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Radiology Departments as COVID-19 entry-door might improve healthcare efficacy and efficiency, and Emergency Department safety

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Abstract

Background Possible COVID-19 pneumonia (ppCOVID-19) patients generally overwhelmed EDs during the first COVID-19 wave. Home-confinement and primary care phone follow-ups was the first-level regional policy for preventing EDs to collapse. But when ppCOVID-19 needed x-rays assessment, the traditional outpatient workflow at the radiology department (RD) was inefficient and raised concerns about potential interpersonal infections. We aimed to assess the efficiency of a primary care high-resolution radiology service (pcHRRS) for ppCOVID-19 in terms of time consumed at hospital and decision's reliability.

Methods We assessed 849 consecutive ppCOVID-19 patients, 418 appointed by general practitioners to the pcHRRS (home-confined ppCOVID-19 cases with negative –group-1- and positive -group-2- x-ray results) and 431 arriving the ED by themselves (group-3). The pcHRRS provided x-rays and oximetry in an only-one-patient agenda for home-confined ppCOVID-19 patients. Radiologists made next-step decisions (group-1: pneumonia-, home-confinement follow-up; group-2: pneumonia+, ED assessment) according to x-rays results. ANOVA and Bonferroni correction, t-student, Kruskal-Wallis, and Chi2 tests were used to analyse changes in the ED workload, time-to-decision differences between groups, and pcHRRS performance for discriminating need for admission.

Results The pcHRRS halved ED respiratory patients (49.2%), allowed faster decisions (group-1 vs. home-discharged group-2 and group-3 patients: 0:41±1:05h vs. 3:50±3:16h; group-1 vs. all group-2 and group-3 patients: 0:41±1:05h vs. 5:36±4:36h; group-2 vs. group-3 admitted patients: 5:27±3:08h vs. 7:42±5:02h; *P* <0.001) and prompted admission in most cases (84/93, 90.3%).

Conclusions A Radiology Department pcHRRS may be a more efficient entry-door for ppCOVID-19 by decreasing ED patients and making expedited decisions while guaranteeing social distance.

Key Points

-The pcHRRS provided safe and efficient support for home-confined possible COVID–19 pneumonia.

-The pcHRRS was easy to set up and succeeded very soon.

- A radiology triage reduced both workload and time in the emergency department.

- The pcHRRS potentially decreased infection hazards for patients and health professionals.

Abbreviations

3DDT: Digital 3D tomosynthesis

ED: Emergency Department

G1: Group 1

G2: Group 2

G3: Group 3

GP: General practitioner

RD. Radiology Department

pcHRRS: primary care high-resolution radiology service

ppCOVID–19: possible pneumonia COVID–19

Background

In the Region of Murcia, Spain, general practitioners (GPs) see patients within a primary care network constituted by nine health areas with their own referral hospital. Each area includes basic health areas pivoting on primary care health centres. Given the previous experiences in Italy and other Spanish regions, with the arrival of the COVID-19 wave in February 2020, regional health authorities put forward a strategy based on primary care health centres GPs keeping patients with mild clinical presentation at home, similarly to the European recommendations [1]; at the Region of Murcia, they controlled more than 26,800 symptomatic cases suspected or diagnosed with COVID-19, and more than 34,600 asymptomatic contacts at home, only by close telephone follow-up [2]. But soon, dyspnoea, recommendations for thorax x-rays even in the more resource constrained scenario [3, 4], the high volume of home-confined patients, and the growing number of subjects asked by phone to go to the Emergency (ED) or the Radiology Departments (RD) at the referral hospital without previous warning, urged us to set up a secure primary care high-resolution radiology service (pcHRRS) in our health area, out of the ED. The pcHRRS operated with a specific RD team 12-hours daily, being at the same time the ED entry-door when appropriated. It was designed to offer GPs prompt objective respiratory clinical information from their home-based patients; to immediately transfer patients with pneumonia to the ED; to avoid overwhelming arrivals of respiratory patients to the ED; and, finally, to pilot and export the idea to the other health areas. Assuming the potential infection risk at overcrowded environments [5], we hypothesized that the pcHRRS would provide a much more efficient safer care. For that purpose, we aimed to analyse the pcHRRS efficiency in terms of reduced ED workload, waiting-times, and admission triage through a simple radiology algorithm.

Methods

This cross-sectional study followed the SQUIRE guidelines and was approved by our hospital ethical committee (C.I. EST: 55/20). Patients' informed consent was waived.

1. Background

Our health area coped with the highest COVID-19 burden (26.4%) at the Region of Murcia. There were 233 confirmed SARS-CoV-2 infections, 4004 accumulated possible cases and 4687 contacts by April 17th, 2020, when recruitment ended. In the same period, 152 COVID-19 patients were hospitalized, which was also the highest number in all health areas (23.4%).

Considering the usual number of patients seen in our ED before the pandemic start (e.g. 20-26 February: 1657 patients) and a ratio of respiratory/non-respiratory patients close to 1 (0.94, 206/218, 20-26 March) during the first epidemic week, we expected 118 [(1657/2)/7] or more daily respiratory emergencies during the epidemic wave. The average waiting time for patients with suspected respiratory infection at the ED during the epidemic wave was 5:48h. Despite the ED having established separated ways for respiratory and non-respiratory patients, COVID-19 infection risk would presumably increase if health care was provided through the usual indoors overcrowded ED environment with extended waiting-times [5]. Accordingly, we designed a straightforward specific radiology algorithm trying to keep the vast majority of possible pneumonia (ppCOVID-19) patients out of the ED, through an individualised short-time service while being highly effective for triaging need for admission.

2. Intervention

2.1 pcHRRS characteristics

The pcHRRS provided thorax x-rays and oximetry, making unnecessary a direct GP-to-patient contact. To be useful, the pcHRRS had to be 1) relevant: by deciding next steps; 2) accessible: available in less than 24 hours for any home-confined patient; 3) swift: less than 15 minutes RD workflow without waiting time on an only-one-patient appointment and expedited electronic report for the GP or the ED; and 4) safe: by reducing risks of a) Staff infections: radiographers and nurses in charge of the oximetry and patient's navigation avoided close contacts with the available personal protective equipment; b) Patients infections: they knew in advance how to reach the radiology room limiting interactions with other patients; barrier and hygiene resources were always available; and c) Wrong communication with the ED: COVID-19 ED physicians were fully aware of patient's management through the pcHRRS .

2.2. pcHRRS resources (fig.1, Supplementary fig.1)

1. General practitioners.Suspected or confirmed COVID-19 cases were interviewed by telephone every day. GPs had to rule out ppCOVID-19 if fever remained more than 6-7 days or persistent respiratory symptoms or worsening of respiratory or general condition at any time (especially dyspnoea). Those patients were appointed to the pcHRRS.
2. Specific electronic agenda. GPs could schedule thorax x-rays into the radiological information system from 9:00 a.m. to 9:00 p.m., every 15 minutes Monday to Sunday, and every 30 minutes on weekends and holidays.

3. COVID-19 radiology room. Short street access room with a robotized x-ray digital 3D tomosynthesis (3DDT) and immediate PACS archiving, limiting any patient-to-patient and patient-to-staff interactions.
4. Radiology Department workflow

a) Administrative staff. As soon a patient was appointed, a Radiology secretary phoned encouraging him to attend the appointment and giving instructions for a safe access to the radiology room (Supplementary fig.2). A radiology resident played that role on weekends and holidays.

b) Reception. Upon arrival, the patient warned the reception staff that he was coming through the pcHRRS and was provided with a surgical mask. Relatives generally waited in the street to avoid person-to-person interactions. The reception staff checked that patients knew how to reach the radiology room, preventing random navigation through other areas.

c) Radiology Department radiographers and nurses. When arriving to the radiology room, the patient proceeded immediately when the door was open. They were instructed to clean their hands with hydro-alcoholic solution, alcohol or to put gloves on, depending on daily resources. Within the room they received remote instructions from the radiographer so as to do the posteroanterior and lateral thorax x-ray radiographs, or a lateral radiograph and 3DDT. Then, the nurse performed oximetry and informed the radiology resident. Once the radiologists assessed the x-rays and decided the next step, the nurse informed the patient and, when needed, went with him to the ED admission point, preventing him from accidentally leaving the pcHRRS or random navigations, and avoiding delays and x-rays repetitions. When occasional delays made an arriving patient to wait outside the room, the patient within stayed in the changing room while the radiographer cleaned every contacted element. Once the decision was made, the technical staff cleaned the changing room and started again.

d) Radiologists. A resident and a staff radiologist worked close to the COVID-19 room, allowing a fast and direct communication always maintaining a safe distance with radiographers and nurses, and between themselves. The Radiology resident, who was the only additional pcHRRS personnel resource, 1) assessed thorax x-rays and was allowed to send the patient to the ED when sure about signs of pneumonia; abnormal x-ray with findings different from pneumonia where handled as usual (Supplementary fig.3); 2) drafted structured reports to be eventually validated by the radiologist; he used standardized radiology information according to scientific recommendations [6], also including oximetry results and the patient's final destination (Supplementary fig.4); 3) phoned the ED COVID-19 physicians warning about abnormal x-rays; 4) recorded and followed up every case; 5) recorded every pcHRRS incident; and 6) played the administrative role on weekends and holidays, being the reason for the 30 minutes time slots on those days. The radiologist supervising the pcHRRS on weekdays was one of our regular on-duty emergency radiologists, and the on-call radiologist on weekends and holidays. They guaranteed a correct workflow, supervised the radiology resident, and validated radiology reports in non-conclusive and normal cases, and whenever requested by the resident.

5. Emergency Department. A COVID-19 physician evaluated every pcHRRS patient with radiological findings of pneumonia. The workflow was streamlined since the patient didn't need a triage and had reported x-rays and oximetry.

6. Crisis committee. The Head of the RD, the Primary Care Network Director and the Medical Director of our health area, and one of the emergency radiologists met every day to know the number of involved patients, clinical results and incidents, so as to make changes on the fly. When required, the RD Supervisor and the Administrative Coordinator, and the ED COVID-19 Medical Coordinator attended the initial meetings.

For our purposes, all consecutive pcHRRS and the ED patients with respiratory infection symptoms were retrospectively studied from 5 days before the pcHRRS started. All pcHRRS patients underwent conventional thorax x-rays with posteroanterior and lateral views. A systematic assessment by 3DDT and oximetry were implemented later in the pcHRRS.

3. Statistical analysis

Patients were stratified in: Group 1 (G1: pcHRRS; normal x-rays; returning home); Group 2 (G2: pcHRRS; x-rays pneumonia findings; referred to the ED); and Group 3 (G3: ED; respiratory infection symptoms according to the ED physician). For G1, the process length was the period between the pcHRRS appointment time and the radiology report validation time; if any patient arrive at hospital before the appointment time, the process length was considered the period between the exam acquisition and the radiology report validation time; for G2 and G3, it went from the arrival time to the ED to the clinical report signature time. Any G1 patient deciding to seek medical advice at the ED after leaving the pcHRRS was included in G3. Patients leaving or requesting voluntary medical discharge were included in the number of patients attended, but excluded from the time analysis, as this variable was lacking.

Patients' inflow was represented by daily absolute and relative frequencies, and the total accumulated frequency for all groups, and the daily ratio of hospitalized patients for groups 2 and 3.

Komogorov-Smirnov test was used to assess the normal distribution of the quantitative variables. The Kruskal-Wallis, Mann Withney U and Chi^2 tests were applied when appropriate. Qualitative variables are shown as absolute and relative frequency. Quantitative variables as mean ± standard deviation, median and interquartile range in square brackets or 95% confidence interval (95%CI), as appropriate Statistically significant differences were assumed when $P<0.05$. The analysis was performed with the IBM Statistics SPSS 20 software. Precise p values could not be extracted for the non-parametric tests using SPSS. For graphs, we also used the Excel Microsoft Office 365 software.

Results

A top of 1494 confirmed and 5010 possible cases/week was reached in March 23-29th, 2020, with a maximum of 119 confirmed cases/day on March 25th, 2020. We considered that day to be the peak of the epidemic wave. The pcHRRS started on March 26th, 2020 and has been active since then. From March 26th to April 17th, 2020, 418 and 431 respiratory infection patients were seen through the pcHRRS and the ED, respectively. Ten scheduled patients did not attend the pcHRRS appointment. Those 418 patients accounted for 9.86% of the active confirmed or possible accumulated cases (233 and 4004 patients, respectively) followed-up by telephone in that period of time, and 0.16% of our health area population (265.842 people).

The distribution of pcHRRS patients was: G1 325/418 (77.75%) and G2 93/418 (22.24%) patients (Supplementary fig.5). One patient with known fibrotic pulmonary lesions and other with a calcified granuloma where sent back home and included in G1. One patient refused the ED assessment. Among ED patients (G3), 224/431 (52%), 203/431 (47.10%) and 4/431 (0.93%) returned home, were admitted, or refused admission, respectively. Eight pcHRRS patients encouraged to go home asked for ED assessment before being finally discharged. All them went out from G1 (n = 317; 325 - 8) to be included in G3 (n = 439; 431 + 8) for the efficiency analysis; one G2 patient and four G3 patients refused medical attention and were excluded (Supplementary fig.5).

After starting the pcHRRS, the number of patients/day in the ED gradually decreased (fig.2). G1 patients =0:28 [0:36] h stayed in hospital significantly less time than G2 and G3 subjects (4:40 [2:53] h and 4:41 [23:13] h, respectively; P <0.001; fig.3), even when G2 and G3 patients returned home (2:24 [4.33] h and 2:59 [3:03] h, respectively; P <0.001; fig. 4). The time span in the ED did not differ between G2 and G3 when they returned home (2:24 [4.33] h and 2:59 [3:03] h; P = 0.800), but was significantly shorter for G2 when patients were admitted (4:45 [2:37] h vs. 6:13 [5:12] h; P < 0.001; fig. 4). Even considering pcHRRS and ED times together in G2, patients waited less time than G3 patients, except for the 9/93 (9.6%) G2 patients returning home (3:00 vs 2:59 h; fig.4). The pcHRRS had a high yield for admission decisions considering that G2 patients were admitted (84/93, 90.3%) more frequently than G3 (203/431, 47.1%; P 0.00000000000005773 according to Chi^2 test), with a rate per day always higher for G2 (mean rates: 0.92, range 0.67-1 vs. 0.48, range 0.18-0.75), regardless the epidemics time point (fig.5).

All 418 pcHRRS patients underwent posteroanterior and lateral thorax radiographs. Oximetry was implemented on March 31st, being applied systematically from patient 109. After getting empirically good results in four patients, 3DDT was systematically performed since April 1st, starting with patient 152. When we began to write this manuscript, we had all radiological and laboratory data records for the first 212 consecutive patients, all with conventional thorax radiographs and 73 with additional 3DDT. Their mean age was 46.75 ± 13.93 years, 87 (41%) men. Forty-eight (22.64%), 148 (69.81%) and 16 (7.54%) had abnormal, normal and questionable radiographs, respectively. All 48 patients with abnormal radiographs were referred to the ED, as well as 2 patients with normal radiographs and 4 patients with questionable radiographs in whom 3DDT brought out signs of pneumonia (6/54, 11.1%). These 54 patients (G2) were older (50.46 ± 15.73 years) than G1 patients (45.41 ± 13.01 years; $P = 0.019$), men showing a trend to be more frequently referred to the ED than women (29/87, 33.33% vs. 27/115, 23.48%; $P = 0.057$) due to radiological abnormalities.

Among those first consecutive 212 patients, a follow-up chest radiograph was requested in 61 cases. That request was less frequent when initial radiographs were normal than when abnormal or questionable (18/148, 12.2% vs. 38/48, 75% vs. 5/16, 31.2%; P = 1.39186134980766700E-19 according to Chi2 test). On the other hand, though follow-up radiographs worsen, respectively, in 15/48 (31.2%) and 2/16 (12.5%) patients with initial abnormal or questionable exams, no initial normal radiograph did it (0/148, 0%) (P = 1.39186134980766700E-19 according to Chi2 test).

SARS-CoV-2 infection was confirmed by reverse transcription polymerase chain reaction (PT-PCR), serology, or both in 37/212 (17.45%) and ruled out in 77/212 patients. In 87/212 patients the infection was ruled out, though results are now under review. We have no data to date on 11/212 patients.

Oximetry was performed in 107/212 patients; in 6/212 data were missing. Mean blood oxygen saturation was lower in patients with abnormal (98 [2], 95%CI 96.45-98.02, n = 17) vs. normal (98 [1], 95%CI 98.29-98.69, n = 75) or questionable radiograph (98 [1], 95%CI 97.82-98.71, n = 15; $P = 0.003$ according to two-sides Kruskal-Wallis test).

Discussion

During the first COVID-19 epidemic wave, respiratory patients were managed significantly faster through the pcHRRS, regardless they returned home or were admitted. The pcHRRS contributed to halve the number of patients arriving to the ED for respiratory symptoms, triaging effectively the need for admission out of the ED.

The screening strategy recommended by the American College of Radiology and the Society of Thoracic Radiology for SARS-CoV-2 infection [7], based on RT-PCR and serology tests, has been applied in some countries [8]. But resources for laboratory tests in suspected SARS-CoV-2 infection were scarce and urged us to manage patients as potential infections in most occasions. Whatever the clinical setting, the RD was strategic when SARS-CoV-2 pneumonia had to be ruled out because hospital admission was then usually warranted [9]. Moreover, providing care for all suspected cases on a hospital basis may likely increase the number of infections in an already overwhelmed health system [8]. Therefore, according to our experience, a radiology entry-door may play a central role in ongoing waves of COVID-19 as our RD provided a faster and more efficient management, that was potentially safer [5].

The RD role to assess need for hospital admission in confirmed or possible COVID-19 patients has been a key innovative efficient strategy but it was applied without a specific referral from the primary care network, and used CT as imaging technique [10]. Accordingly, the way home-confinement patients were managed and the straightforward imaging assessment are important differences in our case. Potential reduction of infection spread with our pcHRRS might have been achieved by keeping ppCOVID-19 outpatients with respiratory infection isolated in a specific route from the beginning [11, 12]. But, not less important, a personalised agenda contributes to clear facilities [13], guaranteeing a safe environment both for patients and health workers [10, 12, 14–16]. Risk contacts were significantly reduced through our pcHRRS by providing an extremely quick response in terms of specific appointments, safer x-ray technology and oximetry for decision making, and expedited information transmission, always out of the ED. At the same time, it safely discriminated patients needing admission from those still ready to be managed at home. More than ¾ of ppCOVID-19 patients managed through the pcHRRS returned home and only 12% of those cases needed further x-rays assessment, who never showed radiological worsening. ppCOVID-19 patients seen through the pcHRRS and the ED routes were discharged in 77% and 52%, respectively, but the pcHRRS route was 5.2 times faster. Moreover, it had a remarkably high performance for discriminating ppCOVID-19 patients needing hospital admission, as over 90% of those referred to the ED were admitted. Some authors have agreed on the discriminating potential of thorax radiography as an independent factor for hospital admission [9]. In our case, that performance remained at the same level both at the epidemic peak and while it was declining.

Following our legal obligation [17], we have to keep a safe specific route for patients potentially infected by SARS-CoV-2, which necessarily needs x-ray assessment. We think that our RD workflow for ppCOVID-19 outpatients is this study's main strength as we haven't found reported a similar approach. Furthermore, the characteristics of age, gender and oximetry of our G2 patients were similar to those previously reported [9, 18], and the way both cohorts were finally built up within a strict home-confinement regional strategy reproduces a real setting whose results might be used as a model in ongoing pandemic waves. Furthermore, we believe that the higher pcHRRS discriminative performance makes beneficial to maintain and expand the RD entry-door role in the long term to be prepared for future COVID-19 waves or other similar pandemics. But we also acknowledge some weaknesses. We have now complete clinical and radiological follow-up data in 212 patients, so many final outcomes are still under assessment. But when patients returned home, GPs closely followed them up and we can assume that pcHRRS decisions were safe. Furthermore, a retrospective assessment of the pcHRRS x-rays exams by independent staff radiologists is still waiting. But the radiological reports were always validated by board-certified radiologists in patients without pneumonia findings, who never needed admission regardless they were occasionally reassessed. Finally, we couldn't compare the economic issues at this moment, but, in principle, only a resident without any additional income was required in the pcHRRS, while patients navigating through the ED would normally increase expenses due to other laboratory analysis and medical variability.

Conclusion

In summary, a RD positioned as a COVID-19 entry-door may be efficient in an epidemic setting to decrease respiratory patients at the ED, while potentially reducing infection hazards through safe and expedited decisions.

Declarations

Ethics approval and consent to participate

This cross-sectional study followed the SQUIRE guidelines and was approved by our hospital ethical committee (C.I. EST: 55/20).

Consent for publication

Not-applicable

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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This study didn't have any funding.

Authors' contributions

JMGS conceived the study idea.

JMPM, JMGS and PMM contributed to the study design.

JMPM, PFO, MLR, MCSA, GPH contributed to the data collection.

JMPM and JMGS performed the study analysis.

JMPM and JMGS drafted the first version of the manuscript.

All authors critically reviewed the manuscript and approved the final version.

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Figures

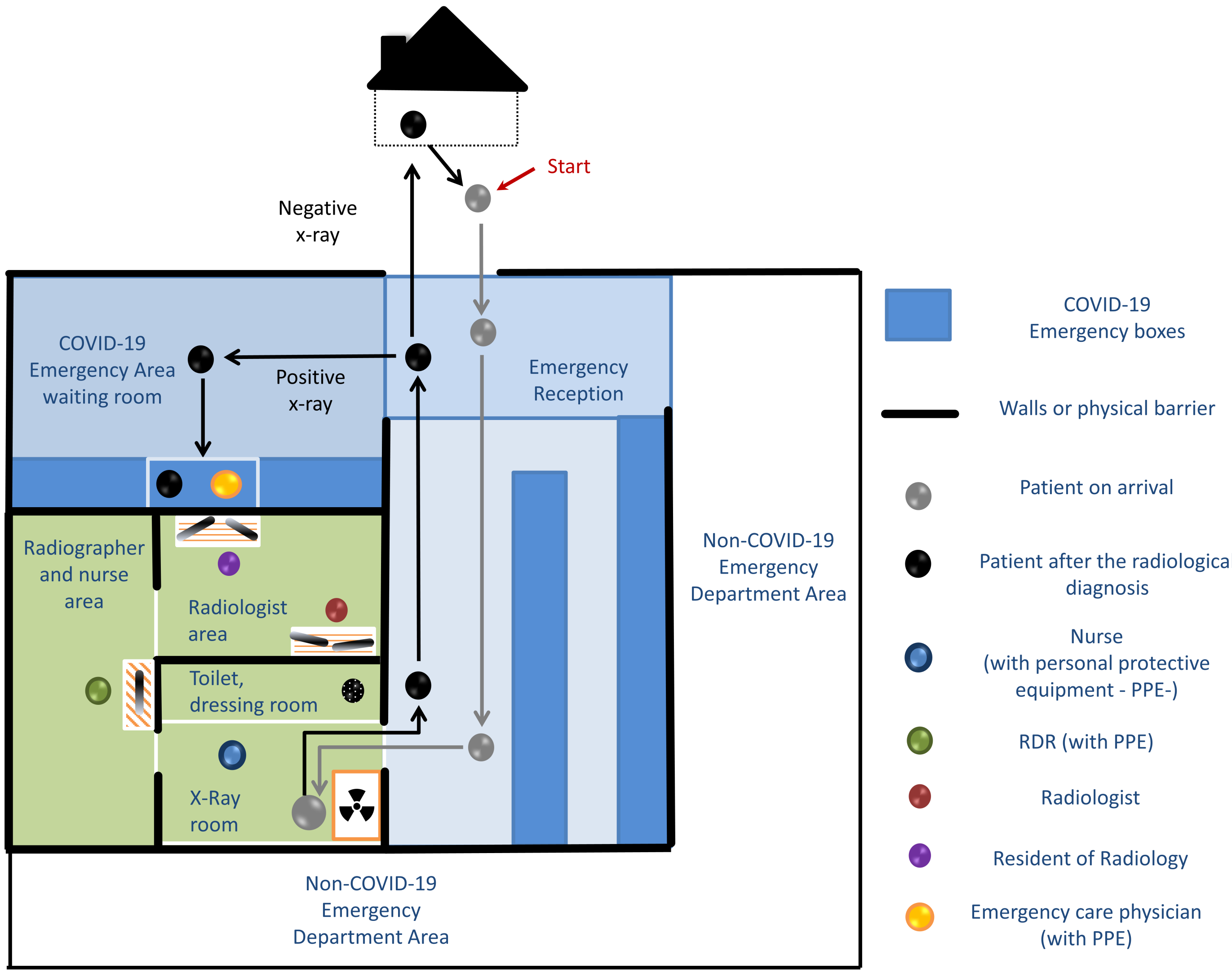
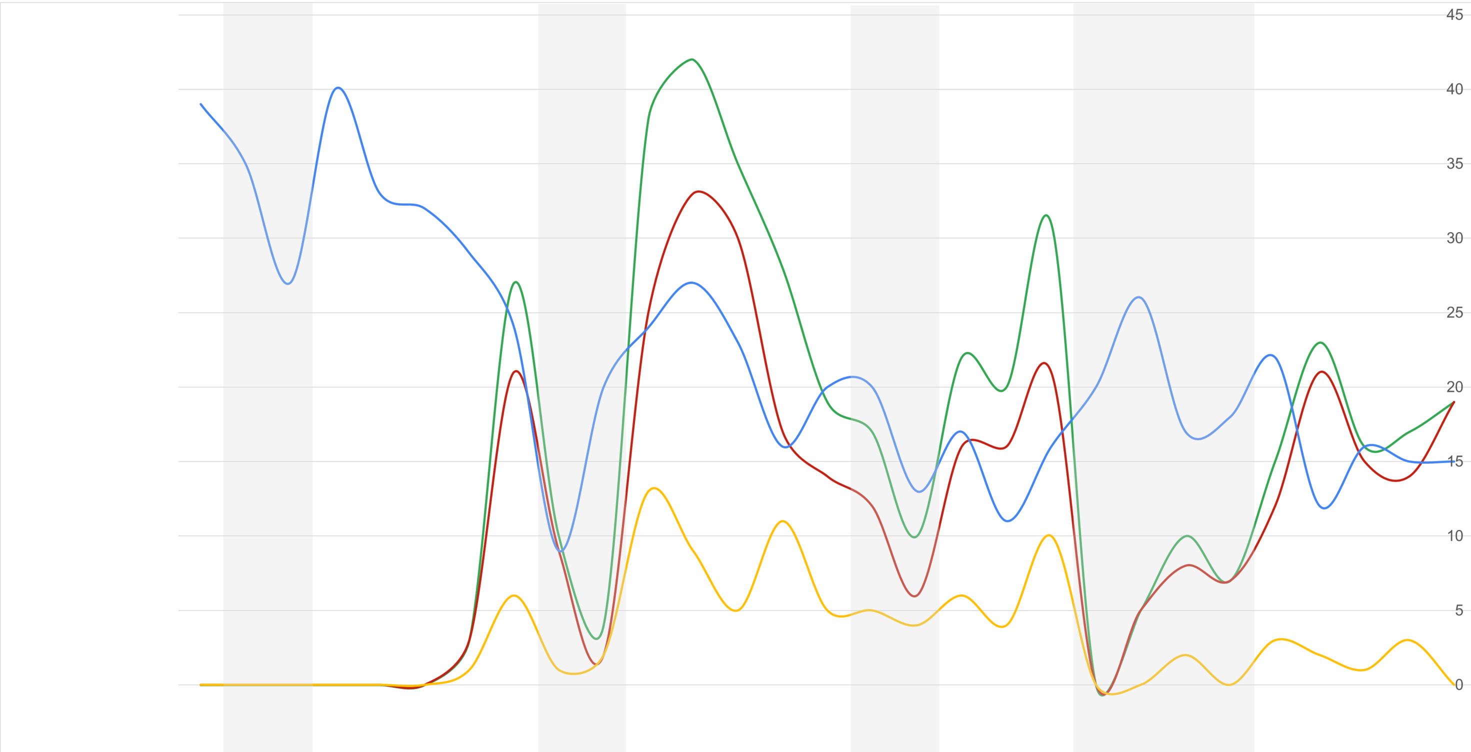


Figure 1

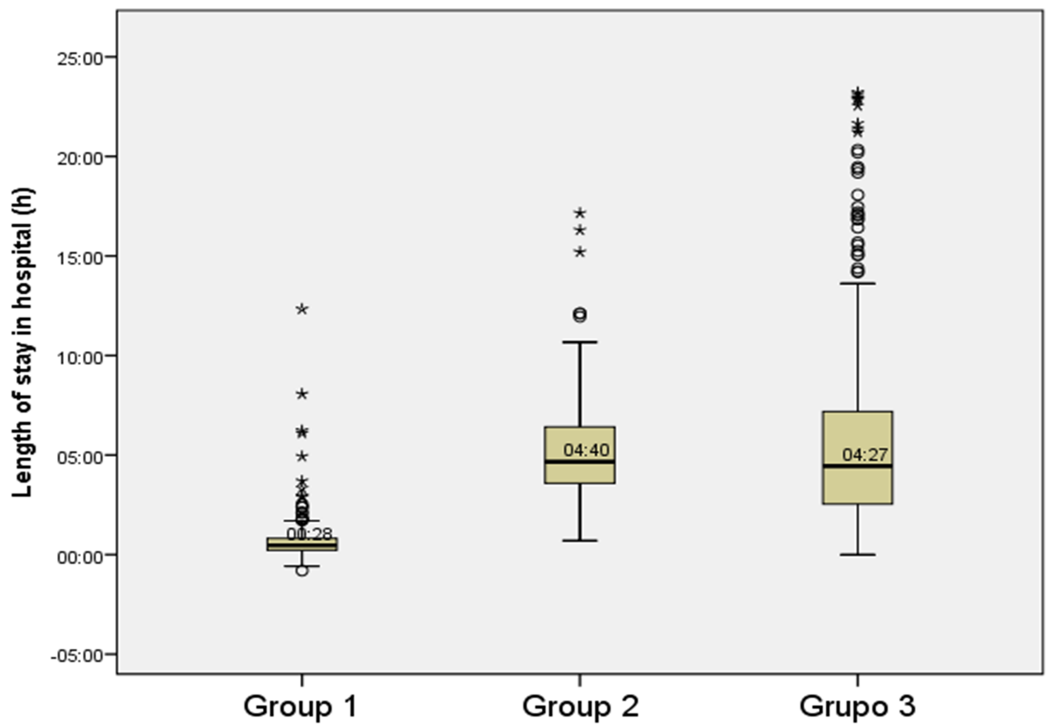
Primary Care High-resolution radiology service (pcHRRS) workflow. The pcHRRS was integrated in the Emergency Radiology area (green background) and in the COVID-19 area at the Emergency Department (blue background). PPE: Personal protective equipment; RDR: Radiology Department Radiographer.



	20/03/2020	21/03/2020	22/03/2020	23/03/2020	24/03/2020	25/03/2020	26/03/2020	27/03/2020	28/03/2020	29/03/2020	30/03/2020	31/03/2020	01/04/2020	02/04/2020	03/04/2020	04/04/2020	05/04/2020	06/04/2020	07/04/2020	08/04/2020	09/04/2020	10/04/2020	11/04/2020	12/04/2020	13/04/2020	14/04/2020	15/04/2020	16/04/2020	17/04/2020
Number of patients assisted in the HRRS	0	0	0	0	0	0	3	27	10	4	38	42	35	28	19	17	10	22	20	31	0	5	10	7	15	23	16	17	19
Group 1	0	0	0	0	0	0	3	21	9	2	25	33	30	17	14	12	6	16	16	21	0	5	8	7	12	21	15	14	19
Group 2	0	0	0	0	0	0	1	6	1	2	13	9	5	11	5	5	4	6	4	10	0	0	2	0	3	2	1	3	0
Group 3	39	35	27	40	33	32	29	24	9	20	24	27	23	16	20	20	13	17	11	16	20	26	17	18	22	12	16	15	15

Figure 2

Daily respiratory infection patients' flow during the epidemic wave in the Region of Murcia: a) All primary care high-resolution radiology service (pcHRRS) patients (green line); b) pcHRRS discharged patients (Group 1, red line); c) pcHRRS patients referred to the Emergency Department (ED) (Group 2, yellow line); d) Patients arriving to the ED by themselves (Group 3, blue line). Grey bands correspond to holidays. Patients seen within the pcHRRS (green line) exceeded the number of patients arriving to the ED (blue line) in the study window, except for holidays, when, despite being operational, patients were less referred to pcHRRS. Most patients seen at the pcHRRS went back home (red line).



	Group 1	Group 2	Grupo 3
Mean	0:41	5:25	5:36
Standard Deviation	1:05	3:08	4:36
Median	0:28	4:40	4:27
Interquartile Range	0:36	2:53	4:41
Range	13:08	16:27	23:13
N	317	93	439

Figure 3

Process length in the 3 clinical groups. Time span was longer and dispersion higher when patients arrived to the emergency department (ED) by themselves (group 3) or when referred to the ED from the primary care high-resolution radiology service (pcHRRS) (Group 2) than pcHRRS patients discharged with normal x-rays (Group 1). Box upper and lower edges correspond to quartiles 3 (Q3) and 1 (Q1) respectively; ends of the whiskers represent Q3+1.5*(Q3-Q1) and Q1-1.5*(Q3-Q1), respectively; circles and asterisks represent the extreme and very extreme data, respectively (values above or below the whiskers). Group 1 extreme data of 5 hours or more correspond to a few specific patients who did not show up at their scheduled time but did so later and even on the following day. N indicates the number of biologically independent patients in each group. According to two-sides Krusal-Wallis test, the process length was significantly different among the 3 clinical groups (P < 0.001)

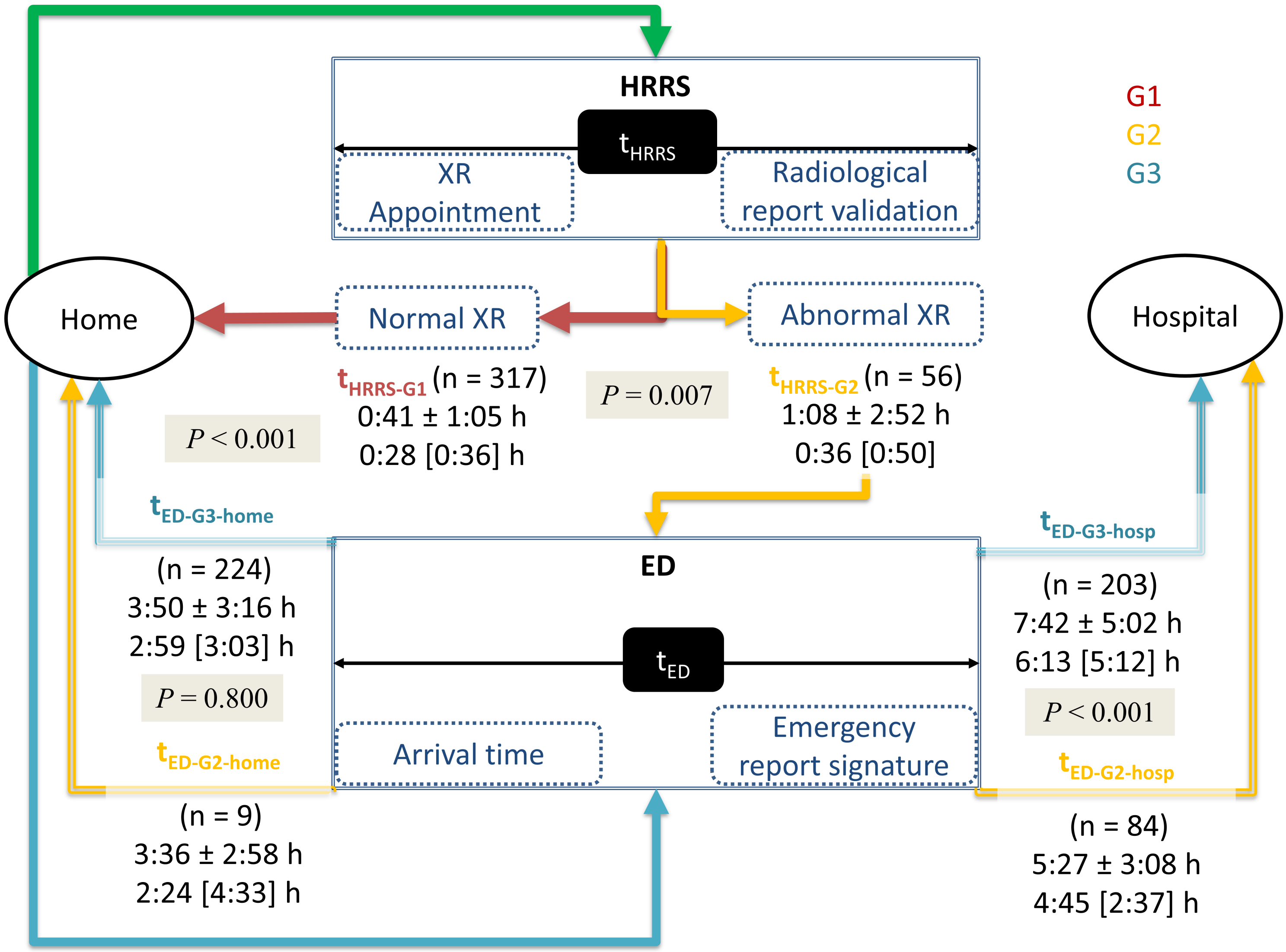


Figure 4

Differences in the process length in each clinical group (G). Decision for G1 patients was always discharge; for G2 and G3 patients could be discharge (home) or hospital admission (hosp). Time length in G1 was always shorter than in G3, regardless G3 patients could return home. Time length in G2 was always shorter than in G3, whatever the decision, even when tpcHRRS was added to the tED, except for the 9 patients arriving from the pcHRRS who were finally discharged. The process length for most G2 patients was probably shorter since the emergency physicians were notified immediately about the x-ray findings. In those cases, the validation of the radiological report was often delayed, so tpcHRRS-G2 and tED-G2 overlapped in most cases. tpcHRRS: time span through the primary care high-resolution radiology service (pcHRRS) from the x-ray (XR) appointment to the radiological report validation; tED: time span in the Emergency Department (ED) from the arrival to the clinical report signature. Two-sided independent samples Mann-Whitney U test was used to assess time differences, given a no normal distribution of the sample according to Kolmogorov-Smirnov test. Numbers are shown as mean ± standard deviation and, in the row below, as median and interquartilic range (in square brackets). N indicates the number of biologically independent patients in each group.

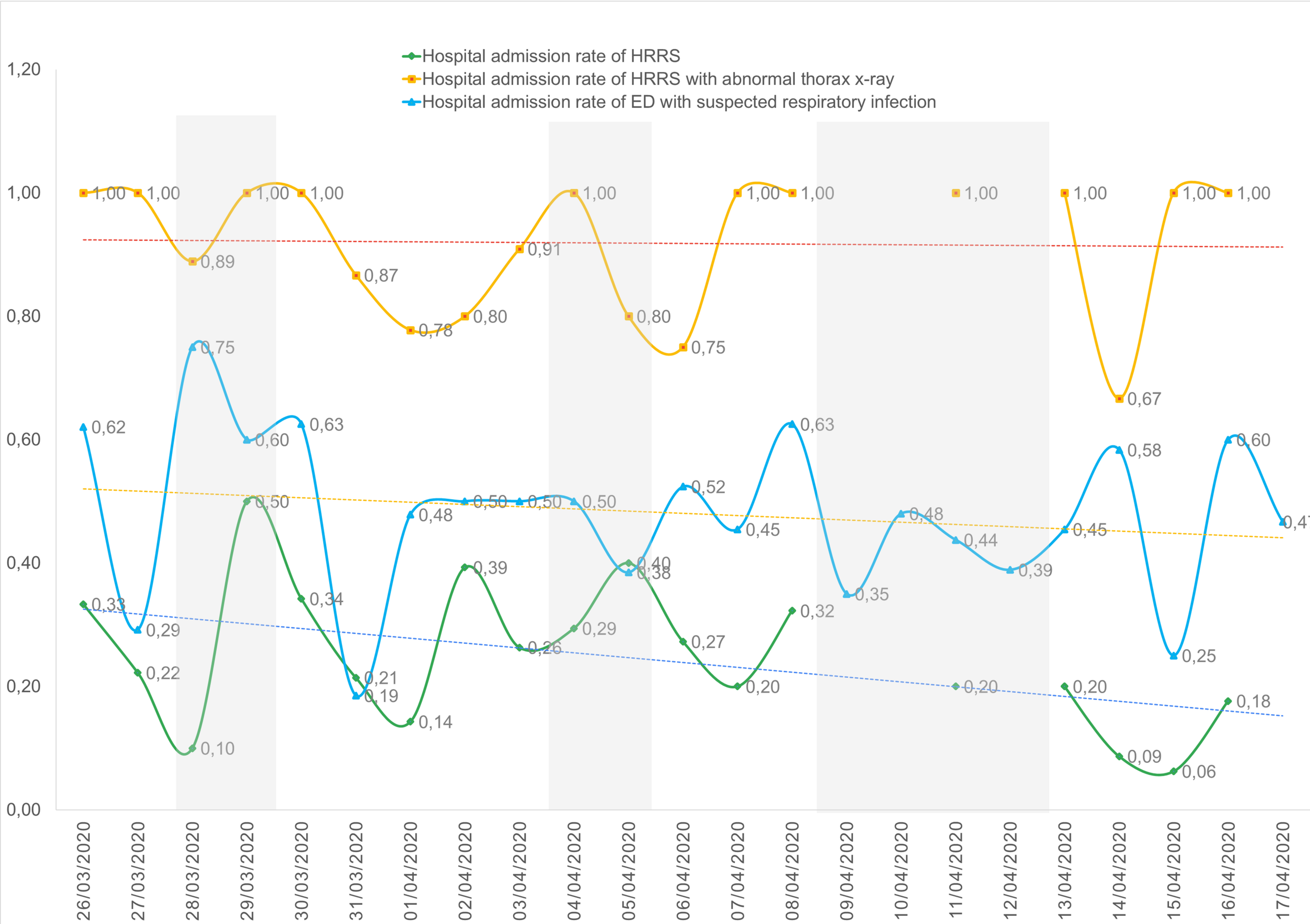


Figure 5

Daily hospital admission rate for the different groups: patients seen through the primary care high-resolution radiology service (pcHRRS, green line), those arriving to the emergency department (ED, blue line) by themselves, and those seen through the pcHRRS but later referred to the ED due to pneumonia findings (yellow line). Grey bands correspond to holidays, when despite being operational, patients were less appointed for a pcHRRS. On March 9th, no patient was appointed for a pcHRRS; on March 10th and 12th, pcHRRS patients didn't require admission.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementaryfigure1.TIF
- Supplementaryfigure2.TIF
- Supplementaryfigure3.TIF

- Supplementaryfigure4.TIF
- Supplementaryfigure5.docx