Supplementary Online Content

SARS-CoV-2 seroconversion and occupational exposure of employees at a Swiss university hospital: a large longitudinal cohort study

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This appendix has been provided by the authors to give readers additional information about their work.

eAppendix 1. Details considering the recruitment & follow-up of study participants

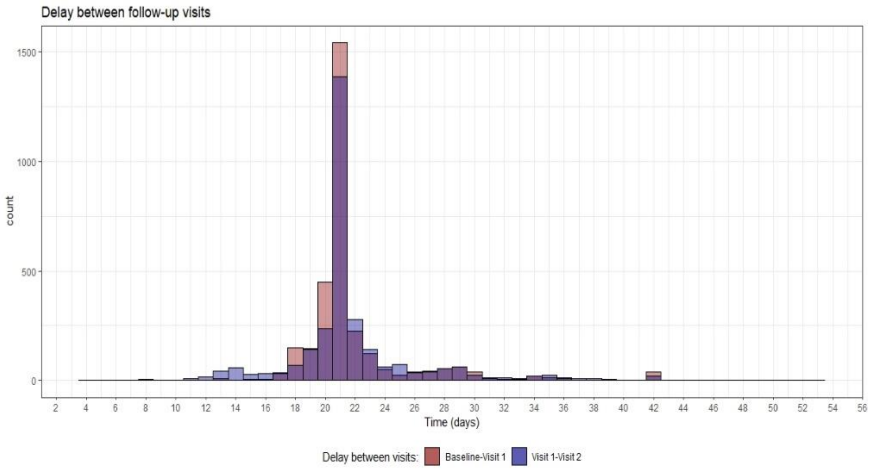
Recruitment:

We performed convenience sampling of all volunteering employees present at the recruitment centres for blood drawing. We could neither refuse, nor select an employee to participate in this study, but selected the location of recruitment centres based on the hospital sectors considered in our study plan. The timing and place of recruitment visits were predefined to prioritize units at high risks, as defined by our methodology. This means that the frequency and duration of recruitment visits were higher in these units (intensive care, anaesthesiology, emergencies, screening centre), to increase the volume of participants working in these units (eFigure 7). Potential participants were recruited at the baseline from March, 30th to April, 17th, continuously during working hours from Monday to Friday. Location and duration of visits were defined in a plan communicated to the concerned services & the overall institution prior to the first recruitment visits.

As a reminder, units at high, intermediate, and low risk were defined *a priori* based on exposure to COVID-19 positive patients. Anaesthesiology was defined as high-risk sectors because this sector intersect with Intensive Care Units both geographically and functionally. Furthermore, frequent aerosol generating procedures are performed in this specific sector. Emergencies were also considered as high risk because they were exposed first hand to COVID-19 patients, consulting for respiratory symptoms. Other wards were less exposed to these patients (except COVID-19 cohorting wards and COVID testing centre), and were consequently regarded as moderately exposed.

Follow-up visits:

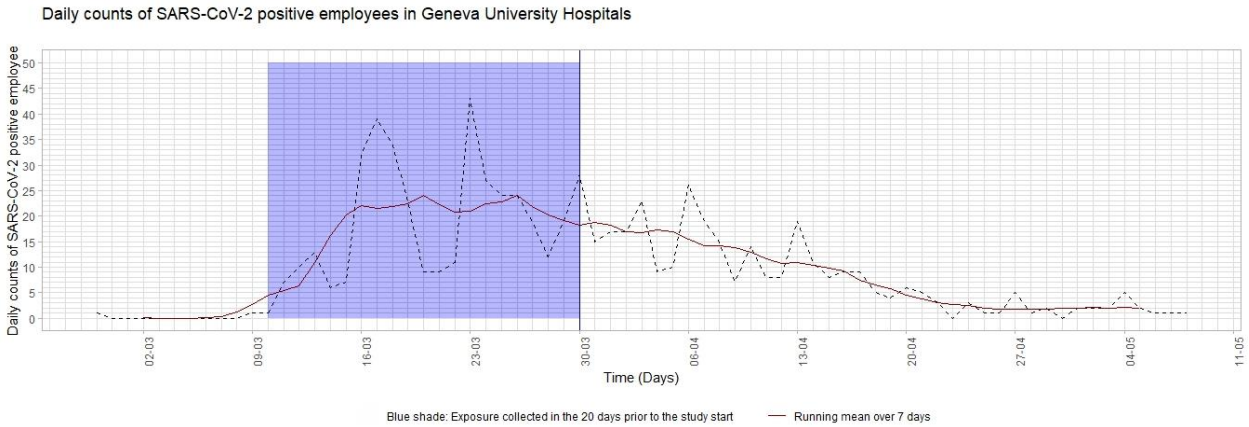
Once recruited at baseline, we directly recontacted each of the 3'436 participants by mail to communicate the planning of follow-up visits, and asked them to attend the next blood drawing 3 weeks after the previous visit. Participants were then free to choose the location and timing of future visits within the time-window for the 1st (20.04-08.05), and 2nd follow-up visit (11.05-12.06). Furthermore, we employed 2 assistants for calling each participant not present at the planned follow-up visits, to remind them to attend. When measuring the delay between the initial recruitment visit and 1st follow-up visit, as well as between the 1st visit and 2nd visit, we observed a median delay of 21 days (IQR : 1.25) and 21 days (IQR: 1), respectively. The distribution of the mentioned delays is illustrated in the graph below.



eAppendix 2. Discussion considering the equivalence of seropositive and seroconverted employees in the context of this study

Classical serological studies require a change in detectable antibodies level to establish seroconversion (e.g. CONCISE statement on the reporting of seroepidemiologic studies for influenza). However, this recommendation concerns conventional virus circulating in a population immunologically exposed, such as Influenza, to distinguish true seroconversion events persons exposed in the past. In the context of an emerging and completely novel virus, the detailed knowledge of the local epidemiology and the absence of vaccine at that time, we can consider that all seropositive patients recently seroconverted during the early phase of the first pandemic wave. However, due to the lack of similar experience with such emerging virus, and to our knowledge, no recommendations currently addressed this situation.

Furthermore, Geneva hosts the national centre of emerging viral diseases and started to test patients for SARS-CoV-2 in early January 2020, as one of the first national reference hotspots in Europe. Thus, we are very confident to establish true seroconversion events in our study population. The figure below illustrates our local epidemiology compared to the period concerned by data collection at baseline (20 days prior recruitment). In complement to our argument above, this figure illustrates that we were likely to capture almost all relevant exposures for seroconversions of employees positive at baseline.



eAppendix 3. Screening surveillance among hospital employees, and origin from PCRs Data

As part of the institutional HCW screening policy, testing by PCR was offered to each symptomatic employee from the February 24 onwards. This testing included symptomatic screening, and contact tracing in case of large-scale nosocomial clusters.

PCR tests performed during these routine screenings were collected from surveillance data and their results were matched to study participants. To preserve confidentiality, reports of all PCR-positive and -negative results were coded by the Occupational Health Unit, and matched to the database by an institutional identifier. If participants were PCR-positive, we only kept the first positive PCR. Otherwise, we kept the last negative PCR-result.

eAppendix 4. Non-pharmaceutical measures and infection control measures implemented at the national, cantonal, and institutional level

Among non-pharmaceutical interventions, borders to France were partially closed from March 13 to June 15, gatherings of more than 5 people were banned from March 23 to May 31, and a lockdown was implemented from March 17 to May 10. In the hospital, multiple medical, geriatric and rehabilitation wards were dedicated to cohorting of COVID-19 patients from February to July. Non-COVID-19 hospitalized patients were transferred, and surgical interventions were either postponed or performed by private hospitals from March 23 to May 04. Visitors were restricted from March 13 to March 18 and forbidden from March 18 to May 15. Universal masking for HCWs was implemented from March 17 to June 29. Detailed measures implemented in community and in the hospital, as well as detailed list of COVID-19 dedicated units are also described in Suppl. Fig 1 & 2.

eAppendix 5. Definition and categorization of exposure

Definitions

Aerosol generating procedures

As defined above, aerosol generating procedures were categorized by trained research assistant and clinicians experienced in Infection Control Programs. Among the different procedures collected, the ones defined at risk were cardio-pulmonary resuscitation, tracheal intubation, tracheotomy, bronchoscopy, sputum, airway aspiration, nasopharyngeal swab, continuous positive airway pressure, respiratory physiotherapy, tracheostomy care, extubation, bronchoalveolar lavage, trans-oesophageal echography, gastroscopy, endoscopy, nasogastric probe, and ventilation/respirator disconnection.

Cohorting units

The cohorting units were based on institutional data (cf Suppl Fig 1).

Units with confirmed nosocomial outbreaks

Four geriatric units, as well as two rehabilitation sectors experienced COVID outbreaks. The outbreaks in geriatric wards occurred from March 12 to April 18, and in the two rehabilitation sectors, from March 15 to April 19, and from March 15 to March 25 respectively.

Categorization of places and professions

Both professional categories and workplaces were available as pre-specified choice (tick boxes) or as a free text on the paper CRF.

Professional categories were pre-defined as physicians (1), nurses (2), Allied Health professionals (3, eg: physiotherapists, ergo therapists, paramedics, …), mid-wives (4), hospital cleaners (5), nurse assistants and socio-educational assistants (6), administrative profession (7), and other professions (mainly technician in radiology or laboratory, other technicians, restauration, …) (8). For ease of analysis and due to low numbers, we merged mid-wives and hospital cleaners with other professions.

Original categories of workplaces were pre-defined and included: intensive care and anaesthesiology (1), COVID testing centre centre (2), medical wards dedicated to COVID patients (3), geriatric and rehabilitation wards dedicated to COVID patients (4), emergencies and ambulatory emergencies (5), non-COVID dedicated medical wards (6), non-COVID dedicated geriatric and rehabilitation wards (7), surgical wards (8), haemato-oncology and radio-oncology wards (9), paediatric, gynaecological, and obstetric wards (10), administrative sector (11), and finally undetermined wards (which mainly included persons with no available information, or with mixed assignments, working in the whole institution such as pool nurses, or physiotherapists) (12). In order to simplify the categories for the later multivariate models, multiple workplaces were merged to provide areas with high exposure (1, 5, and 2), and intermediate exposure (6, 8, 9, and 10).

If the workplace changed during follow-up visits, the new places replaced the old ones. If employees worked in multiple areas, the sector with the highest exposure was prioritized (in the following order: COVID testing centre, intensive care units and anaesthesiology, dedicated medical wards, dedicated geriatric and rehabilitation wards, emergency wards, medical wards, geriatric and rehabilitation wards, surgical wards, paediatric, gynaecologic and obstetric wards, oncologic wards, administrative sector, others).

Working sectors of all participants with an administrative background but a non-administrative sector (ex: receptionist in emergencies) were considered as “administrative” for ease of analysis. Similarly, professions of participants that worked in an administrative sector (ex: nurse working in occupational health) were considered as “administrative”. This applied not only per follow-up visit, but also per participant.

eAppendix 6. Serological testing of anti-SARS-CoV-2 IgG antibodies

Serological investigations were conducted applying a two-tiered diagnostic strategy using a first ELISA-based screening followed by a second assay in case of equivocal or positive results. Each sera was first processed using an S1 protein-based IgG enzyme-linked immunosorbent assay (ELISA) (EUROIMMUN AG, Lübeck, Germany, # EI 2606-9601 G). Based on a large in-house validation study13, the cut-off levels for positivity proposed by the manufacturer were adapted to increase test accuracy; all OD ratios below 0.5 were classified as negative, those ranging 0.5 to 1.5 were categorized as equivocal and those above 1.5 were considered positive. Following the two-tiered strategy, all samples with undetermined and positive results were then re-tested with an ElectroChemiLuminescence ImmunoAssay (ECLIA) Elecsys Anti-SARS-CoV-2 Ig (Roche Diagnostics, Germany) according to the manufacturer. This second serological test uses a recombinant nucleocapsid as an antigen and delivers binary results according to a threshold (Cut-Off Index) of 1.0. First step equivocal and positive results were considered positive only if confirmed by the ECLIA test; all others were considered as negative.

eAppendix 7. Selection of candidate variables in the multivariate model

Persistence of variables and amplitude of coefficients (path of coefficients) was evaluated for a range of LASSO complexity parameters (from 0.01 to 100). Finally, the complexity parameter minimizing the mean cross-validated error was used in a LASSO regression to extract coefficients of interest. A backward stepwise multi-variate logistic regression model, and the “best model” following Bayesian Model Averaging methods were both evaluated on all variables to evaluate the robustness of the effect estimates for each exposure of interest. These 3 methods showed concordance to retain the following variables: professional category, working sector, COVID-19 positive contact in the community or hospital, report of nosocomial COVID-19 related outbreak, and the use of masks. Following these procedures, the number of household members and number of children per household were excluded from the mixed effect multivariate model. Other variables not retained initially were forced into the models based on clinical reasoning and the current literature. To note, a binomial distribution of a binary event (being SARS-CoV-2 positive at least once during the study period) was used in the 3 methods described above.

eAppendix 8. Handling of missing events and exposure

Missing events:

Loss to follow-up: As the main outcome was the cumulative proportion of seroconverted HUG employees, missing serological results were inferred when possible from other follow-up visits. A negative result was inferred when ulterior results were negative, and positive results were inferred when at least one previous result was positive. Therefore, a positive employee remained positive for the whole study period. When inferring such serological results, new observations were created, but did not include associated metadata (such as fixed or time-varying exposures). In other words, missing visits could sometimes be filled by inferred serological results, but not exposures. Therefore, these missing visits were not included in univariate and multivariate analysis evaluating the effect of exposures.

We only had 8% of missing information about outcomes (99.4%, 91.1%, and 92% of participants with available outcomes respectively during baseline, the 1st and the 2nd visit, and among a total of 3'421 employees screened; cf. Fig. 1). We inferred prior missing outcomes by negative results (only) when future outcomes were negative. This inference concerned 156 missing outcomes for 156 participants (cf. eTable 4), and was based on the assumption of absence of sero-reversion. This phenomenon was rarely observed among our cohort, with 3 of 271 (1%) seropositive employees. However, we also inferred ulterior missing outcomes by positive results (only) when previous outcomes were positive (based on the same assumption). This inference concerned 36 outcomes for 26 participants. In total, 192 positive and negative outcomes were inferred for 182 participants.

To evaluate further the potential impact of these inferences on the main study findings, we performed a sensitivity analysis using the same regression model on all available outcomes, without any inferred results (data not shown). We observed no variation in effect estimates, confidence intervals and p-values. The very small rate of sero-reversion observed as well as this sensitivity analysis confirm the validity of our original inference and effect estimates.

Missing exposure:

We only had 2-7% of missing information about exposures. We performed a complete-case analysis, deleting all observations with missing exposure. Nonetheless, in this case, the long format of our database (one row per patient per visit) allowed keeping information about time-varying exposures from other visits of concerned participants.

eAppendix 9. Amplitude and direction of a potential selection bias

Comparison of PCR-based prevalence between participants and non-participants

Among all employees who underwent PCR-based testing, study participants had a positivity rate of 14·7%. According to occupational health medicine, the proportion of positive PCR results among tested non-participants was 19·9% (535/2'690). This suggests fewer incentives for PCR-positive employees to participate in the study, which might have slightly underestimated the true seroconversion rate. Another explanation would be that isolated employees with a SARS-CoV-2-positive PCR result might have under-represented this population and the observed seroconversion rates.

Comparison of basic demographic characteristics between study participants and the overall population of hospital employees.

During the study period, from the 30.03 to 12.06 and among all hospital employees, respectively 1'034 (8.34%) were nursing assistants, 3'823 (30.83%) were nurses, 2'267 (18.28%) were physicians, 1'762 (14.21%) were administrative workers, 517 (4.17%) were allied health professionals, and 24% were other categories. As comparison, our study population had a median age of 43 years, with 77.6% being female. Our study population included 17% of nursing assistants, 1'286 (38%) nurses, 6% of Allied Health Professionals, 17% of physicians, 11% of administrative staff, and 12% in other categories (radiologist, hospital cleaners, catering staff, logistical, technical staff). Overall, we might have slightly over-represented proportion of women, nursing assistants, and nurses in our study population compared to the overall population of hospital employees.

Comparison of our finding with the available evidence.

Of note, our seroprevalence estimates are close to other published studies that used random sampling. As a reminder, the overall percentage of seroconverted employees in our study was 7·9% (271/3421) [95%CI, 7.0-8.8], and the percentage of seroconverted healthcare workers (physicians, nurses, nursing assistant) was 9.1% (201/2'216) at the last follow-up visit. Similar seroprevalence studies observed 9.3% (54/578, [95%CI: 7.1-12.0]) among randomly selected Spanish healthcare workers from March 28th to April 9th.16 Another study including 202 employees in an Italian hospital observed a seroprevalence of 7.4% (3.8–11.0%, using IgG).17

eTable 1. Schedule of assessments of the three visits

Time (weeks)	***0***	***+3***	***+6***
Visit	*Screening*	*1st visit*	*2nd visit*
Oral and written Information	+		
Written consent	+		
Check inclusion-/exclusion criteria	+		
Baseline questionnaire	+		
Follow up questionnaire		+	+
Serum sample	+	+	+

eTable 2. Proportion of seroconverted employees from each serological test used in the two tiered strategy

	EuroImmun ELISA test (1st step in the two tiered strategy)	**Roche ECLIA test (2nd step in the two tiered strategy)**
1st visit	7.93% [95%CI 6.99-8.87]	4.42% [95%CI 3.73 - 5.11]
2nd visit	11.9% [95%CI 10.8 - 13.1]	7.33% [95%CI 6.44 - 8.22]
3d visit	13.7% [95%CI 12.4 -14.9]	8.54% [95%CI 7.57 - 9.51]

eTable 3. Proportion of seroconverted employees among follow-up visits after inference of serological results*

Baseline result	Results at the 1st visit	Results at the 2nd visit	Retained status	Count (%)
NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	2902 (84.83 %)
POSITIVE	POSITIVE	POSITIVE	POSITIVE	151 (4.41 %)
NEGATIVE	Not available	Not available	NEGATIVE	134 (3.92 %)
NEGATIVE	NEGATIVE	Not available	NEGATIVE	114 (3.33 %)
NEGATIVE	POSITIVE	POSITIVE	POSITIVE	87 (2.54 %)
NEGATIVE	NEGATIVE	POSITIVE	POSITIVE	19 (0.56 %)
NEGATIVE	Not available	POSITIVE	POSITIVE	12 (0.35 %)
Not available	POSITIVE	POSITIVE	POSITIVE	2 (0.06 %)
				3421 (100%)

* Footnote to eTable 3

This table represent the number of seroconverted employees after inference of serological results in case of missing visits, and modification of serological results (e.g. when an employee is positive at baseline and negative at the first visit) as described in the main study and eAppendix 4.

eTable 4. Proportion of seroconverted employees among follow-up visits before inference of serological results*

Baseline result	Results at the 1st visit	Results at the 2nd visit	Retained status	count
NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	2749 (80.36 %)
NEGATIVE	Not available	NEGATIVE	NEGATIVE	139 (4.06 %)
NEGATIVE	Not available	Not available	NEGATIVE	134 (3.92 %)
POSITIVE	POSITIVE	POSITIVE	POSITIVE	126 (3.68 %)
NEGATIVE	NEGATIVE	Not available	NEGATIVE	111 (3.24 %)
NEGATIVE	POSITIVE	POSITIVE	POSITIVE	82 (2.40 %)
NEGATIVE	NEGATIVE	POSITIVE	POSITIVE	19 (0.56 %)
Not available	NEGATIVE	NEGATIVE	NEGATIVE	14 (0.41 %)
NEGATIVE	Not available	POSITIVE	POSITIVE	12 (0.35 %)
POSITIVE	Not available	Not available	POSITIVE	10 (0.29 %)
POSITIVE	Not available	POSITIVE	POSITIVE	7 (0.20 %)
POSITIVE	POSITIVE	Not available	POSITIVE	5 (0.15 %)
NEGATIVE	POSITIVE	Not available	POSITIVE	4 (0.12 %)
Not available	NEGATIVE	Not available	NEGATIVE	3 (0.09 %)
POSITIVE	POSITIVE	NEGATIVE	POSITIVE	2 (0.06 %)
Not available	POSITIVE	POSITIVE	POSITIVE	2 (0.06 %)
NEGATIVE	POSITIVE	NEGATIVE	POSITIVE	1 (0.03 %)
POSITIVE	NEGATIVE	POSITIVE	POSITIVE	1 (0.03 %)
				3421 (100%)

* Footnote to eTable 4

Seroprevalence results based on EuroImmun and confirmatory ROCHE test, before inference of missing values.

eTable 5A: Proportion of seroconverted employees for SARS-CoV-2 among all participating employees in hospital subsectors over the three visits

Exposure Category[a]	Hospital sub-sector	Visit	Proportion of seroconverted employees (%) [b]	Confidence Interval
Low exposure	Administrative services	baseline	3.48 (13/374)	[1.62-5.33]
		1st visit	4.1 (15/366)	[2.07-6.13]
		2nd visit	4.95 (18/363)	[2.73-7.19]
Intermediate exposure	Geriatric & Rehabilitation wards	baseline	7.73 (47/608)	[5.61-9.85]
		1st visit	12.03 (64/532)	[9.27-14.79]
		2nd visit	12.36 (64/518)	[9.52-15.19]
	Surgical wards[c]	baseline	0.59 (1/170)	[0-1.74]
		1st visit	2.96 (5/169)	[0.4-5.51]
		2nd visit	1.78 (3/169)	[0-3.77]
	Oncohaematology & Radiooncology wards[c]	baseline	1.57 (3/191)	[0-3.33]
		1st visit	3.76 (7/186)	[1.03-6.5]
		2nd visit	3.26 (6/184)	[0.69-5.83]
	Internal Medicine wards[c]	baseline	3.43 (7/204)	[0.93-5.93]
		1st visit	4.74 (11/232)	[2.01-7.48]
		2nd visit	4.21 (9/214)	[1.52-6.89]
	Paediatrics, Gynecology and Obstetrics[c]	baseline	3.6 (16/444)	[1.87-5.34]
		1st visit	4.23 (18/426)	[2.32-6.14]
		2nd visit	4.61 (20/434)	[2.64-6.58]
High exposure	COVID G&R wards	baseline	8.56 (16/187)	[4.55-12.57]
		1st visit	23.93 (39/163)	[17.38-30.48]
		2nd visit	32.35 (44/136)	[24.49-40.22]
	COVID Internal Medicine wards	baseline	3.2 (14/437)	[1.55-4.85]
		1st visit	5.06 (16/316)	[2.65-7.48]
		2nd visit	8.72 (32/367)	[5.83-11.61]
	ICU & Anesthesiology[d]	baseline	2.79 (7/251)	[0.75-4.83]
		1st visit	4.43 (9/203)	[1.6-7.27]
		2nd visit	3.9 (8/205)	[1.25-6.55]
	COVID testing centre	baseline	1.56 (1/64)	[0-4.6]
		1st visit	0 (0/55)	[0-0]
		2nd visit	2.13 (1/47)	[0-6.25]
	Emergencies[d]	baseline	4.8 (11/229)	[2.03-7.57]
		1st visit	8.91 (18/202)	[4.98-12.84]
		2nd visit	9.45 (19/201)	[5.41-13.5]
Undetermined exposure	Undetermined wards	baseline	5.84 (15/257)	[2.97-8.7]
		1st visit	7.81 (21/269)	[4.6-11.01]
		2nd visit	8.86 (28/316)	[5.73-11.99]

[a] *Exposure pre-determined arbitrarily based on volume of COVID-19 patients, and used in bivariate analysis.*

[b] *Despite the cumulative nature of this outcome, certain observations might decrease among sectors and follow-up visits because of missing results, or seroconverted employees changing ward affiliations between visits.*

[c, d] *Categories were merged in the regression model*

eTable 5B: Proportion of seroconverted employees for SARS-CoV-2 among all participating employees of different professional activities over the three visits

Professional activities	Visit	Proportion of seroconverted employees (%)	Confidence Interval
Administrative services	baseline	3.48 (13/374)	[1.62-5.33]
	1st visit	4.1 (15/366)	[2.07-6.13]
	2nd visit	4.95 (18/363)	[2.73-7.19]
Nursing assistant	baseline	5.76 (33/573)	[3.85-7.67]
	1st visit	10.51 (52/495)	[7.8-13.21]
	2nd visit	11.74 (60/511)	[8.95-14.53]
Other professional activities	baseline	2.63 (5/190)	[0.36-4.91]
	1st visit	4.12 (7/170)	[1.13-7.1]
	2nd visit	3.47 (6/173)	[0.74-6.19]
Hospital cleaners [a]	baseline	6.85 (10/146)	[2.75-10.95]
	1st visit	8.21 (11/134)	[3.56-12.86]
	2nd visit	7.91 (11/139)	[3.43-12.4]
Nurses	baseline	3.97 (51/1285)	[2.9-5.04]
	1st visit	6.96 (82/1179)	[5.5-8.41]
	2nd visit	8.01 (96/1198)	[6.48-9.55]
Physician	baseline	4.68 (27/577)	[2.96-6.4]
	1st visit	8.02 (41/511)	[5.67-10.38]
	2nd visit	8.88 (45/507)	[6.4-11.35]
Allied Health Professionals	baseline	5.73 (11/192)	[2.44-9.02]
	1st visit	7.61 (14/184)	[3.78-11.44]
	2nd visit	8.11 (15/185)	[4.17-12.04]
Mid-wives [a]	baseline	1.27 (1/79)	[0-3.73]
	1st visit	1.3 (1/77)	[0-3.83]
	2nd visit	1.3 (1/77)	[0-3.83]

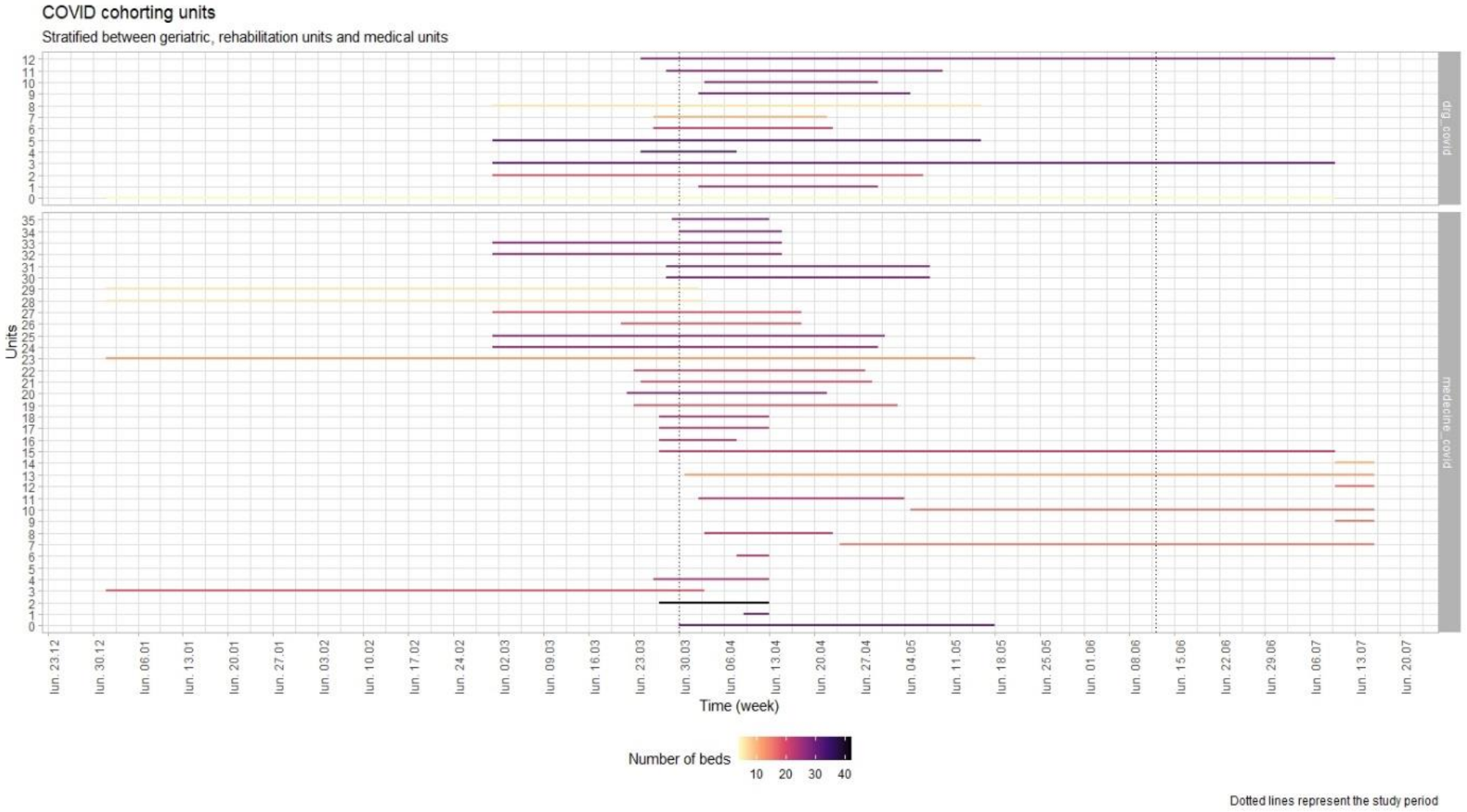
[a] *Categories were merged in the regression model*

eTable 6. Univariate Poisson regression: Risk factors for SARS-CoV-2 seroconversion among hospital employees, using random effects on time and participant

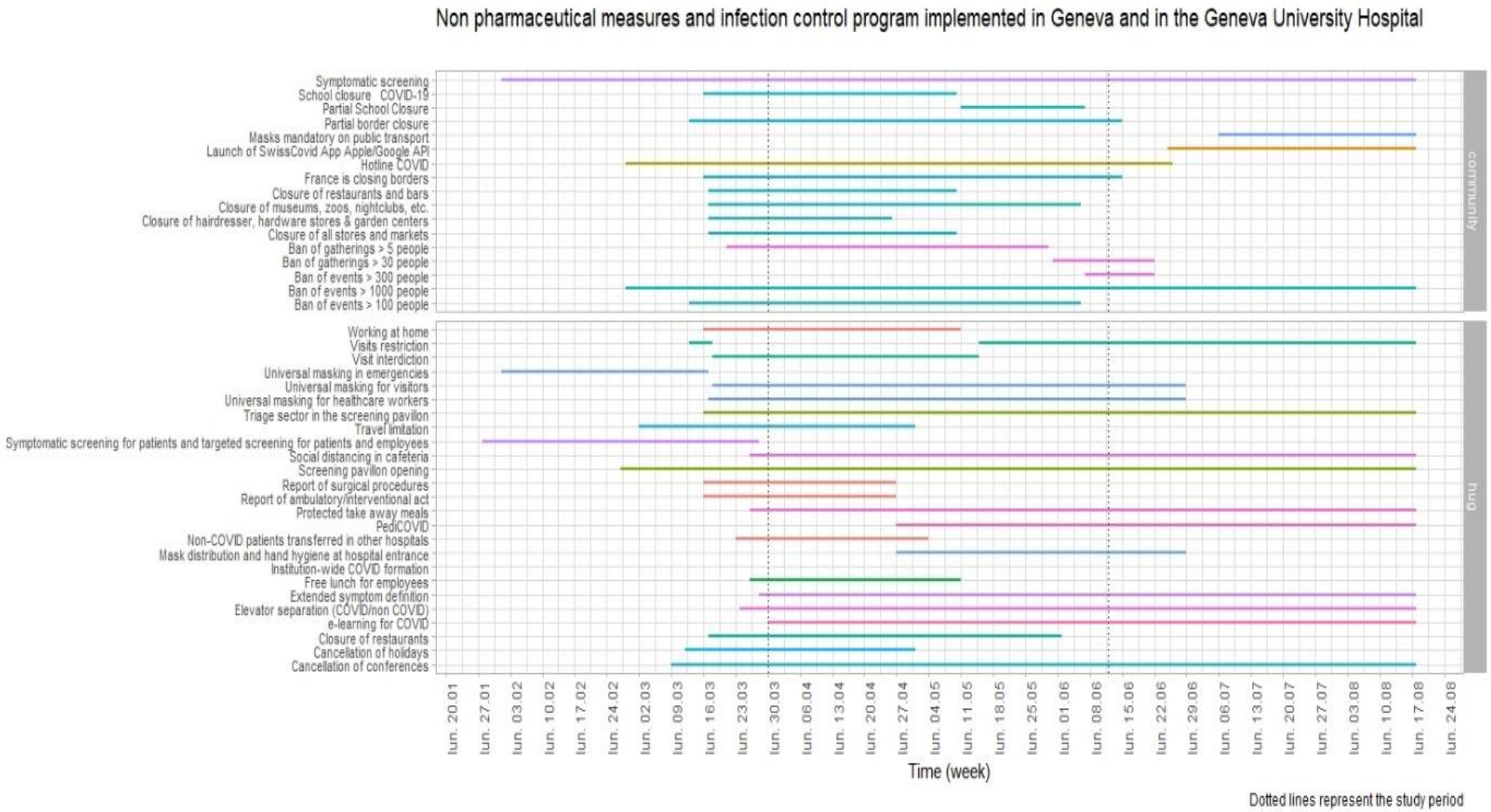
		Prevalence Ratio	95% Confidence Interval	P value
DEMOGRAPHICS				
Age (1-y increments)		0.99	[0.98-1]	0.01
	Female	*reference*		
	Male	1.01	[0.84-1.22]	0.924
Follow-up visit	Baseline	*reference*		
	1st visit	2.26	[1.25-4.07]	0.007
	2nd visit	1.8	[1.1-2.96]	0.02
Sub-cohort based on enrollment week	First week of enrollment (30.03-04.04)	*reference*		
	Second week of enrollment (06.04-10.04)	0.99	[0.7-1.4]	0.971
	Third week of enrollment (13.04-17.04)	0.94	[0.67-1.33]	0.731
COMMUNITY EXPOSURE				
Transportation	Private (include biking)	*reference*		
	Public and private	1.13	[0.88-1.44]	0.339
	Public	1.47	[1.18-1.83]	0.001
Number of household members		1.02	[0.96-1.07]	0.541
Number of children (0-10 years)		0.9	[0.81-1.01]	0.08
Number of children (11-20 years)		1.05	[0.95-1.15]	0.358
Number of children (21-30 years)		1.08	[0.95-1.24]	0.242
Contact in community with a person positive for SARS-CoV-2 (<1m) in the prior 20 days		2.99	[2.42-3.7]	<0.001
Contact with another SARS-CoV-2 positive employee (<1m) in the prior 20 days		1.58	[1.33-1.87]	<0,001
OCCUPATIONAL EXPOSURE				
Professional category				
Physician		*reference*		
Nurse		0.87	[0.7-1.09]	0.241
Nursing assistant		1.28	[1-1.64]	0.046
Allied Health professionals		0.99	[0.69-1.42]	0.945
Office workers		0.57	[0.41-0.81]	0.001
Other professional activities		0.62	[0.44-0.85]	0.004
Working place				
Hospital sector	Haemato-oncology, radio-oncology, paediatrics, gynaecology, obstetrics, surgery, internal medicine (non COVID) ward	*reference*		
	Geriatric and rehabilitation (non-COVID) ward	2.98	[2.34-3.8]	<0,001
	Geriatric and rehabilitation (COVID) ward	6.44	[4.89-8.49]	<0,001

	Internal medicine (COVID) ward	1.58	[1.15-2.17]	0.005
	COVID testing centre, emergencies, anesthesiology, intensive care units	1.51	[1.13-2.04]	0.006
	Administrative sector	1.17	[0.83-1.66]	0.362
	Undetermined wards	2.1	[1.54-2.86]	<0,001
Report of a nosocomial COVID-outbreak in the concerned ward		4.73	[3.9-5.74]	<0,001
IPC measures				
Know the IPC recommandations		1.72	[0.82-3.59]	0.15
Self-perceived adherence to IPC recommendations (0-10) concerning SARS-CoV-2		1.14	[1.06-1.23]	0.001
Mask use	Respirator (FFP2/N95)	0.71	[0.56-0.89]	0.003
	Surgical mask	1.74	[1.46-2.06]	<0,001
Other occupational exposures				
Aerosol generating procedures in the prior 20 days		1.15	[0.96-1.38]	0.129
Close contact with a patient positive for SARS-CoV-2 (<1m) in the prior 20 days		1.62	[1.38-1.91]	<0,001

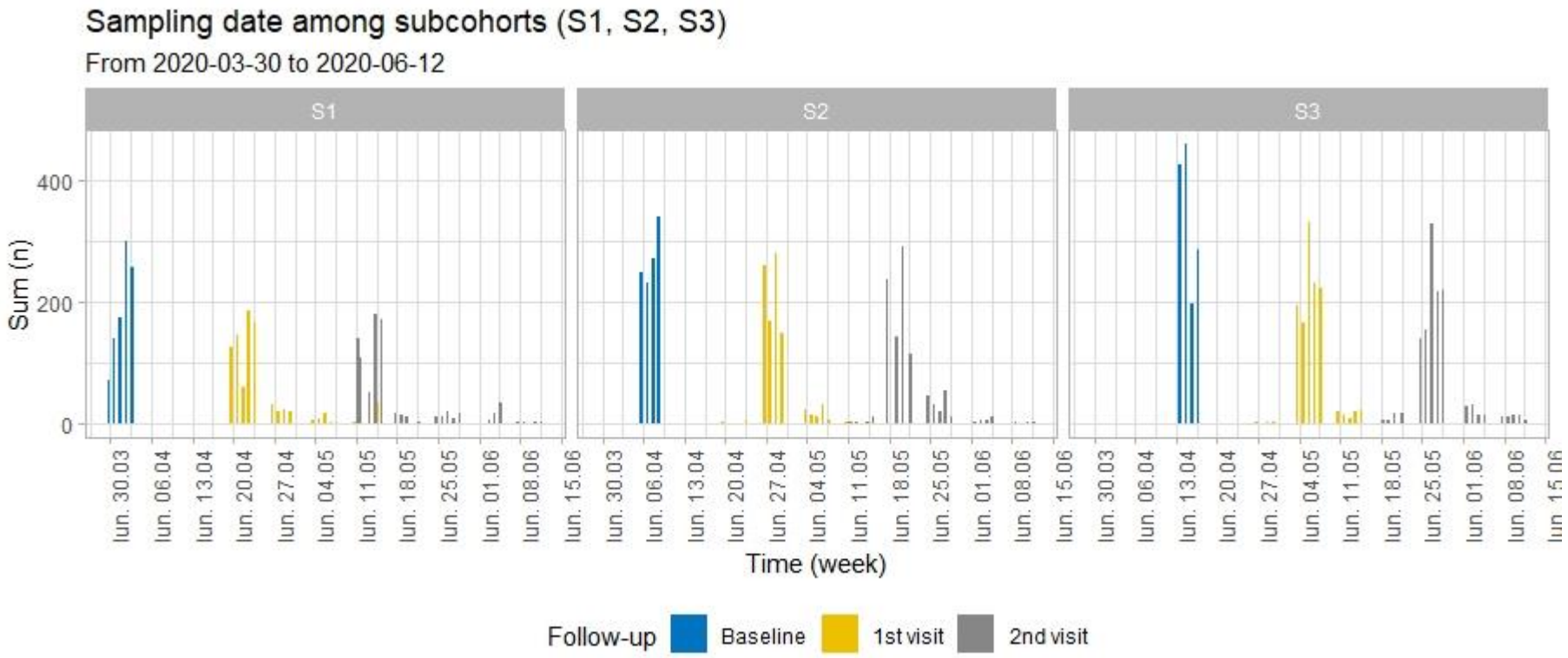
eFigure 1. Creation of COVID geriatric and rehabilitation, as well as COVID medicine wards across weeks, with number of beds in each dedicated ward, and delimitation of the study period



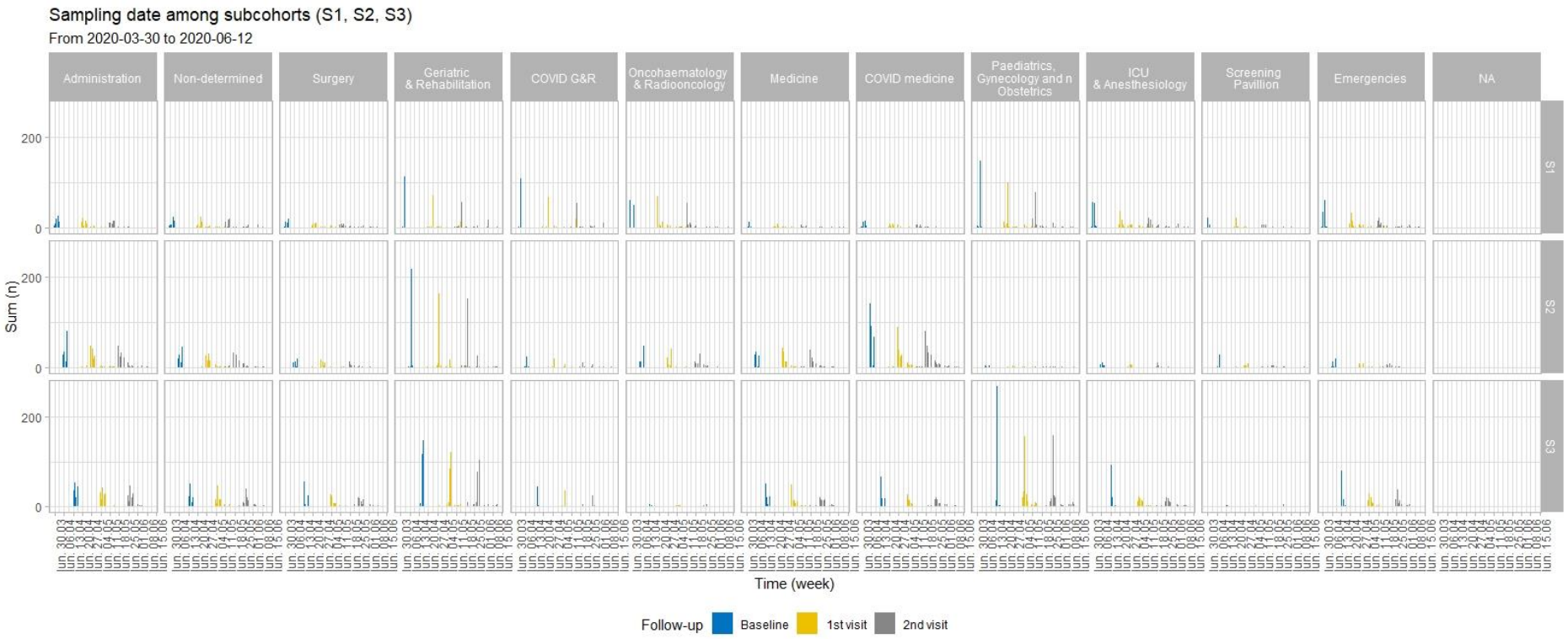
eFigure 2. Non pharmaceutical measures and infection control program implemented in Geneva and in the Geneva University Hospital across weeks, with delimitation of the study period



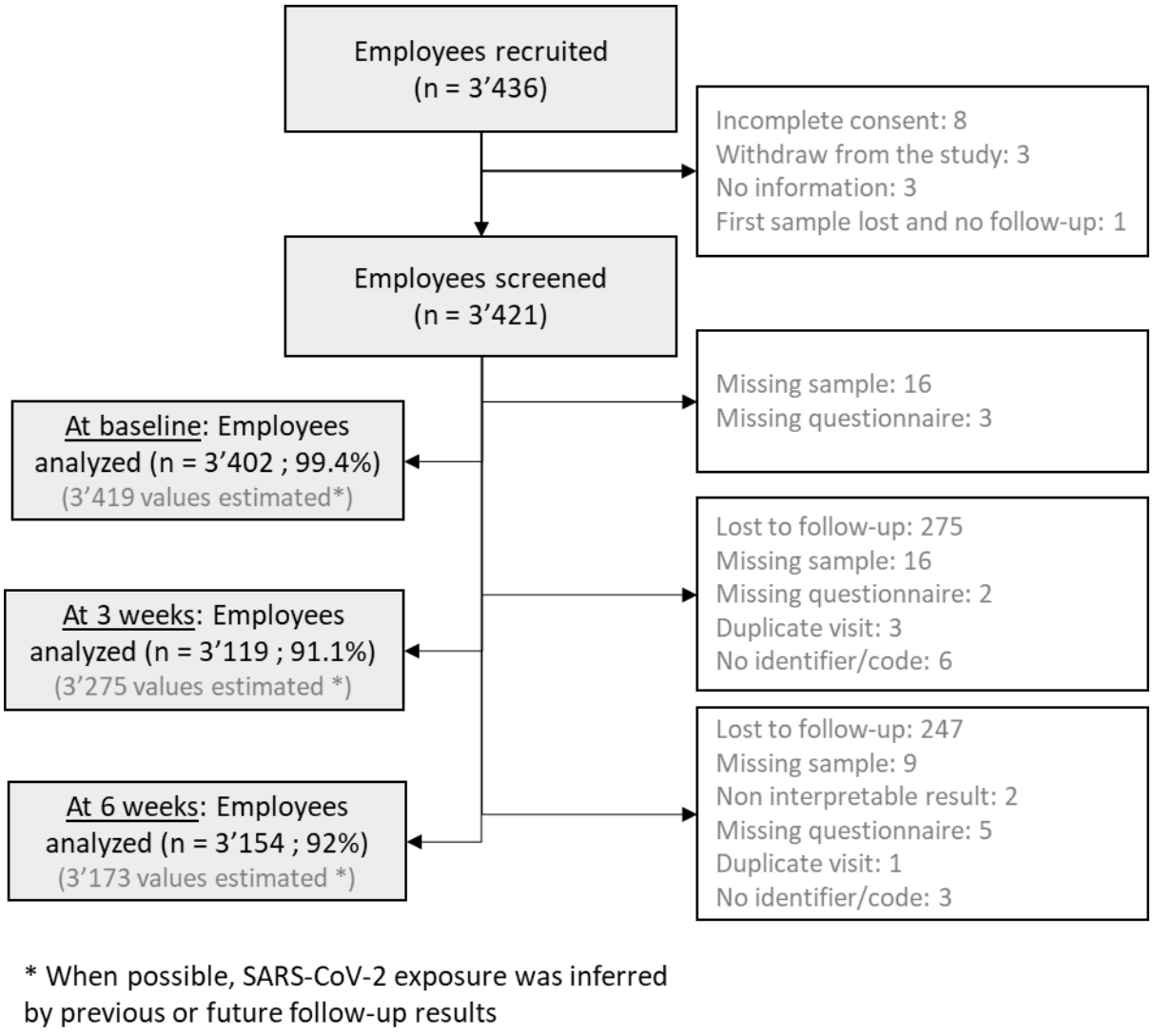
eFigure 3. Sampling dates among cohorts of participants enrolled the 1st week, the 2nd week, and the 3d week of the recruitment period



eFigure 4. Sampling dates among hospital sectors, and among cohorts of participants enrolled the 1st week, the 2nd week, and the 3d week of the recruitment period

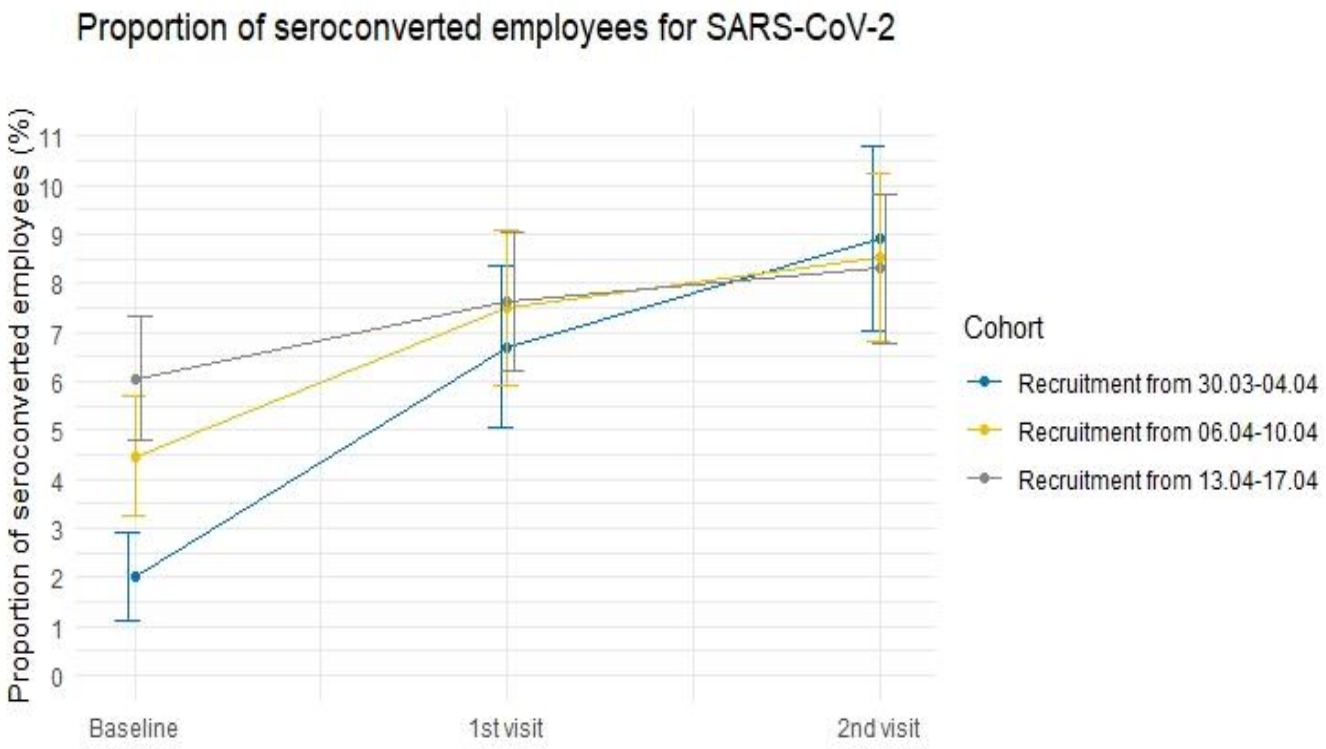


eFigure 5. Flowchart of study participants



* When possible, SARS-CoV-2 exposure was inferred by previous or future follow-up results

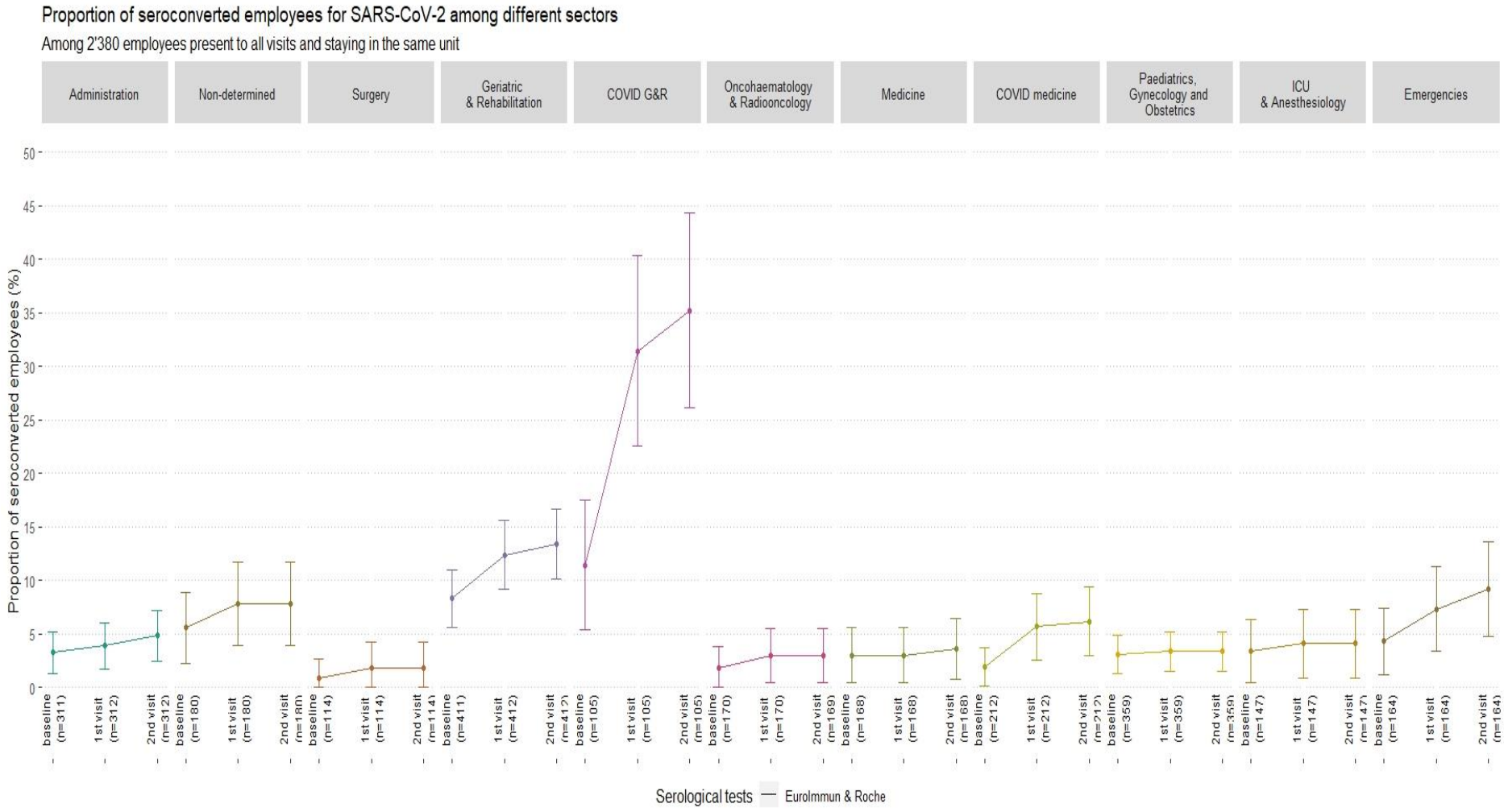
eFigure 6. Proportion of seroconverted employees for SARS-CoV-2 among enrolment weeks*



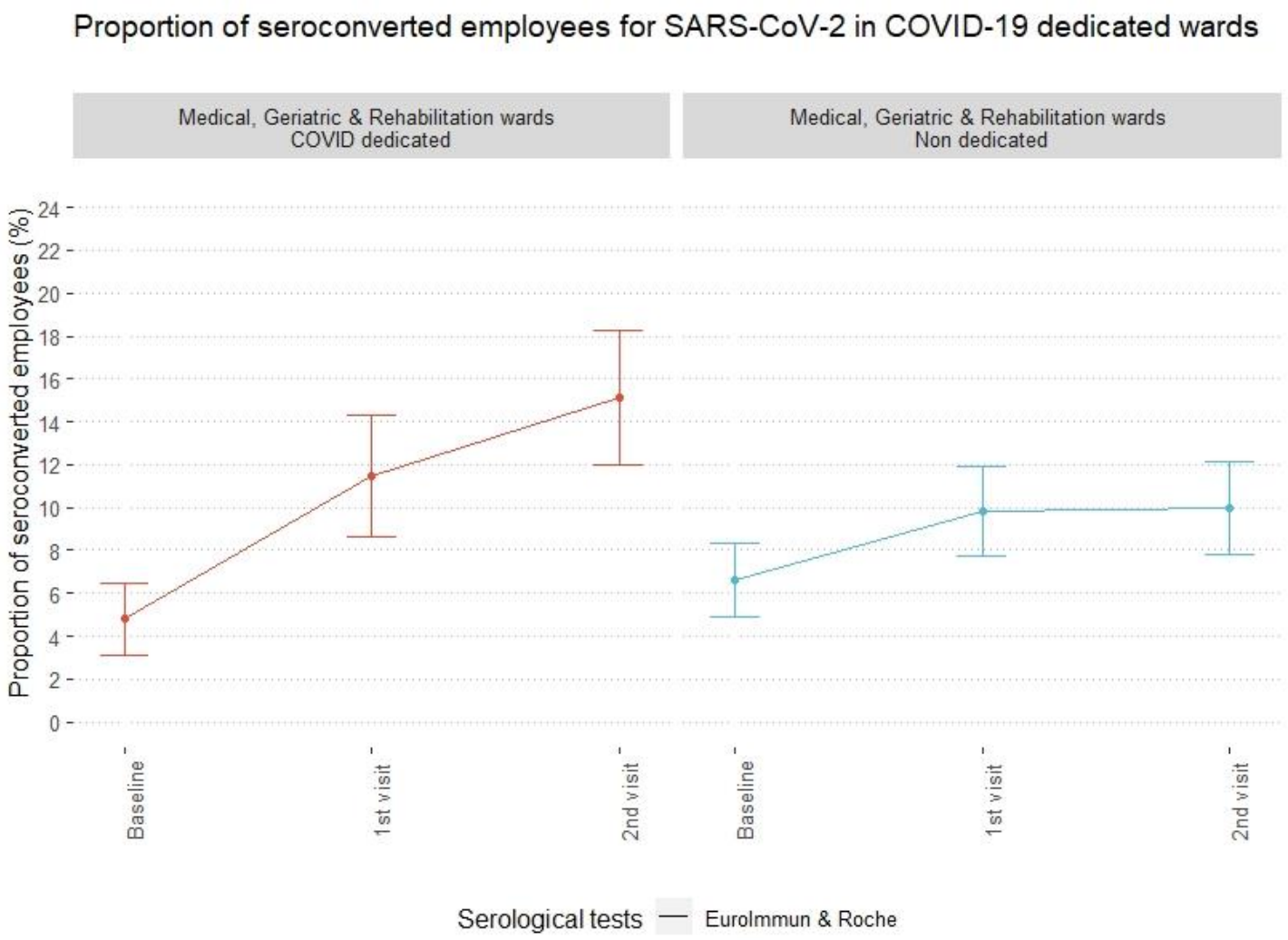
* Footnote to eFigure 6

Units sampled from the 30.03-04.04 (Hemato-oncology, anaesthesiology, intensive care units, COVID testing centre, emergencies, Medicine, surgery, paediatric, gynecology, obstetric, Geriatrics and rehabilitation). Units sampled from the 06.04-10.04 (Radio-oncology, COVID testing centre, Medicine, surgery, Geriatrics and rehabilitation, Administration). Units sampled from the 13.04-17.04 (anaesthesiology, intensive care units, COVID testing centre, emergencies, paediatric, gynecology, obstetric, Geriatrics and rehabilitation, medicine, surgery)

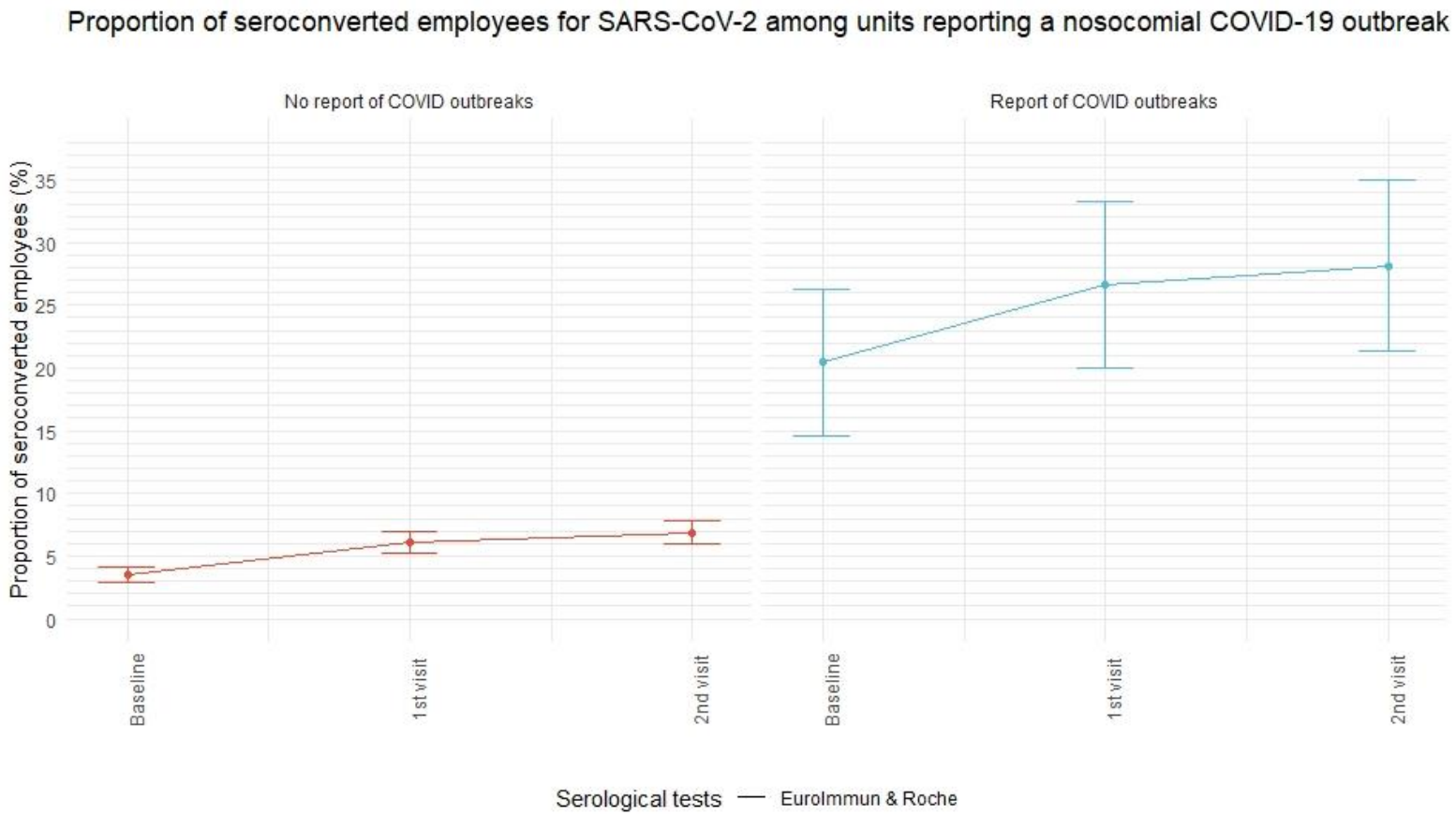
eFigure 7. Proportion of seroconverted employees for SARS-CoV-2 among different sectors when only including employees who stayed in the same units and present in all visit



eFigure 8. Proportion of seroconverted employees for SARS-CoV-2 COVID-19 dedicated wards



eFigure 9. Proportion of seroconverted employees for SARS-CoV-2 among units reporting a nosocomial COVID-19 outbreak



eAppendix. STROBE Statement—Checklist of items that should be included in reports of cohort studies

	Item No	Recommendation	Page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	P. 1 l.(1-2)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	P. 2 l.(31-57)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P.4 l.(89-104)
Objectives	3	State specific objectives, including any prespecified hypotheses	P.4 l.(103-104)
Methods			
Study design	4	Present key elements of study design early in the paper	P.4-5 l.(108-122)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P.5 l.(123-129)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	P.5 l.(130-137)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P.4-5 l.(116-118) P.5-6 l.(138-166)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P.5-6 l.(138-166)
Bias	9	Describe any efforts to address potential sources of bias	P.6-7 l.(174-181)
Study size	10	Explain how the study size was arrived at	P.7 l.(188-189)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P.7 l.(178)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	P.6-7 l.(170-190)
		(*b*) Describe any methods used to examine subgroups and interactions	P.7 l.(187-188)
		(*c*) Explain how missing data were addressed	P.6-7 l.(174-177)
		(*d*) If applicable, explain how loss to follow-up was addressed	P.6-7 l.(174-177)

		(*e*) Describe any sensitivity analyses	P.8 l.(219-221)
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P.7 l.(199-203)
		(b) Give reasons for non-participation at each stage	P.7 l.(199-203)
		(c) Consider use of a flow diagram	P.7 l.(199-203) ; Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P.7 l.(199-203) ; Table 1
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	P.7-8 l.(205-219) P.9 l.(243-254)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P.7-8 l.(205-219) P.9 l.(243-254)
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P.8 l.(219-221)
Discussion			
Key results	18	Summarise key results with reference to study objectives	P.9-10 l.(257-266)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P.11 l.(313-329)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P.10-12 l.(270-335)
Generalisability	21	Discuss the generalisability (external validity) of the study results	P.10-12 l.(270-335)
Other information			
Funding	22	Give the source of funding and the role of the funders	P.7 l.(194-

	for the present study and, if applicable, for the original study on which the present article is based	197)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

eAppendix. Case Report Forms

Feuille de consentement :
Séroprévalence du nouveau Coronavirus 2019 parmi les soignants aux Hôpitaux Universitaires de Genève

Information : Pour mesurer l'immunité individuelle et de groupe aux HUG en particulier et à Genève en général, vous êtes invité à participer de manière complétement volontaire à une évaluation longitudinale de la présence d'anticorps contre le Coronavirus 2019 (SARS-CoV-2 ou CoVID-19), entre le 30.03 et le 30.06.2020. Parallèlement à cette évaluation en milieu hospitalier sous la responsabilité du Pr Didier Pittet (Service PCI, Direction médicale), une évaluation au sein de la communauté Genevoise se déroulera sous la responsabilité du Pr Idris Guessous (Département de médecine de premier recours). La proportion de séroprévalence pourra être comparée entre: la population genevoise en général, les collaborateurs en contact avec des patients dans les secteurs à faible versus haute exposition, et les collaborateurs sans contact avec les patients. Ceci afin de déterminer d'éventuelles différences d'exposition entre la vie en communauté et le travail en milieu hospitalier.

Pour cela, votre taux d'anticorps spécifique sera mesuré par une prise de sang (aucune autre analyse ne sera faite avec votre sang), et certaines données sur votre exposition au Coronavirus 2019 seront collectées. Suite à cette première évaluation, vous serez ré-invité dans 3 semaines puis dans 6 semaines. Les risques sont ceux liés aux prélèvements sanguins (douleur, trace de ponction), qui seront effectués par des infirmières. Les résultats de vos tests sérologiques seront disponibles auprès du service de la médecine du personnel seulement au terme de l'évaluation de la séroprévalence en milieu communautaire et hospitalier. Vous êtes libre de participer à ce projet et pouvez vous en retirer à tout moment sans conséquence. Un suivi à 3 mois vous sera proposé dans le cas ou votre statut immunitaire indiquerait une exposition à SARS-CoV-2.

Je soussigné _____,
Consens à l'analyse du questionnaire que j'aurais rempli pour évaluer le risque d'acquisition du virus SARS-CoV-2 (nouveau Coronavirus 2019), au prélèvement de mon sang pour y mesurer ma protection immunitaire (taux d'ImmunoGlobulines) contre ce virus, et à une publication ultérieure des résultats de ces données de manière anonyme.

Je souhaite au terme de cette évaluation connaitre le statut de mon immunité spécifique au virus SARS-CoV-2 au moyen du numéro de téléphone suivant : _____. Si non j'aurai la possibilité d'obtenir cette information ultérieurement, directement auprès du service de la médecine du personnel.

Date, signature :

Si vous souhaitez plus d'informations, n'hésitez pas à contacter les responsables de l'enquête:

Romain Martischang
Médecin – Assistant de recherche
Tél. : 022 372 98 97

Anne Iten
Médecin adjointe - SPCI
Tél. : 022 372 98 38

Laure Vieux
Médecin du travail
Tél. : 022 372 54 46

N° virologie

N° sérothèque

Numéro d'identification :	

VISITE BASELINE Date : ____/____/_____

Nom :										
Prénom :										
Date de naissance :	j	j		m	m		y	y	y	y
Numéro de matricule :										
Initiales HUG :										

1. **Sexe :** ☐1 Homme ☐0 Femme

2. **Age :** _____

3. **Profession du soignant :**

   ☐0 Infirmier(e) ☐1 Médecin

   ☐2 Aide-soignant ☐3 Autre : _____

4. **Unité dans laquelle vous travaillez actuellement**

   ☐0 SINPI ☐1 Soins intensifs ☐2 JUL 41/42

   ☐3 ARV-0 ☐4 Tente E ☐5 3C-Unité : _____

   ☐6 Administratif ☐7 Autre unité

   Autre unité:

   _____

5. **Contact avec un patient/soignant SARS-CoV-2 <u>confirmé</u> positif ces 20 derniers jours ?**

   Avez-vous été proche (<1 mètre) d'un patient positif SARS-CoV-2?

   Oui ☐1 Non ☐0

   Avez-vous été proche (<1 mètre) d'un soignant positif SARS-CoV-2?

   Oui ☐1 Non ☐0

6. **Autres expositions professionnelles ces 20 derniers jours ?**

   Avez-vous été impliqué dans des procédures de soins générant des aérosols ?

   (Réanimation cardio-pulmonaire, intubation trachéale, trachéotomie, bronchoscopie, aspiration des voies aériennes, expectorations, autres…)

   ☐1 Oui ☐0 Non Si autre, veuillez préciser_____

Numéro d'identification :	

7. Autres expositions communautaires ces 20 derniers jours ?

Combien de personnes vivent dans le même domicile que vous ? *(compte aussi toute personne ayant passé au moins une nuit dans votre domicile ces 20 derniers jours)*

Si vous avez des enfants à domicile, veuillez indiquer leur nombre dans chaque catégorie d'âge *(indiquez combien d'enfants sont âgés entre 0-10 ans, 11-20 ans, 21-30 ans)*

0-10 ans | | | 11-20 ans | | | 21-30 ans | | |

Prenez-vous les transports publiques ou privés pour venir jusqu'au travail ?

☐$_0$ Publique ☐$_1$ Privé (inclus marche, vélo…) ☐$_2$ Les deux

Avez-vous été en contact proche (<1 mètre) avec une personne positive SARS-CoV-2 en dehors de votre travail ?

☐$_1$ Oui ☐$_0$ Non

8. Prévention et contrôle de l'infection

Avez-vous pris connaissance des recommandations VIGIGERME® concernant le SARS-CoV-2 aux HUG ?

☐$_1$ Oui ☐$_0$ Non

Comment estimeriez-vous votre adhérence aux recommandations VIGIGERME® concernant SARS-CoV-2 ? *Veuillez cocher ☒ la case qui convient le mieux*

Jamais — Parfois — Toujours

0	1	2	3	4	5	6	7	8	9	10

Quel type de masque avez-vous utilisé lors des contacts avec un patient positif SARS-CoV-2 ? *Seulement si vous avez eu des contacts avec un patient positif, en dehors des procédures de soin générant des aérosols (c.f. question 6), si vous n'avez pas eu de contact, laissez le champ vide.*

☐$_1$ Respirateur (FFP2/N95) ☐$_0$ Masque chirurgical

9. Symptôme(s) présent(s) depuis ces 20 derniers jours

Cocher (☒) les cases correspondantes (plusieurs réponses possibles)

☐$_0$ Toux	☐$_1$ Fièvre ou sensation de fièvre	☐$_2$ Maux de tête
☐$_3$ Maux de gorge	☐$_4$ Douleur musculaire	☐$_5$ Rhume

Numéro d'identification :	

FORMULAIRE DE SUIVI

Numéro de la visite : _____ Date de la visite : ____/____/_____

Visite n°1 (visite initiale avec inclusion dans l'enquête), visite n°2, visite n°3, …

DEPUIS LA DERNIERE VISITE (durant ces 3 dernières semaines) :

1. **Travaillez-vous toujours dans la même unité ?**
   ☐0 Oui ☐1 Non → ***Si non,*** *précisez le nom de l'unité actuelle:* _____

2. **Contact avec un patient/soignant SARS-CoV-2 confirmé positif**
   Avez-vous été proche (<1 mètre) d'un patient positif SARS-CoV-2?
   Oui ☐1 Non ☐0
   Avez-vous été proche (<1 mètre) d'un soignant positif SARS-CoV-2?
   Oui ☐1 Non ☐0

3. **Autres expositions professionnelles**
   Avez-vous été impliqué dans des procédures de soins générant des aérosols ?
   (Réanimation cardio-pulmonaire, intubation trachéale, trachéotomie, bronchoscopie, aspiration des voies aériennes, expectorations, autres…)
   ☐1 Oui ☐0 Non Si autre, veuillez préciser_____

4. **Expositions communautaires**
   Avez-vous été proche (<1 mètre) d'une personne positive SARS-CoV-2 en dehors de votre travail ?
   ☐1 Oui ☐0 Non

5. **Symptôme(s) présent(s)** *(toujours durant ces 3 dernières semaines)*
   Cocher (☒) les cases correspondantes (plusieurs réponses possibles)

☐0 Toux	☐1 Fièvre ou sensation de fièvre	☐2 Maux de tête
☐3 Maux de gorge	☐4 Douleurs musculaires	☐5 Rhume

N° virologie	**N° sérothèque**