# Measuring dynamic social contacts in a rehabilitation hospital: effect of wards, patient and staff characteristics.

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# Supplementary material

**Supplementary Table S1: mean (sd) of the number of daily distinct CPIs and the daily cumulative CPI duration in minutes among patients**

| | | CPIs frequency mean (sd) | CPIs duration (minutes) mean (sd) |
|---|---|---|---|
| ward | W1 | 12.74 ( 4.56 ) | 32.58 ( 18.68 ) |
| | W2 | 10.93 ( 5.04 ) | 30.27 ( 20.12 ) |
| | W3 | 12.9 ( 7.34 ) | 20.9 ( 19.02 ) |
| | W4 | 11.14 ( 5.9 ) | 32.26 ( 19.95 ) |
| | W5 | 8.58 ( 5.13 ) | 47.16 ( 33.67 ) |
| Reason for hospitalization | Neurology | 11.85 ( 4.94 ) | 31.36 ( 19.08 ) |
| | Orthopedic | 10.73 ( 5.46 ) | 26.11 ( 19.29 ) |
| | Nutrition | 12.89 ( 7.59 ) | 22.56 ( 21.71 ) |
| | Post-operative | 14.71 ( 9.16 ) | 34.53 ( 16.39 ) |
| | Geriatric | 8.62 ( 5.16 ) | 47.19 ( 33.92 ) |

**Supplementary Table S2: mean (sd) of the number of daily distinct CPIs and the daily cumulative CPI duration in minutes among hospital staff**

| | | CPIs frequency mean (sd) | CPIs duration (minutes) mean (sd) |
|---|---|---|---|
| Hospital staff | Hospital porter | 24.58 ( 13.4 ) | 8.96 ( 4.41 ) |
| | Physician | 21.32 ( 7.02 ) | 13.2 ( 6.76 ) |
| | HCW | 14.29 ( 5.29 ) | 14.94 ( 8.28 ) |
| | Reeducation staff | 15.03 ( 6.04 ) | 11.6 ( 9.62 ) |
| | AHS | 12 ( 6.22 ) | 15.71 ( 9.52 ) |
| | Logistic | 7.23 ( 3.86 ) | 8.07 ( 9.43 ) |
| ward | W1 | 15.34 (6.07 ) | 14.7 ( 9.64 ) |
| | W2 | 16.81 ( 6.81 ) | 17.21 ( 6.13 ) |
| | W3 | 14.6 ( 3.31 ) | 15.1 ( 7.54 ) |
| | W4 | 14.91 ( 4.47 ) | 12.84 ( 3.72 ) |
| | W5 | 10.98 ( 3.97 ) | 18.8 ( 11.85 ) |
| | Transversal staff | 12.73 ( 7.18 ) | 11.67 ( 15.57 ) |

**Supplementary Text S1: Calculation of individual-specific and category-specific daily distinct CPIs and cumulative duration of CPIs**

The ***number of daily distinct CPIs*** (DDC) for individual *i* on day *t* was calculated according to the following formula:

(1) $DDC(i,t) = \sum_{j \in H(t)} I(i,j,t)$

Where *t* is a day of presence of individual *i* in the hospital, and *H(t)* is the ensemble of all individuals present in the hospital on day *t* and *I(i,j,t)* is defined by:

$$I(i,j,t) = \begin{cases} 0, & \text{if no CPI recorded between } i \text{ and } j \text{ on day t} \\ 1, & \text{if at least one recorded CPI between } i \text{ and } j \text{ on day t} \end{cases}$$

The ***daily cumulative duration of CPIs*** of two individuals *i* and *j* on day *t* is noted *DCD(i,j,t)* and is calculated as the sum of all CPI durations shared by *i* and *j* on day *t*.

The ***number of category-specific daily distinct CPIs*** (cDDC) depicted in Fig. 2A was calculated according to the following formula:

$$(2)\ \forall\, c, cDDC(c) = \frac{1}{N_c}\sum_{i\in c}\frac{1}{D_i}\sum_{t=1}^{D_i} DDC(i,t)$$

Where *c* is the category (eg. HCW, patients, etc.), $N_c$ is the number of individuals *i* belonging to category *c*, $D_i$ the number of days of presence of individual *i* in the hospital and *DDC(i,t)*, the number of daily distinct CPIs on day *t* for individual *i*.

The ***category-specific cumulative duration of CPIs*** (cDCD) depicted in Fig. 2B was calculated as follows:

$$(3)\ \forall\, c, cDCD(c) = \frac{1}{N_c}\sum_{i\in c}\frac{1}{D_i}\sum_{t=1}^{D_i}\sum_{j\,\epsilon\, H(t)} DCD(i,j,t)$$

Where *c* is the category (eg. HCW, patients, etc.), $N_c$ is the number of individuals *i* belonging to category *c*, $D_i$ the number of days of presence of individual *i* in the hospital, H(t) is the ensemble of all individuals present in the hospital on day *t*, and *DCD(i,j,t)* the cumulative duration of CPIs on day *t* between individuals *i* and *j*.

**Supplementary Text S2: Calculation of contact frequency and contact duration matrices**

For each ward *w*, the contact matrix depicts the CPI frequency for all individuals of the ward according to their category. The values depicted in Fig. 3 are calculated as follows:

$$(4)\ \forall\, (w, c_1, c_2), wDDC(c_1, c_2) = \frac{1}{N_{w,c1}}\sum_{i=1}^{N_{w,c1}}\frac{1}{D_i}\sum_{t=1}^{D_i}\sum_{j=1}^{N_{c2}} I(i,j,t)$$

Where $c_1$ and $c_2$ are two categories, *w* is the ward number, $N_{w,c1}$ is the number of individuals *s* belonging to category $c_1$ (staff categories or patients), an $D_i$ is the number of days of presence of individual *i* in the hospital, $N_{c2}$ is the number of individuals from category $c_2$ in the hospital, and *I(i,j,t)* equals 1 if at least one contact was recorded between *i* and *j* on day *t* and 0 otherwise.

For each ward *w*, the contact duration for a given category and a given ward depicted in Fig. 4 was calculated:

$$(5)\ \forall\, (w, c_1, c_2), wDCD(c_1, c_2) = \frac{1}{N_{w,c1}}\sum_{i=1}^{N_{w,c1}}\frac{1}{D_i}\sum_{t=1}^{D_i}\sum_{j=1}^{N_{c2}} DCD(i,j,t)$$

Where $c_1$ and $c_2$ are two categories, *w* is the ward number, $N_{w,c1}$ is the number of individuals *s* belonging to category $c_1$ (staff categories or patients), an $D_i$ is the number of days of presence of

individual *i* in the hospital, $N_{c2}$ is the number of individuals from category $c_2$ in the hospital, and DCD*(i,j,t)* is the *daily cumulative duration of CPIs* of two individuals *i* and *j* on day *t*.

**Supplementary Text S3: Calculation of the threshold used for the GLMM**

(6) $M_w = \frac{1}{N}\sum_{p=1}^{N}\frac{1}{Nd_p}\sum_{k=1}^{Nd_p} C_k^p$

Where $N$ individuals included in the study. $Nd_p$ the number of days for which contacts were recorded for individual present (indicator or presence in the hospital), $C_k^p$ is the number of distinct CPI (or cumulative duration with other individual) recorded for individual *p* on day *k*.

**Supplementary Text S4: description of the generalized linear mixed-effects models (GLMM) equations**

The GLMM model of the high daily contact frequency and high daily cumulative duration among hospital staff was calculated:

(7) $Y_{among\ hospital\ staff} = (\beta_0 + \beta_{ward}) + \beta_1 Category + \beta_2 days\ of\ week$

Where $Y_{among\ hospital\ staff}$ represent the high daily contact frequency or the high daily cumulative duration. $\beta_{ward}$ represents the ward specific random intercepts, $\beta_1$ and $\beta_2$ the fixed effect of the category and days of week as follows.

The GLMM model of the high daily contact frequency and high daily cumulative duration among patient was calculated as:

(8) $Y_{among\ patient} = (\beta_0 + \beta_{ward}) + \beta_1 Reasons\ for\ hospitalization + \beta_2 Age + \beta_3 Gender + \beta_4 days\ of\ week$

Where $Y_{among\ patient}$ represent the high daily contact frequency or the high daily cumulative duration. $\beta_{ward}$ represents the ward specific random intercepts and $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ the fixed effect of the reasons for hospitalization, age, gender and days of week.

**Supplementary Table S3: sensitivity analysis of the generalized linear mixed-effects models with different thresholds (mean, mean + 1 standard deviation (SD), mean + 2 SD and mean + 3SD).** Factors associated with high daily distinct CPI frequency and high daily cumulative duration of CPIs among hospital staff or patients, resulting from a mixed model with ward-specific random intercepts to account for within-ward and between-ward variations.

| | ***Factor*** | ***level*** | ***OR*** | ***CI 95%*** | ***p-value*** |
|---|---|---|---|---|---|
| High daily distinct CPI frequency among hospital staff (mean threshold) | Category (ref :HCW) | AHS | 0.40 | ( 0.32 - 0.50 ) *** | 9,00E-39 |
| | | Hospital porter | 4.54 | ( 2.85 - 7.22 ) *** | |
| | | Logistic | 0.23 | ( 0.15 - 0.37 ) *** | |

| | | | | | |
|---|---|---|---|---|---|
| | | Physician | 1.32 | ( 0.66 - 2.64 ) | |
| | | Reeducation staff | 0.81 | ( 0.66 - 1.00 ) | |
| | days of week (ref: Wednesday) | Monday | 0.91 | ( 0.75 - 1.10 ) | 1.20E-08 |
| | | Tuesday | 0.94 | ( 0.77 - 1.15 ) | |
| | | Thursday | 1.15 | ( 0.94 - 1.41 ) | |
| | | Friday | 1.00 | ( 0.82 - 1.22 ) | |
| | | Saturday | 0.83 | ( 0.66 - 1.05 ) | |
| | | Sunday | 0.53 | ( 0.42 - 0.67 ) *** | |
| High daily cumulative duration of CPIs among hospital staff (mean threshold) | Category (ref :HCW) | AHS | 1.25 | ( 1.01 - 1.54 ) * | 1.40E-06 |
| | | Hospital porter | 0.60 | ( 0.33 - 1.10 ) | |
| | | Logistic | 0.59 | ( 0.33 - 1.05 ) | |
| | | Physician | 0.20 | ( 0.06 - 0.68 ) ** | |
| | | Reeducation staff | 0.52 | ( 0.38 - 0.71 ) *** | |
| | days of week (ref: Wednesday) | Monday | 1.03 | ( 0.82 - 1.30 ) | 0.4 |
| | | Tuesday | 1.09 | ( 0.85 - 1.38 ) | |
| | | Thursday | 1.18 | ( 0.92 - 1.50 ) | |
| | | Friday | 1.15 | ( 0.91 - 1.45 ) | |
| | | Saturday | 1.07 | ( 0.81 - 1.40 ) | |
| | | Sunday | 1.32 | ( 1.02 - 1.71 ) * | |
| High daily distinct CPI frequency among patients (mean threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 5.62 | ( 0.78 - 40.48 ) | 0.012 |
| | | Neurology | 0.86 | ( 0.68 - 1.08 ) | |
| | | Nutrition | 0.74 | ( 0.57 - 0.95 ) * | |
| | | Post-operative | 0.92 | ( 0.69 - 1.22 ) | |
| | Age (ref: [50,60) ) | [18,30) | 1.75 | ( 1.22 - 2.50 ) ** | 0.00043 |
| | | [30,40) | 1.25 | ( 1.04 - 1.51 ) * | |
| | | [40,50) | 0.91 | ( 0.77 - 1.07 ) | |
| | | [60,70) | 1.09 | ( 0.92 - 1.28 ) | |
| | | [70+] | 1.25 | ( 1.03 - 1.52 ) * | |
| | Gender (ref: Female) | Male | 0.76 | ( 0.68 - 0.85 ) *** | 1.80E-06 |
| | days of week (ref: | Monday | 1.07 | ( 0.89 - 1.27 ) | 9,00E-164 |
| | | Tuesday | 0.71 | ( 0.59 - 0.86 ) *** | |

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|---|---|---|---|---|---|
| | Wednesday) | Thursday | 1.08 | ( 0.90 - 1.29 ) | |
| | | Friday | 1.67 | ( 0.98 - 1.39 ) | |
| | | Saturday | 0.20 | ( 0.16 - 0.25 ) *** | |
| | | Sunday | 0.15 | ( 0.12 - 0.19 ) *** | |
| High daily cumulative duration of CPIs among patients (mean threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 1.20 | ( 0.59 - 2.46 ) | 0.0079 |
| | | Neurology | 1.42 | ( 1.13 - 1.78 ) ** | |
| | | Nutrition | 0.69 | ( 0.45 - 1.07 ) | |
| | | Post-operative | 1.06 | ( 0.81 - 1.38 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.70 | ( 0.48 - 1.01 ) | 2.60E-07 |
| | | [30,40) | 0.97 | ( 0.80 - 1.17 ) | |
| | | [40,50) | 1.13 | ( 0.95 - 1.33 ) | |
| | | [60,70) | 1.00 | ( 0.84 - 1.20 ) | |
| | | [70+] | 0.58 | ( 0.47 - 0.71 ) *** | |
| | Gender (ref: Female) | Male | 1.07 | ( 0.96 - 1.20 ) | 0.2 |
| | days of week (ref: Wednesday) | Monday | 1.13 | ( 0.93 - 1.37 ) | 4.20E-33 |
| | | Tuesday | 1.16 | ( 0.95 - 1.41 ) | |
| | | Thursday | 1.15 | ( 0.94 - 1.40 ) | |
| | | Friday | 1.20 | ( 0.98 – 1.45 ) | |
| | | Saturday | 1.98 | ( 1.63 - 2.41 ) *** | |
| | | Sunday | 2.59 | ( 2.14 - 3.13 ) *** | |
| High daily distinct CPI frequency among hospital staff (mean plus one SD threshold) | Category (ref :HCW) | AHS | 0.63 | ( 0.46 - 0.88 ) ** | 1.10E-32 |
| | | Hospital porter | 10.81 | ( 7.15 - 16.36 ) *** | |
| | | Logistic | 0.51 | ( 0.25 - 1.03 ) | |
| | | Physician | 2.99 | ( 1.47 - 6.09 ) ** | |
| | | Reeducation staff | 1.24 | ( 0.92 - 1.68 ) | |
| | days of week (ref: Wednesday) | Monday | 0.86 | ( 0.66 - 1.13 ) | 2.30E-17 |
| | | Tuesday | 1.00 | ( 0.75 - 1.32 ) | |
| | | Thursday | 1.38 | ( 1.06 - 1.82 ) * | |
| | | Friday | 1.35 | ( 1.04 - 1.75 ) * | |
| | | Saturday | 0.65 | ( 0.45 - 0.93 ) * | |
| | | Sunday | 0.25 | ( 0.16 - 0.40 ) *** | |

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|---|---|---|---|---|---|
| High daily cumulative duration of CPIs among hospital staff (mean plus one SD threshold) | Category (ref :HCW) | AHS | 1.07 | ( 0.80 - 1.42) | 5.50E-05 |
| | | Hospital porter | 0.43 | ( 0.16 - 1.20 ) | |
| | | Logistic | 0.81 | ( 0.38 - 1.72 ) | |
| | | Physician | 0.00 | ( 0.00 - 1.3e+46 ) | |
| | | Reeducation staff | 0.37 | ( 0.22 - 0.63 ) *** | |
| | days of week (ref: Wednesday) | Monday | 1.06 | ( 0.77 - 1.46 ) | 0.00075 |
| | | Tuesday | 1.04 | ( 0.75 - 1.46 ) | |
| | | Thursday | 0.87 | ( 0.61 - 1.24 ) | |
| | | Friday | 1.14 | ( 0.83 - 1.57 ) | |
| | | Saturday | 1.03 | ( 0.71 - 1.5 ) | |
| | | Sunday | 1.88 | ( 1.35 - 2.61 ) *** | |
| High daily distinct CPI frequency among patients (mean plus one SD threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.65 | ( 0.22 - 1.95 ) | 0.0017 |
| | | Neurology | 0.87 | ( 0.61 - 1.25 ) | |
| | | Nutrition | 0.64 | ( 0.46 - 0.88 ) ** | |
| | | Post-operative | 1.77 | ( 1.15 - 2.73 ) ** | |
| | Age (ref: [50,60) ) | [18,30) | 2.27 | ( 1.41 - 3.66 ) *** | 6.30E-06 |
| | | [30,40) | 1.70 | ( 1.29 - 2.21 ) *** | |
| | | [40,50) | 1.08 | ( 0.83 - 1.39 ) | |
| | | [60,70) | 1.30 | ( 1.02 - 1.66 ) * | |
| | | [70+] | 0.80 | ( 0.58 - 1.09 ) | |
| | Gender (ref: Female) | Male | 0.86 | ( 0.73 - 1.02 ) . | 0.084 |
| | days of week (ref: Wednesday) | Monday | 0.82 | ( 0.62 - 1.08 ) | 1.10E-66 |
| | | Tuesday | 0.74 | ( 0.56 - 0.98 ) * | |
| | | Thursday | 1.47 | ( 1.14 - 1.90 ) ** | |
| | | Friday | 1.52 | ( 1.19 - 1.96 ) *** | |
| | | Saturday | 0.11 | ( 0.06 - 0.19 ) *** | |
| | | Sunday | 0.16 | ( 0.10 - 0.26 ) *** | |
| High daily cumulative duration of CPIs among patients (mean plus one SD threshold) | Reasons for hospitalization (ref: | Geriatric | 2.75 | ( 0.87 - 8.75 ) | 0.15 |
| | | Neurology | 1.31 | ( 0.96 - 1.80 ) | |
| | | Nutrition | 0.64 | ( 0.19 - 2.15 ) | |
| | | Post-operative | 0.91 | ( 0.62 - 1.33 ) | |

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|---|---|---|---|---|---|
| | Orthopaedic) | | | | |
| | Age (ref: [50,60) ) | [18,30) | 1.04 | ( 0.62 - 1.75 ) | 8.70E-10 |
| | | [30,40) | 1.27 | ( 0.97 - 1.66 ) . | |
| | | [40,50) | 1.18 | ( 0.93 - 1.51 ) | |
| | | [60,70) | 1.42 | ( 1.10 - 1.82 ) ** | |
| | | [70+] | 0.41 | ( 0.29 - 0.60 ) *** | |
| | Gender (ref: Female) | Male | 1.31 | ( 1.12 - 1.54 ) *** | 0.00083 |
| | days of week (ref: Wednesday) | Monday | 0.92 | ( 0.68 - 1.26 ) | 1.30E-33 |
| | | Tuesday | 1.17 | ( 0.87 - 1.58 ) | |
| | | Thursday | 1.09 | ( 0.81 - 1.49 ) | |
| | | Friday | 1.11 | ( 0.82 - 1.50 ) | |
| | | Saturday | 2.01 | ( 1.52 - 2.7 ) *** | |
| | | Sunday | 3.39 | ( 2.60 - 4.41 ) *** | |
| High daily distinct CPI frequency among hospital staff (mean plus two SD threshold) | Category (ref :HCW) | AHS | 0.59 | ( 0.23 - 1.23 ) | 3.80E-29 |
| | | Hospital porter | 20.70 | ( 11.76 - 36.44 ) *** | |
| | | Logistic | 0.55 | ( 0.13 - 2.38 ) | |
| | | Physician | 8.74 | ( 3.75 - 20.37 ) *** | |
| | | Reeducation staff | 1.21 | ( 0.66 - 2.21 ) | |
| | days of week (ref: Wednesday) | Monday | 1.46 | ( 0.84 - 2.54 ) | 1,00E-15 |
| | | Tuesday | 0.74 | ( 0.38 - 1.44 ) | |
| | | Thursday | 2.30 | ( 1.33 - 3.97 ) ** | |
| | | Friday | 3.21 | ( 1.92 - 5.35 ) *** | |
| | | Saturday | 0.30 | ( 0.08 - 1.00 ) | |
| | | Sunday | 0.09 | ( 0.01 - 0.65 ) * | |
| High daily cumulative duration of CPIs among hospital staff (mean plus two SD threshold) | Category (ref :HCW) | AHS | 0.95 | ( 0.62 - 1.45 ) | 2.80E-06 |
| | | Hospital porter | 0.18 | ( 0.02 - 1.33 ) | |
| | | Logistic | 1.02 | ( 0.43 - 2.44 ) | |
| | | Physician | 0.00 | ( 0.00 - Inf ) | |
| | | Reeducation staff | 0.09 | ( 0.02 - 0.35 ) *** | |

| | | | | | |
|---|---|---|---|---|---|
| | days of week (ref: Wednesday) | Monday | 0.83 | ( 0.51 - 1.35 ) | 0.00063 |
| | | Tuesday | 1.07 | ( 0.66 - 1.74 ) | |
| | | Thursday | 0.93 | ( 0.56 - 1.54 ) | |
| | | Friday | 1.12 | ( 0.71 - 1.79 ) | |
| | | Saturday | 1.33 | ( 0.80 - 2.21 ) | |
| | | Sunday | 2.24 | ( 1.44 - 3.49 ) *** | |
| High daily distinct CPI frequency among patients (mean plus two SD threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.65 | ( 0.29 - 1.47 ) | 0.047 |
| | | Neurology | 1.02 | ( 0.63 - 1.63 ) | |
| | | Nutrition | 1.24 | ( 0.72 - 2.13 ) | |
| | | Post-operative | 2.33 | ( 1.27 - 4.25 ) ** | |
| | Age (ref: [50,60) ) | [18,30) | 2.10 | ( 1.04 - 4.25 ) * | 0.074 |
| | | [30,40) | 1.37 | ( 0.88 - 2.14 ) | |
| | | [40,50) | 0.88 | ( 0.57 - 1.35 ) | |
| | | [60,70) | 1.00 | ( 0.65 - 1.54 ) | |
| | | [70+] | 0.68 | ( 0.39 - 1.19 ) | |
| | Gender (ref: Female) | Male | 0.86 | ( 0.64 - 1.15 ) | 0.31 |
| | days of week (ref: Wednesday) | Monday | 1.22 | ( 0.69 - 2.13 ) | 2,00E-39 |
| | | Tuesday | 1.09 | ( 0.61 - 1.94 ) | |
| | | Thursday | 3.28 | ( 2.02 - 5.31 ) *** | |
| | | Friday | 3.14 | ( 1.94 - 5.08 ) *** | |
| | | Saturday | 0.00 | ( 0.00 - Inf ) | |
| | | Sunday | 0.04 | ( 0.01 - 0.31 ) ** | |
| High daily cumulative duration of CPIs among patients (mean plus two SD threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 9.35 | ( 1.54 - 56.67 ) * | 0.065 |
| | | Neurology | 0.89 | ( 0.51 - 1.55 ) | |
| | | Nutrition | 0.25 | ( 0.04 - 1.57 ) | |
| | | Post-operative | 0.82 | ( 0.41 - 1.60 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.81 | ( 0.28 - 2.30 ) | 6.30E-08 |
| | | [30,40) | 2.12 | ( 1.44 - 3.12 ) *** | |
| | | [40,50) | 1.16 | ( 0.78 - 1.74 ) | |
| | | [60,70) | 1.57 | ( 1.07 - 2.29 ) * | |
| | | [70+] | 0.38 | ( 0.21 - 0.69 ) ** | |

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|---|---|---|---|---|---|
| | Gender (ref: Female) | Male | 1.47 | ( 1.14 - 1.88 ) ** | 0.0026 |
| | days of week (ref: Wednesday) | Monday | 1.09 | ( 0.65 - 1.85 ) | 3.70E-15 |
| | | Tuesday | 1.66 | ( 1.02 - 2.70 ) * | |
| | | Thursday | 1.10 | ( 0.65 - 1.88 ) | |
| | | Friday | 1.28 | ( 0.77 - 2.13 ) | |
| | | Saturday | 2.57 | ( 1.62 - 4.08 ) *** | |
| | | Sunday | 3.96 | ( 2.56 - 6.11 ) *** | |
| High daily distinct CPI frequency among hospital staff (mean plus three threshold) | Category (ref :HCW) | AHS | 0.48 | ( 0.15 - 1.58 ) | 6,00E-12 |
| | | Hospital porter | 21.14 | ( 9.41 - 47.49 ) *** | |
| | | Logistic | 1.55 | ( 0.33 - 7.19 ) | |
| | | Physician | 5.22 | ( 1.44 - 18.89 ) * | |
| | | Reeducation staff | 1.70 | ( 0.74 - 3.91 ) | |
| | days of week (ref: Wednesday) | Monday | 1.44 | ( 0.51 - 4.03 ) | 4.80E-14 |
| | | Tuesday | 1.39 | ( 0.47 - 4.08 ) | |
| | | Thursday | 3.48 | ( 1.35 - 8.95 ) ** | |
| | | Friday | 7.88 | ( 3.29 - 18.90 ) *** | |
| | | Saturday | 0.38 | ( 0.04 - 3.21 ) | |
| | | Sunday | 0.00 | ( 0.00 - Inf ) | |
| High daily cumulative duration of CPIs among hospital staff (mean plus three threshold) | Category (ref :HCW) | AHS | 1.06 | ( 0.55 - 2.03 ) | 0.002 |
| | | Hospital porter | 0.00 | ( 0.00 - Inf ) | |
| | | Logistic | 1.94 | ( 0.72 - 5.17 ) | |
| | | Physician | 0.00 | ( 0.00 - Inf ) | |
| | | Reeducation staff | 0.10 | ( 0.01 - 0.75 ) * | |
| | days of week (ref: Wednesday) | Monday | 1.96 | ( 0.88 - 4.37 ) | 0.00037 |
| | | Tuesday | 1.42 | ( 0.58 - 3.46 ) | |
| | | Thursday | 0.94 | ( 0.35 - 2.56 ) | |
| | | Friday | 2.27 | ( 1.02 - 5.03 ) * | |
| | | Saturday | 2.49 | ( 1.05 - 5.91 ) * | |
| | | Sunday | 4.48 | ( 2.06 - 9.70 ) *** | |
| High daily distinct CPI frequency among patients (mean plus three threshold) | Reasons for hospitali | Geriatric | 0.85 | ( 0.19 - 3.79 ) | 0.0031 |
| | | Neurology | 2.05 | ( 0.95 - 4.41 ) | |
| | | Nutrition | 1.35 | ( 0.60 - 3.04 ) | |

| | | | | | |
|---|---|---|---|---|---|
| | zation (ref: Orthopaedic) | Post-operative | 5.01 | ( 2.17 - 11.58 ) *** | |
| | Age (ref: [50,60) ) | [18,30) | 1.95 | ( 0.69 - 5.50 ) | 0.88 |
| | | [30,40) | 1.02 | ( 0.50 - 2.07 ) | |
| | | [40,50) | 1.00 | ( 0.56 - 1.79 ) | |
| | | [60,70) | 1.08 | ( 0.57 - 2.02 ) | |
| | | [70+] | 1.24 | ( 0.61 - 2.50 ) | |
| | Gender (ref: Female) | Male | 0.98 | ( 0.64 - 1.50 ) | 0.93 |
| | days of week (ref: Wednesday) | Monday | 1.26 | ( 0.43 - 3.65 ) | 2.50E-36 |
| | | Tuesday | 0.49 | ( 0.12 - 1.99 ) | |
| | | Thursday | 5.36 | ( 2.22 - 12.96 ) *** | |
| | | Friday | 10.52 | ( 4.51 - 24.54 ) *** | |
| | | Saturday | 0.00 | ( 0.00 - Inf ) | |
| | | Sunday | 0.00 | ( 0.00 - Inf ) | |
| High daily cumulative duration of CPIs among patients (mean plus three threshold) | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 7.12 | ( 0.48 - 106.35 ) | 0.014 |
| | | Neurology | 0.34 | ( 0.09 - 1.15) | |
| | | Nutrition | 0.00 | ( 0.00 - 5.53e+55 ) | |
| | | Post-operative | 0.62 | ( 0.13 – 2.96 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.85 | ( 0.11 - 6.43 ) | 2.40E-06 |
| | | [30,40) | 3.19 | ( 1.74 - 5.84 ) *** | |
| | | [40,50) | 0.72 | ( 0.31 - 1.63 ) | |
| | | [60,70) | 1.79 | ( 0.98 - 3.26 ) | |
| | | [70+] | 0.31 | ( 0.11 - 0.82 ) * | |
| | Gender (ref: Female) | Male | 1.50 | ( 0.99 - 2.28 ) | 0.058 |
| | days of week (ref: Wednesday) | Monday | 2.13 | ( 0.79 - 5.68 ) | 2,00E-06 |
| | | Tuesday | 1.99 | ( 0.73 - 5.39 ) | |
| | | Thursday | 1.78 | ( 0.65 - 4.91 ) | |
| | | Friday | 2.32 | ( 0.88 - 6.12 ) | |
| | | Saturday | 4.72 | ( 1.92 - 11.60 ) *** | |
| | | Sunday | 6.46 | ( 2.69 - 15.46 ) *** | |

***Note: Observed level of the Wald test for each parameter: * <0.05, ** <0.01, *** <0.001. OR: odds ratio.***

**Supplementary Table S4: Factors associated with high daily contact frequency and high daily cumulative duration with HCW, Physician, Reeducation staff or Hospital porter among patients, resulting from a mixed model with ward-specific random intercepts to account for within-ward and between-ward variations.**

| | *Factor* | *level* | *OR* | *CI 95%* | *p-value* |
|---|---|---|---|---|---|
| High daily distinct CPI frequency with HCW | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 3.03 | ( 0.77 - 11.87 ) | 1.50E-11 |
| | | Neurology | 2.37 | ( 1.64 - 3.44 ) *** | |
| | | Nutrition | 0.74 | ( 0.50 - 1.08 ) | |
| | | Post-operative | 4.18 | ( 2.75 - 6.36 ) *** | |
| | Age (ref: [50,60) ) | [18,30) | 0.96 | ( 0.54 - 1.71 ) | 4.20E-10 |
| | | [30,40) | 0.75 | ( 0.58 - 0.98 ) * | |
| | | [40,50) | 1.25 | ( 1.02 - 1.53 ) * | |
| | | [60,70) | 0.99 | ( 0.79 - 1.24 ) | |
| | | [70+] | 2.00 | ( 1.58 - 2.53 ) *** | |
| | Gender (ref: Female) | Male | 0.84 | ( 0.73 - 0.97 ) * | 0.019 |
| | days of week (ref: Wednesday) | Monday | 1.05 | ( 0.85 - 1.30 ) | 1.90E-77 |
| | | Tuesday | 0.50 | ( 0.40 - 0.64 ) *** | |
| | | Thursday | 0.62 | ( 0.49 - 0.78 ) *** | |
| | | Friday | 0.94 | ( 0.76 - 1.16 ) | |
| | | Saturday | 0.16 | ( 0.11 - 0.22 ) *** | |
| | | Sunday | 0.16 | ( 0.12 - 0.22 ) *** | |
| High daily cumulative duration of CPIs with HCW | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 14.42 | ( 3.33 - 62.48 ) *** | 2,00E-12 |
| | | Neurology | 3.42 | ( 1.83 - 6.40 ) *** | |
| | | Nutrition | 5.64 | ( 2.55 - 12.45 ) *** | |
| | | Post-operative | 6.46 | ( 3.43 - 12.16 ) *** | |

| | | | | | |
|---|---|---|---|---|---|
| | Age (ref: [50,60) ) | [18,30) | 0.08 | ( 0.01 - 0.60 ) * | 1.30E-22 |
| | | [30,40) | 0.02 | ( 0.002 - 0.11 ) *** | |
| | | [40,50) | 1.12 | ( 0.83 - 1.52 ) | |
| | | [60,70) | 0.53 | ( 0.36 - 0.78 ) ** | |
| | | [70+] | 0.53 | ( 0.34 - 0.80 ) ** | |
| | Gender (ref: Female) | Male | 0.78 | ( 0.62 - 0.97 ) * | 0.029 |
| | days of week (ref: Wednesday) | Monday | 1.27 | ( 0.89 - 1.84 ) | 0.029 |
| | | Tuesday | 1.19 | ( 0.82 - 1.74 ) | |
| | | Thursday | 0.96 | ( 0.64 - 1.42 ) | |
| | | Friday | 0.98 | ( 0.66 - 1.45 ) | |
| | | Saturday | 0.94 | ( 0.63 - 1.41 ) | |
| | | Sunday | 1.61 | ( 1.13 - 2.30 ) ** | |
| High daily distinct CPI frequency with physician | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 2.05 | ( 0.75 - 5.62 ) | 0.045 |
| | | Neurology | 1.18 | ( 0.89 - 1.56 ) | |
| | | Nutrition | 0.63 | ( 0.43 - 0.91 ) * | |
| | | Post-operative | 1.12 | ( 0.80 - 1.55 ) | |
| | Age (ref: [50,60) ) | [18,30) | 1.26 | ( 0.81 - 1.97 ) | 0.00068 |
| | | [30,40) | 0.97 | ( 0.72 - 1.30 ) | |
| | | [40,50) | 1.14 | ( 0.88 - 1.48 ) | |
| | | [60,70) | 1.27 | ( 0.97 - 1.65 ) | |
| | | [70+] | 1.82 | ( 1.39 - 2.39 ) *** | |
| | Gender (ref: Female) | Male | 0.73 | ( 0.62 - 0.86 ) *** | 0.00012 |
| | days of week (ref: Wednesday) | Monday | 1.91 | ( 1.47 - 2.47 ) *** | 2.90E-71 |
| | | Tuesday | 1.28 | ( 0.97 - 1.68 ) | |
| | | Thursday | 2.12 | ( 1.63 - 2.74 ) *** | |

| | | | | | |
|---|---|---|---|---|---|
| | | Friday | 1.92 | ( 1.49 - 2.49 ) *** | |
| | | Saturday | 0.31 | ( 0.21 - 0.46 ) *** | |
| | | Sunday | 0.20 | ( 0.13 - 0.31 ) *** | |
| High daily cumulative duration of CPIs with physician | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.60 | ( 0.07 - 4.74 ) | 0.42 |
| | | Neurology | 1.78 | ( 0.75 - 4.20 ) | |
| | | Nutrition | 0.78 | ( 0.24 - 2.53 ) | |
| | | Post-operative | 1.78 | ( 0.79 - 3.98 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.51 | ( 0.06 - 3.93 ) | 2.60E-05 |
| | | [30,40) | 0.31 | ( 0.07 - 1.34 ) | |
| | | [40,50) | 2.05 | ( 1.04 - 4.03 ) * | |
| | | [60,70) | 0.95 | ( 0.36 - 2.47 ) | |
| | | [70+] | 4.48 | ( 2.16 - 9.27 ) *** | |
| | Gender (ref: Female) | Male | 1.36 | ( 0.79 - 2.34 ) | 0.28 |
| | days of week (ref: Wednesday) | Monday | 0.78 | ( 0.28 - 2.14 ) | 2.40E-05 |
| | | Tuesday | 1.09 | ( 0.42 - 2.82 ) | |
| | | Thursday | 1.74 | ( 0.73 - 4.21 ) | |
| | | Friday | 3.12 | ( 1.41 - 6.89 ) ** | |
| | | Saturday | 0.61 | ( 0.20 - 1.84 ) | |
| | | Sunday | 0.33 | ( 0.09 - 1.24 ) | |
| High daily distinct CPI frequency with reeducation staff | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.49 | ( 0.35 - 0.67 ) *** | 2.80E-06 |
| | | Neurology | 0.72 | ( 0.59 – 0.89 ) ** | |
| | | Nutrition | 1.19 | ( 0.93 - 1.53 ) | |
| | | Post-operative | 0.37 | ( 0.23 – 0.59 ) *** | |
| | Age (ref: [50,60) ) | [18,30) | 1.42 | ( 0.92 - 2.19 ) | 0.0052 |
| | | [30,40) | 1.22 | ( 0.95 - 1.55 ) | |

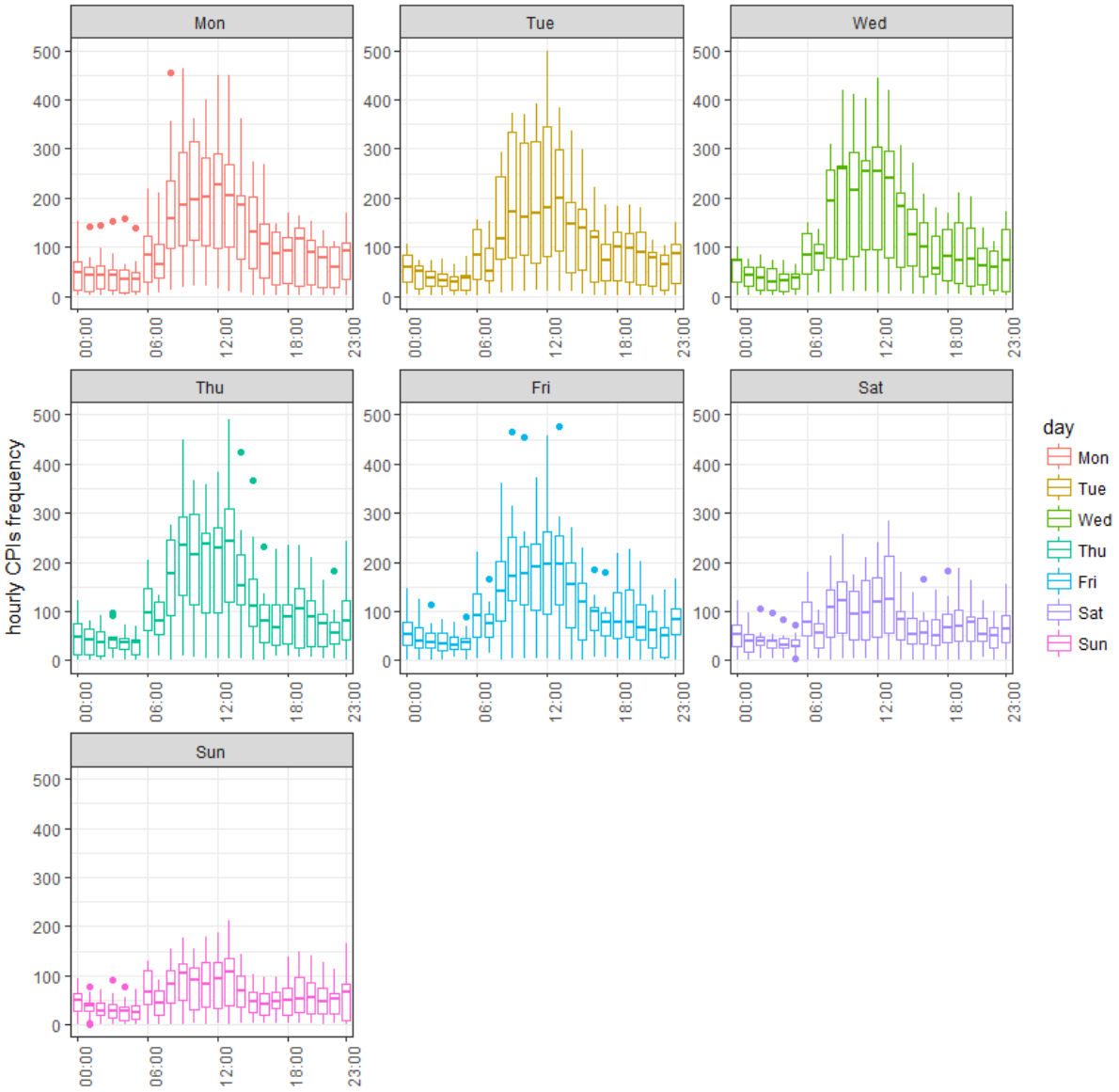
| | | | | | |
|---|---|---|---|---|---|
| | | [40,50) | 0.77 | ( 0.60 - 0.98 ) * | |
| | | [60,70) | 1.05 | ( 0.83 - 1.31 ) | |
| | | [70+] | 0.81 | ( 0.62 - 1.06 ) | |
| | Gender (ref: Female) | Male | 0.82 | ( 0.71 – 0.96 ) * | 0.015 |
| | days of week (ref: Wednesday) | Monday | 1.20 | ( 0.94 - 1.52 ) | 1.40E-140 |
| | | Tuesday | 1.19 | ( 0.93 - 1.52 ) | |
| | | Thursday | 1.37 | ( 1.07 - 1.74 ) * | |
| | | Friday | 1.75 | ( 1.39 - 2.20 ) *** | |
| | | Saturday | 0.00 | ( 0.00 - 4.63e+67 ) | |
| | | Sunday | 0.00 | ( 0.00 - 2.79e+59 ) | |
| High daily cumulative duration of CPIs with reeducation staff | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 1.35 | ( 0.83 - 2.19 ) | 7,00E-04 |
| | | Neurology | 0.72 | ( 0.51 - 1.02 ) | |
| | | Nutrition | 1.64 | ( 1.09 - 2.45 ) * | |
| | | Post-operative | 0.82 | ( 0.45 - 1.50 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.38 | ( 0.14 - 1.05 ) | 0.01 |
| | | [30,40) | 0.58 | ( 0.37 - 0.90 ) * | |
| | | [40,50) | 0.58 | ( 0.40 - 0.86 ) ** | |
| | | [60,70) | 0.61 | ( 0.42 - 0.89 ) * | |
| | | [70+] | 0.65 | ( 0.42 - 1.01 ) | |
| | Gender (ref: Female) | Male | 1.10 | ( 0.87 - 1.39 ) | 0.44 |
| | days of week (ref: Wednesday) | Monday | 1.63 | ( 1.12 - 2.38 ) * | 1.80E-47 |
| | | Tuesday | 1.43 | ( 0.96 - 2.11 ) | |
| | | Thursday | 1.47 | ( 1.00 - 2.17 ) | |
| | | Friday | 1.83 | ( 1.26 - 2.66 ) ** | |

| | | | | | |
|---|---|---|---|---|---|
| | | Sunday | 0.00 | ( 0.00 - 7.57e+146 ) | |
| | | Saturday | 0.00 | ( 0.00 - 4.31e+88 ) | |
| High daily distinct CPI frequency with hospital porter | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.33 | ( 0.16 - 0.68 ) ** | 3.10E-10 |
| | | Neurology | 0.70 | ( 0.54 - 0.92 ) ** | |
| | | Nutrition | 0.58 | ( 0.43 - 0.78 ) *** | |
| | | Post-operative | 0.37 | ( 0.26 - 0.52 ) *** | |
| | Age (ref: [50,60) ) | [18,30) | 0.94 | ( 0.62 - 1.40 ) | 0.71 |
| | | [30,40) | 1.18 | ( 0.95 - 1.46 ) | |
| | | [40,50) | 1.07 | ( 0.88 - 1.29 ) | |
| | | [60,70) | 1.01 | ( 0.83 - 1.23 ) | |
| | | [70+] | 1.03 | ( 0.82 - 1.29 ) | |
| | Gender (ref: Female) | Male | 0.78 | ( 0.69 - 0.89 ) *** | 0.00026 |
| | days of week (ref: Wednesday) | Monday | 1.09 | ( 0.90 - 1.32 ) | 1.60E-265 |
| | | Tuesday | 1.06 | ( 0.87 - 1.29 ) | |
| | | Thursday | 1.11 | ( 0.91 - 1.35 ) | |
| | | Friday | 1.28 | ( 1.05 - 1.55 ) * | |
| | | Saturday | 0.00 | ( 0.00 - 4.11e+39 ) | |
| | | Sunday | 0.00 | ( 0.00 - 0.94 ) * | |
| High daily cumulative duration of CPIs with hospital porter | Reasons for hospitalization (ref: Orthopaedic) | Geriatric | 0.30 | ( 0.18 - 0.49 ) *** | 0.009 |
| | | Neurology | 0.82 | ( 0.59 - 1.13 ) | |
| | | Nutrition | 1.13 | ( 0.76 - 1.66 ) | |
| | | Post-operative | 0.79 | ( 0.43 - 1.46 ) | |
| | Age (ref: [50,60) ) | [18,30) | 0.63 | ( 0.25 - 1.60 ) | 0.008 |

| | | | | |
|---|---|---|---|---|
| | [30,40) | 1.12 | ( 0.73 - 1.70 ) | |
| | [40,50) | 1.62 | ( 1.15 - 2.30 ) ** | |
| | [60,70) | 1.09 | ( 0.74 - 1.59 ) | |
| | [70+] | 1.70 | ( 1.16 - 2.50 ) ** | |
| Gender (ref: Female) | Male | 0.62 | ( 0.48 - 0.79 ) *** | 0.00013 |
| days of week (ref: Wednesday) | Monday | 0.92 | ( 0.62 - 1.38 ) | 9.20E-49 |
| | Tuesday | 1.11 | ( 0.75 - 1.64 ) | |
| | Thursday | 1.27 | ( 0.87 - 1.85 ) | |
| | Friday | 1.9 | ( 1.34 - 2.70 ) *** | |
| | Saturday | 0.00 | ( 0.00 - Inf ) | |
| | Sunday | 0.00 | ( 0.00 - Inf ) | |

***Note: Observed level of the Wald test for each parameter: * <0.05, ** <0.01, *** <0.001. OR: odds ratio.***

**Supplementary Figure S1: Time trends in CPIs over a 24-hour day for each day of the week during the whole study period.** Boxplot of the distribution of hourly CPI


Mon
Tue
Wed
Thu
Fri
Sat
Sun
hourly CPIs frequency
0
100
200
300
400
500
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12:00
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day
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Fri
Sat
Sun

115

116

117