Analysis of the sources of COVID-19 transmission in France by Self-assessment Web-application before and after the partial autumnal lockdown: Observational Study

Fabrice Denis, Anne-Lise Septans, Florian Le Goff, Stephan Jeanneau, François-Xavier Lescure

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Abstract

Background: We developed a questionnaire on a web-application for COVID-19 circumstances of contamination analysis in France during the 2nd wave of pandemic.

Objective: To analyze the impact on contaminations characteristics of the second partial lockdown in France to adapt health public restrictions to further pandemic surges.

Methods: Between 12/15/2020 and 12/24/2020, after a national media campaign, users of sourcecovid.fr web-application were asked questions about their own or a close relative COVID-19 contamination after 8/15/2020 in France. Data of contamination's circumstances were assessed and compared before and after the second partial lockdown which occurred on 10/25/2020 during the second wave of pandemic and was ongoing on 12/24/2020.

Results: As of December 24, 2020, 441 000 connections on web-application were observed. 2218 questionnaires were assessable for analysis. 61.8% were sure of their contamination origin and 38.2% thought they knew it. The median age of users was 43.0 years (IQR 32 to 56), 50.7% were male. The median incubation time of the assessed cohort was 4.0 days (IQR 3 to 5). Private area (family and friends) was the main source of contamination (50.2%) followed by work colleagues: 27.7%. The main time of contamination of the day was the evening (35.3%) before the lockdown and was reduced to 18.2% after it (P<0.001). The person who transmitted the virus to the user before and after the lockdown was significantly different (P<0.001): a friend (29.0% vs 14.1%), a family close relative (23.1% vs 32.7%), a work colleague (23.9% vs 34.2%). The main location where the virus was transmitted to the users before and after lockdown was significantly different too (P<0.001), respectively: Home (21.3% vs 25.5%), at work (22.4% vs 29.6%), collective places (33.0% vs 15.0%), and care centers (4.4% vs 9.7%).

Conclusions: Modalities of transmissions significantly changed before and after the 2nd lockdown in France. The main sources of contaminations remained the private area and work colleagues. Work became the main location of contamination after lockdown whereas collective places contaminations were strongly reduced. Clinical Trial: ClinicalTrials.gov NCT04670003

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Analysis of the sources of COVID-19 transmission in France by Self-assessment Web-application before and after the partial autumnal lockdown: Observational Study

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Trial Registration: ClinicalTrials.gov NCT04670003

Key words: COVID-19; web-application; digital health.

Abstract:

Background

We developed a questionnaire on a web-application for COVID-19 circumstances of contamination analysis in France during the 2nd wave of pandemic.

Objective

To analyze the impact on contaminations characteristics before and after the second partial lockdown in France to adapt health public restrictions to further pandemic surges.

Methods

Between 12/15/2020 and 12/24/2020, after a national media campaign, users of sourcecovid.fr web-application were asked questions about their own or a close relative COVID-19 contamination after 8/15/2020 in France. Data of contamination's circumstances were assessed and compared before and after the second partial lockdown which occurred on 10/25/2020 during the second wave of pandemic and was ongoing on 12/24/2020.

Results

As of December 24, 2020, 441 000 connections on web-application were observed. 2218 questionnaires were assessable for analysis. 61.8% were sure of their contamination origin and 38.2% thought they knew it. The median age of users was 43.0 years (IQR 32 to 56), 50.7% were male. The median incubation time of the assessed cohort was 4.0 days (IQR 3 to 5). Private area (family and friends) was the main source of contamination (50.2%) followed by work colleagues: 27.7%. The main time of contamination of the day was the evening (35.3%) before the lockdown and was reduced to 18.2% after it ($P<.001$). The person who transmitted the virus to the user before and after the lockdown was significantly different ($P<.001$): a friend (29.0% vs 14.1%), a family close relative (23.1% vs 32.7%), a work colleague (23.9% vs 34.2%). The main location where the virus was transmitted to the users before and after lockdown was significantly different too ($P<.001$), respectively: Home (21.3% vs 25.5%), at work (22.4% vs 29.6%), collective places (33.0% vs 15.0%), and care centers (4.4% vs 9.7%).

Conclusions

Modalities of transmissions significantly changed before and after the 2nd lockdown in France. The main sources of contaminations remained the private area and work colleagues. Work became the

main location of contamination after lockdown whereas collective places contaminations were strongly reduced.

Manuscript:

Introduction:

Patient-reported outcomes applications have been shown to improve outcomes including survival benefit. [1-3]

We developed and launched during the growing phase of the COVID-19 pandemic in March 2020 in France a self-assessment and participatory surveillance web-application for coronavirus disease (COVID-19) called maladiecoronavirus.fr. This self-triage tool aimed to help symptomatic patients to be directed towards the emergency call or the general practitioner after analysis of symptoms and co-morbidities. We showed that data from this web-application could be a relevant tool to reduce the burden on emergency call centers. [4] It also proved to be useful in monitoring COVID-19 spread during the whole pandemic, with time and spatial correlations between number of hospitalizations and daily reported anosmia by users higher than large scale RT-PCR positive tests [5]. A national partial lockdown was initiated in France on 10/25/2020 against the second wave of COVID-19 pandemic. Contrary to the first complete lockdown from March to May 2020, this one maintained scholar, professional and shopping activities. However, the circumstances of virus transmissions before and after this lockdown are not well known in France. We thus developed a specific questionnaire on a web-application (sourcecovid.fr) for coronavirus disease source of contamination analysis in France in December 2020 just after the 2nd wave of pandemic. [7]. The objective of this national survey was to analyze the impact on contaminations circumstances before and after the second partial lockdown in France initiated on 10/25/2020 associated with the second wave of pandemic in order to optimize health public policy to further pandemic surges.

Methods:

Users of sourcecovid.fr were recruited via a national media campaigns in France from 12/15/2020 to 12/25/20, including social media, radio, and magazine campaigns, between December 15-18 December 2020. Participants were recruited through the website. Respondents provided information on sociodemographic data, zip code, coexisting disorders anonymously and the severity of their disease. Only symptomatic users were recruited. They were asked to enter data about their own contamination and/or the contamination of a close relative, about their sureness about contamination's circumstances ("I am sure", or "I think I know" or "I don't know") and they also had to answer when, by who and where they thought they (or the close relative) were contaminated. Users who answered "I don't know" were excluded from analysis.

Questionnaires were excluded from the analysis if completion duration was considered inconsistent (below 100 or above 800 seconds), if users had asymptomatic form, if they did not know about contamination's circumstances and if contamination occurred before 8/15/2020 to reduce memory bias.

We excluded incubation times greater than 14 days from the analysis. Incubation time was calculated by comparing the date of presumed contamination and the date of first symptoms. The study was approved by the French National Health-Data Institute which reviews ethical conduct of human subject's research, data confidentiality and safety. The website was not considered a medical device by regulatory authorities since no tracking was performed and data were anonymous. The web-application did not access to testing results. Access to web-application did not require login nor creating an account. The web-application did not identify participants who responded several times.

Data of contamination's circumstances were assessed and compared before and after the second partial lockdown which occurred on 10/25/2020 during the second wave of pandemic and was ongoing on 12/24/2020. Fisher exact test was performed to assess changes in circumstances of contaminations.

Results:

As of December 24, 2020, 441 000 connections on web-application were observed. There were 2 118 questionnaires assessable for analysis; 61.8% (1 309/2 118) of users were sure of their contamination circumstance and 38.2% (809/2 118) thought they know it. Sureness was not different according to age (*P*=.43). The median age of users was 43.0 years (IQR 32 to 56) and 50.7% were male. Population aged more than 65 years were 12.5% of users (265/2 118) and 4.4% (93/2 118) of questionnaires concerned young people less than 18. The median incubation time was assessable in 1 676 questionnaires and was 4.0 days (IQR 3 to 5). Whatever the sureness, time incubation was not different (*P*=.36). Among this, 41.7% (699/1 676) declared a positive RT-PCR or antigenic test.

Mild or moderate infection was reported by 85.1% of questionnaires (1 802/2 118), severe infection in 10.8% (229/2 118) and hospitalization in 4.6% (98/2 118).

Partial lockdown occurred on 8/25/2020 and was associated with 80.0% reduction of daily contaminations. Figure 1.

Figure 1. Impact of the partial lockdown on daily RT-PCR positive tests. Red area: national partial lockdown period initiated on 10/25/2020.
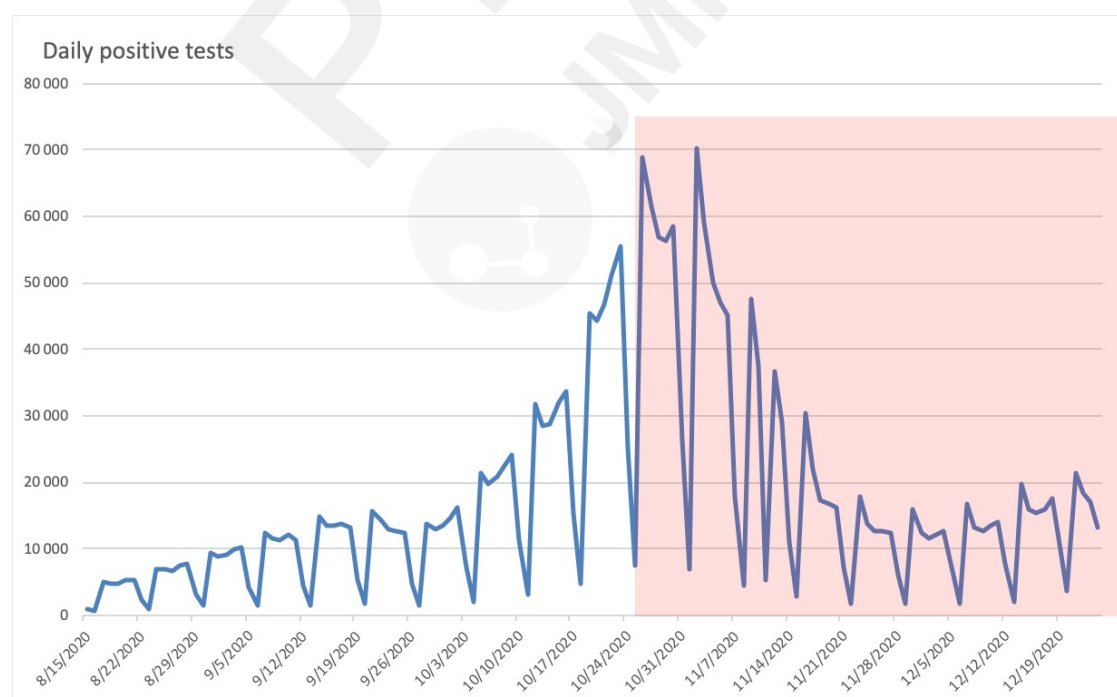
During the period between 8/15/2020 and 12/24/2020, the private area (family and friends) was the main source of contamination (50.2% ie 1 048/2 090) followed by work colleagues: 27.7% (579/2 090), an unknown person in 14.3% (299/2 090) and 3.9% (83/2 090) did not know who contaminated them.

The lockdown occurred on 10/25/2020; 1334 questionnaires described contamination's circumstances between 8/15/2020 and 10/24/2020 and 784 between 10/25/2020 and 12/24/2020.

The person who transmitted the virus to the user before and after the lockdown was significantly different (p<0.001): a friend: 29.0% (382/1 317) vs 14.1% (109/773), a family close relative: (23.1% (304/1 317) vs 32.7% (253/773), a work colleague: 23.9% (315/1 317) vs 34.2% (264/773), P<.001.

Figure 2

The distribution of responses regarding the persons who had contaminated the user is different between user sure and user think know the origin of their contamination (P<.001). If professional relation is privileged for both group, users were more, in proportion, to think it's an unknown person who infected them: 19.1% (151/790) vs 11.4% (148/1 300).

Figure 2: Contamination's circumstances before versus after the partial lockdown which was trigged in France on 10/25/2020. Answer to the question "Who contaminated you or your close relative?" *P*<.001.
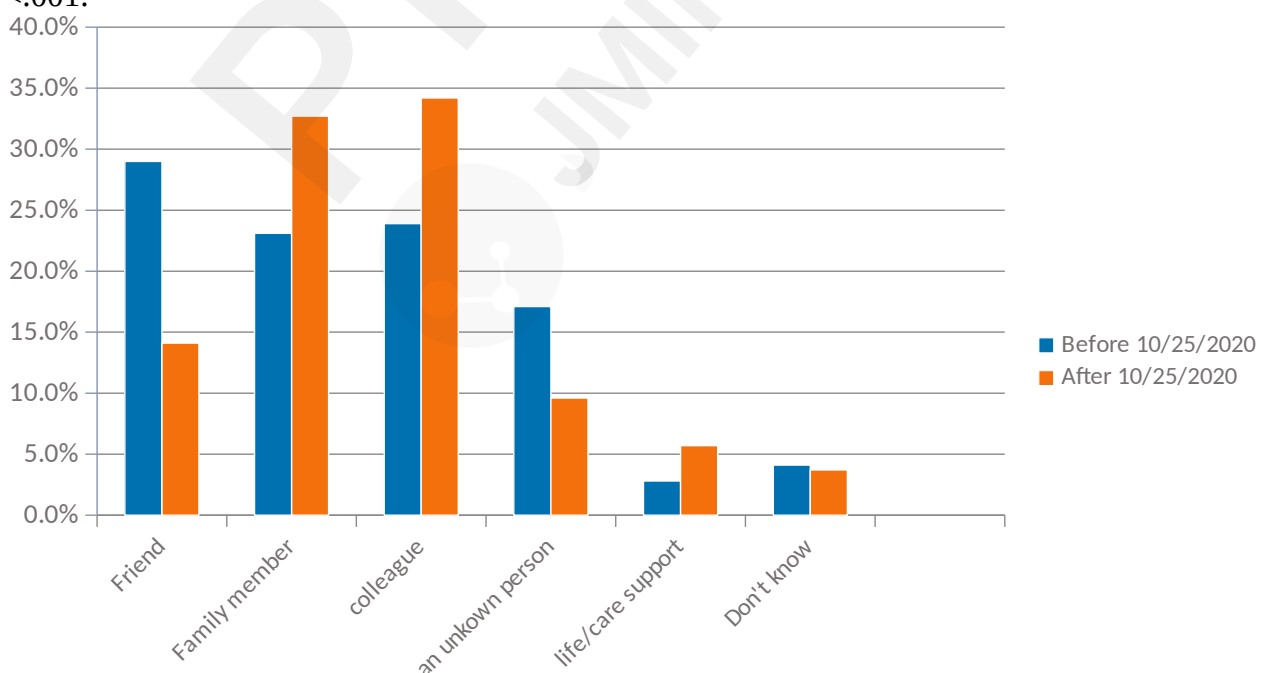
The main time of contamination also changed after the lockdown. Among people who know the time of contamination (n=1434, respectively n=961 before lockdown; n=473 after lockdown), the main time was the evening (35.3%) before the lockdown which was reduced to 18.2% after it (*P*<.001). The main time of contamination became the morning after the lockdown initiation. Morning and noon together became 47.2% of time of contamination. Figure 3

The distribution of responses regarding the moment of contamination is different according to the level of certainty expressed by the user (*P*=.005). Even if the preferred time o ** is the evening, it is observed that users who are less sure estimate more than users sure to have contracted the virus in the morning: 21.5% (114/529) vs 15.5% (140/905), respectively.

Figure 3: Contamination circumstances before and after the partial lockdown which was trigged in France on 10/25/2020.: Answer to the question "When do you think the contamination occurred?" *P*<.001.
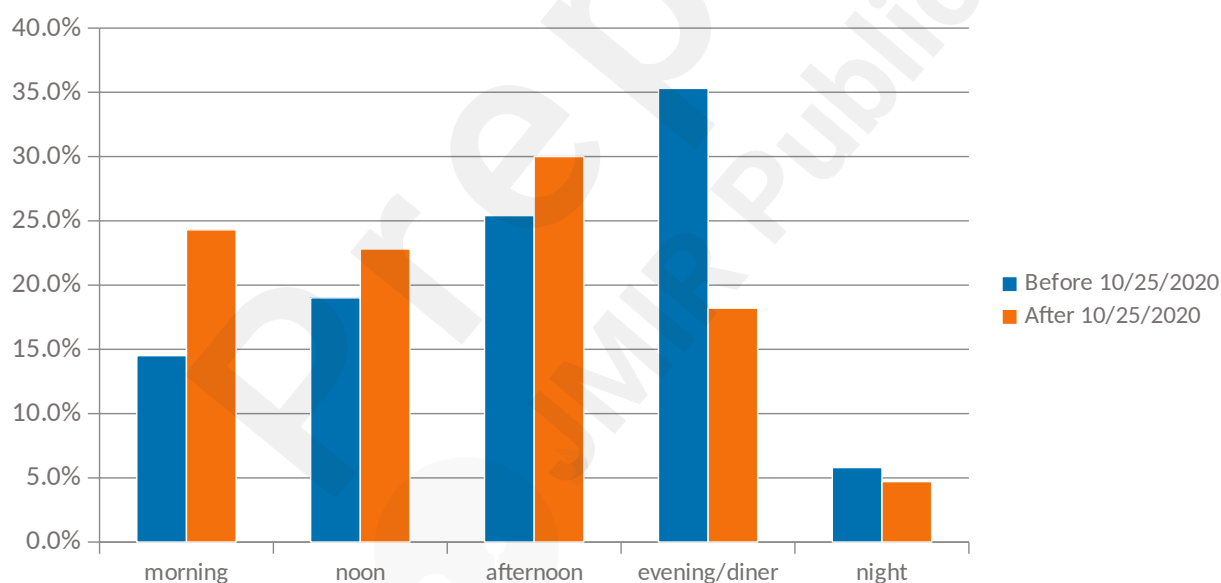
The distribution of responses regarding the location of suspected contamination is different according the sureness of contamination (*P*=.003). For users think they know where or when they were contaminated, they privileged the collective place compared to users who were sure: 29.8% (231/775) vs 24.3% (313/1 290), respectively.

The location of suspected contamination by users of the web-application questionnaire was home (own home, family home or friend home) in 39.1% (510/1 305) of declarations before lockdown and remained high after it: 43.3% (329/760). The other locations where the virus was transmitted to the users changed before versus after lockdown (*P*<.001). It was increased in work area: 22.5% (293/1 305) vs 29.6% (225/760), reduced in collective places: 33.0% (430/1 305) vs 15.0% (114/760) and increased in care centers: 4.4% (58/1 305) vs 9.7% (74/760). Work became the main location of contamination after lockdown. Figure 4

Figure 4: Contamination circumstances before and after the partial lockdown which was trigged in France on 10/25/2020.: Answer to the question "Where do you think the contamination occurred?" *P*<.001.
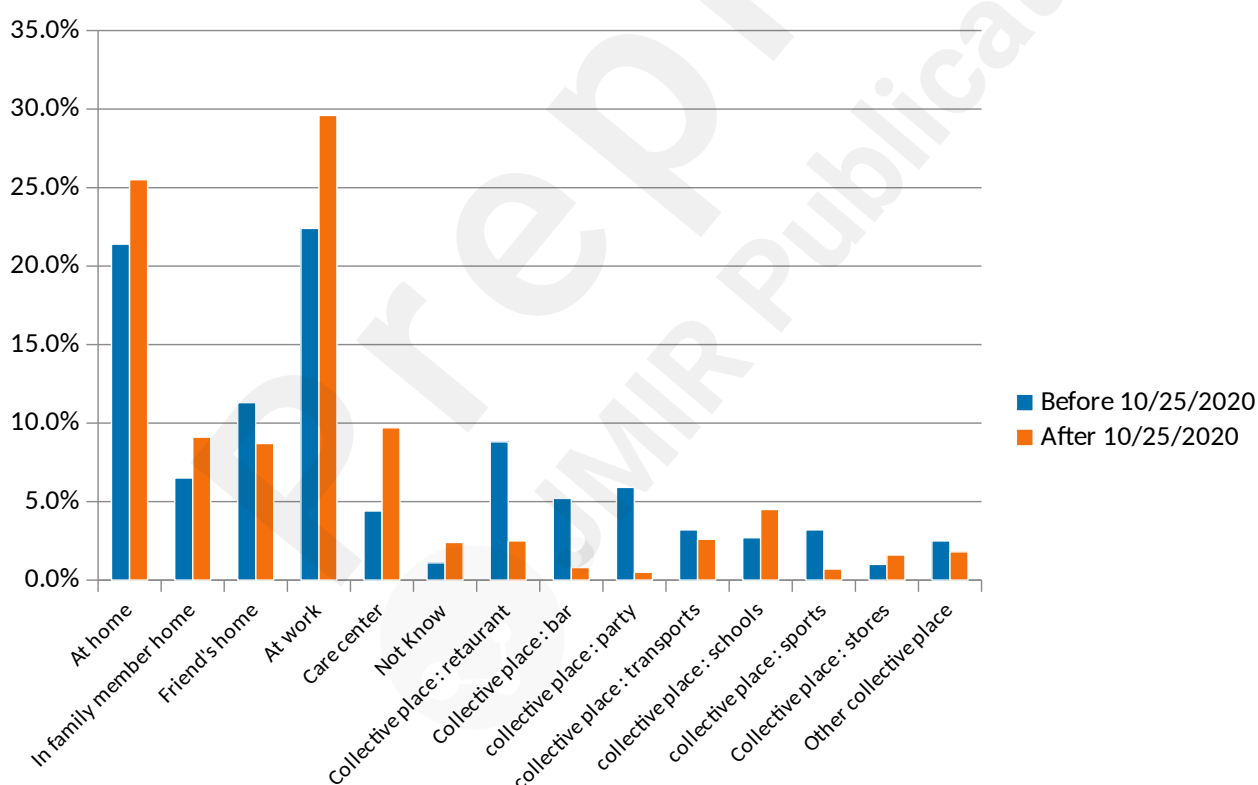

Collective places where transmission occurred, were significantly different before and after lockdown (*P*<.001). The main collective places with transmission of the virus before the lockdown

were restaurants with a reduction from 27.0% (114/422) to 16.7% (19/114), bars: 16.1% (68/422) to

5.2% (6/114), parties: 18.0% (76/422) to 3.5% (4/114), and sports: 10.0% (42/422) to 4.4% (5/114).

Transports and schools became the main collective places of transmissions after the partial

lockdown: 17.5% (20/114) and 29.8% (34/114) respectively. Figure 5.

Other collective places than those cited above were reported by 4.5% (19/422) and 11.4% (13/114) of

users before and after the lockdown initiations respectively (so respectively 1.5% and 1.7% of all

contaminations).

On the total of contaminations, restaurant was the source of only 2.5% (19/760) after lockdown

versus 8.8% (114/1 297) before lockdown, bars 0.8% (6/760) versus 5.2% (68/1 297) before

lockdown, schools and stores were the source of respectively 4.5% (34/760) and 1.6% (12/760)

(versus 2.7% (35/1 297) and 1.0% (13/1 297) respectively before lockdown).

Figure 5: Main collective places concerned by contaminations before and after lockdown.
P<.001 (only main locations of collective area).
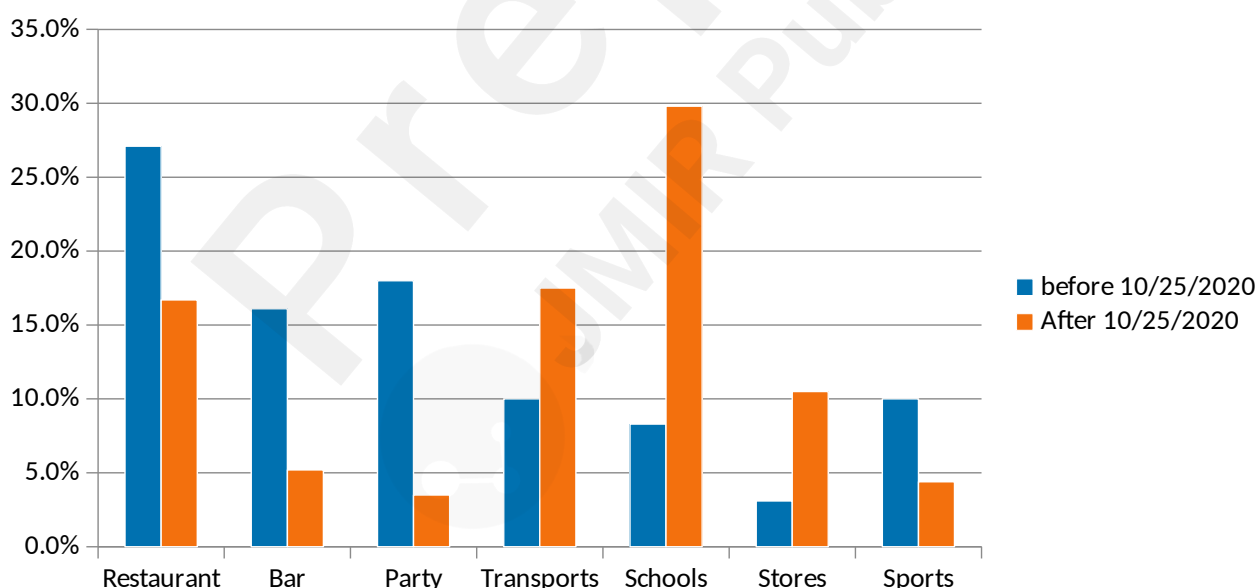
Discussion:

Our results suggest that virus transmission occurred mainly in private area (50.2%) between 8/15 and 12/24/2020 in France and by a colleague at work (27.7%). The partial lockdown which occurred on 10/25/2020 during the second wave of COVID-19 changed the circumstances of contamination.

Contamination by a friend was significantly reduced (29.0% before and 14.1% after it) but increased from a family member or a colleague. Among people who know the time of contamination, the main time of the day was the evening before the lockdown (35.3%) and the morning/noon became the main time of contamination after it (18.2%). The main location of suspected contamination by users of the web-application questionnaire was home (own home, family home or friend home) in 39.1% of declarations before lockdown and remained high after it (43.3%).

It was increased in work area (22.5% vs 29.6%, p<.001), reduced in collective places (33.0% vs 15.0%, p<.001) and increased in care centers (4.4% vs 9.7%, p<.001). Work became the main location of contamination after lockdown. The main collective places impacted by the shutdown were restaurant, bars and parties in which reduction of contaminations was significant.

Our results show that contaminations occurred in collective places in 33.0% and that lockdown reduced it to 15.0% of contaminations (that is a 54.5% reduction) whereas daily anosmia reported on national website maladiecoronavirus.fr showed 86% reduction after the partial lockdown initiation. This can be explained by the voluntary decisions of people to reduce social meetings at a higher rate than government-imposed restrictions on activity during the lockdown and especially friends from which contaminations decreased from 29.0% to 14.1%. [8] As work and school were maintained during the shutdown, higher rate of contaminations was observed in those places. Partial lockdown concerned all cultural locations such as theaters or cinema. We did not ask specifically to users of the web-application sourcecovid.fr if they thought they were contaminated in those sites but only "other locations" was asked. However, "other locations" was answered by near 1.5% of users before and after lockdown, suggesting that cultural sites were not a significant source of contamination.

Although this study is based on unverifiable data, the quality of the data is consolidated by the incubation period calculated at 4.0 days which is the median time reported in literature, the equity between male/female, 10.8% of severe disease (15% in Guan et al report), the median age of users (43 years in our study, 47 in Guan study), and 61.2% of users reported sureness of contamination circumstances. [9] Moreover, results are consistent with published report on excess of risk of contamination in restaurant (x2.4) or bar (x3.9) as well as household (x10) with a higher number of questionnaires in our study (2 218) than in Fisher et al article (314). [10-12]

Our study has limitations. A user of the web-application could use it several times and filled theoretically more than one questionnaire. Memory bias could occur to users contaminated at the beginning of the study period which explain the relative high number of users during the recent lockdown period.

Population aged more than 65 years were 12.5% of users whereas contamination circumstances are not the same as in active population. Moreover, only 4.4% of questionnaires concerned young people less than 18. This has probably underestimated contaminations at school. We do not have enough data to assess geographic variations of lockdown effect, especially to differentiate urban and rural area impact.

However, our study is the first to assess partial lockdown effect on contamination circumstances and may help health authorities to adapt policy of COVID-19 spreading prevention.

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Sponsor: (Weprom) designed and conducted the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Author Contributions:

Pr Denis had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Denis.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: All authors

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Pr Denis, Anne-Lise Septans

Obtained funding: None.

Administrative, technical, or material support: Pr Denis, Weprom, Docaposte, Kelindi.

Supervision: Pr Denis,

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest

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Supplementary Files

Figures

Impact of the partial lockdown on daily RT-PCR positive tests. Red area: national partial lockdown period initiated on 10/25/2020.