are, on average, 47,200 influenza-diagnosed sick leaves, and a further 22,000 (mean 95% CI: 11,000–38,500) sick leaves with other respiratory diseases are due to influenza-related complications. The results are consistent with the sick leave pattern over the seasons 1998/99 to 2005/06 that has been estimated at 48,300 influenza-diagnosed sick leaves and 11,000 influenza-attributable sick leaves with other respiratory illnesses [12]. In 2009/10, the number of sick leaves diagnosed for influenza almost doubled, while the number of influenza-attributable sick leaves diagnosed for other respiratory diseases was similar to the level seen in non-pandemic seasons. The average mean duration of GP-certified sick leave in Norway has been estimated at 7.2 days for influenza, and 10.6 days for other ICPC-2 R diagnoses [12]. Using these figures, our analysis suggests that influenza accounts for 330,000 to 558,000 GP-certified working days lost per year. Assuming that the duration of sick leave was unchanged in the pandemic season, the corresponding estimate for the 2009/10 season was 555,000 to 761,000 working days lost.

Interestingly, we found large regional differences in sick leave rates associated with influenza, with similar trends during the pandemic and the non-pandemic seasons. This variation cannot be explained by regional deviation in influenza activity, i.e. by differences in ILI visits per capita in the regions. The reason for these large discrepancies may be regional habits of GPs using the influenza R80 code or other R codes, or may relate to differences in health seeking behaviour of patients in different regions, and needs to be explored further.

At Norway Post AS, a company that has an 'Inclusive Working Life' (IWL) agreement with full salary compensation during sickness for up to eight calendar days without a GP certificate, seasonal influenza accounted for a loss of 0.1–0.5% of the total working days. This proportion rose to 0.2–0.9% in the pandemic season. In comparison, a recent Canadian study found that seasonal influenza is responsible for a loss of 0.08% of potential hours worked annually with an elevated level of 0.2% in the 2009/10 season [4]. In this study, the larger work loss in the pandemic season was associated with longer average duration of sick leaves, while the number of absent workers was similar to non-pandemic seasons.

The present use of Poisson regression is based on the correlation between ILI rates, laboratory-confirmed RSV and norovirus cases, and sick leave/work absence. The method is therefore sensitive to the quality of the surveillance data and temporal variations in the reported cases, and these limitations should be considered when interpreting the present findings. In particular, there may be time biases in the data collection and laboratory testing as well as in the GP-seeking behaviour during in the pandemic season.

Evaluation of the handling of the 2009 influenza A(H1N1) pandemic in Norway concluded that the surveillance of ILI provided a reliable representation of influenza activity, except at the beginning of the summer wave [19]. The summer wave coincided with an outbreak of human rhinovirus (HRV) in Norway, and circulation of HRV may have reduced the probability of influenza infection [20-22]. The increase in ILI diagnoses during the summer may therefore initially have been caused by HRV, which is also supported by a Norwegian serological survey conducted in August 2009 showing low prevalence of antibodies reactive to the influenza A(H1N1)pdm09 similar to the prevalence in sera collected in 2008 [23]. It is notable that 28% (24,092/84,359) of the influenza-diagnosed GP-certified sick leaves occurred from July to August before major circulation of the influenza (A) H1N1 pdm09 virus was laboratory-confirmed. If these contributions are excluded from the estimates in Table 1, the GP-certified sick leave rates during the pandemic was quite similar to the levels typical of seasonal epidemics. There also appeared to be an excess of influenza-associated sick leaves due to respiratory illness during the summer wave (see Figure 2).

From 28 April 2009, Norwegian public health authorities recommended that people with a suspected influenza illness should stay at home for seven days following the onset of symptoms [24], in line with the advice from the United States Centers for Disease Control and Prevention (CDC). On 18 November 2009, revised recommendations suggested a return to work no earlier than 24 hours after cessation of fever and general symptoms [25]. Ignoring all other factors, this may have increased the number of influenza-related working days lost per sick employee in 2009/10 compared to a normal season. In addition, employees in companies without an IWL agreement had an additional economic incentive to seek medical assistance during the pandemic because without a GP certificate, they were only allowed to stay absent from work for three days with full salary. However, at the beginning of the major pandemic wave (23 October 2009, Figure 1), the Norwegian government and social partners implemented a common policy to extend the self-certification period from three to eight days for non-IWL employees; the agreement remained active until 25 March 2010. In the official Norwegian review of the management of the pandemic it was argued that the seven-day rule may have led to unnecessarily high work absenteeism, in particular during the early phase of the pandemic [23].

Norway Post AS adhered to the national guidelines, which could have caused employees to take more time off work, thereby leading to higher self-certified work absence. However, the data are not suggestive of such a trend. Interestingly, only GP-certified work loss increased, while self-certified work absence remained at a level typical for seasonal influenza. One possible explanation for this finding could be that a larger proportion of employees with influenza symptoms consulted a GP due to awareness and fear of the ongoing pandemic, which is in line with the national data showing increased sick leave rates during the pandemic. However, to our knowledge there is no published literature on this subject. Our finding of a four-fold increase, compared with the 2008/09 epidemic, in influenza-related absence of parents taking care of sick children, corroborates findings that the pandemic mainly affected children and young adults [26-28].

There are additional methodological limitations to the present study. Firstly, we only considered respiratory illnesses in the analysis of GP-certified sick leave. Therefore the excess sick leave observed here may underestimate the true absence burden related to influenza. Other diseases such as cerebrovascular disease or other chronic conditions could have been considered in the analyses, as has been done in studies of excess mortality [9], but their importance for sick leaves is currently not known. Secondly, influenza creates short-lived epidemics of six to eight weeks duration and our estimates would have improved if weekly information on work absence had been available from Norway Post AS. Thirdly, the laboratory data on RSV and norovirus

infections are limited and may not fully represent the underlying epidemics. Fourthly, the analysis concerning GP-certified sick leave at Norway Post AS resulted in estimates with very wide confidence bounds and were less clear than the other analyses with respect to the impact of influenza activity, probably because the majority of GP-certified work absence is caused by long-term illnesses not related to influenza. More precise estimates for influenza could have been achieved if data on short-term work absence had been available. Finally, the findings related to Norway Post AS cannot necessarily be generalised to other types of work places, for instance in the healthcare sector and at schools.

In conclusion, we found higher GP-certified sick leave rates due to influenza in the pandemic season and higher absence rate for parents taking care of sick children at Norway Post AS, while self-certified sick leave in the company was similar to the levels in non-pandemic seasons. Fear of the pandemic, public health recommendations and extension of the duration of paid sick days are likely to have influenced work absence in the 2009/10 season. The duration of paid sick days varies on the Norwegian labour market, which may affect absence rates and GP-seeking behaviour. More studies are needed to quantify the burden of self-certified sick leave, which comprises a substantial part of the economic burden of influenza to society.

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