Expected impact of exit strategies after the second lockdown - France, Nov 2020

Report #23 [previous reports at: www.epicx-lab.com/covid-19.html]

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SUMMARY

This report is an update of previous reports (Report #19, Report #21) on the expected impact of the second lockdown implemented in France on Friday, October 30 to suppress the second wave of COVID-19 epidemic. We provide updated projections simulating a mild lockdown with schools open informed on the estimates on mobility reduction recorded during the first week of lockdown from mobile phone data (Report #22), and explore different exit strategies. The current report focuses on Île-de-France; analyses for other regions will follow.

INTRODUCTION

France is under a second lockdown since Friday, October 30 to curb the second epidemic wave. This report presents an update of the scenario analyses on the expected impact of lockdown and exit strategies (see Report #19, Report #21). This update considers:

- mobility data up to w45;
- the fit of w43-44 to account for school holidays and curfew;
- two different ending dates for the lockdown: December 1, as currently foreseen, and December 20, at the start of school holidays for Christmas;
- different hypotheses on the exit scenario: as in w42, i.e. prior to interventions, or as in the conditions of w44, i.e. with school holidays and curfew.

The report focuses on Île-de-France; analyses on other regions will follow.

METHODS

Model. We used the model developed by INSERM to respond to the COVID-19 pandemic[1–3]. The model was shown to capture the transmission dynamics of the epidemic in the first wave[1], was used to assess the impact of lockdown, exit strategies and reopening of schools in mid-April[1,2], and to evaluate the rate of underdetection of the test-trace-isolate strategy in the months of May-June[3]. It is based on a stochastic discrete age-stratified approach using demographic, age profile, and social contact data of the regions of mainland France, to account for age-specific contact activity and role in COVID-19 transmission. The model accounts for contacts in the population in different settings and activities. Disease progression is specific to COVID-19 and parameterized with current knowledge to include presymptomatic transmission, asymptomatic and symptomatic infections with different degrees of severity (paucisymptomatic, with mild symptoms, with severe symptoms requiring hospitalization). Four age classes are considered: [0-11), [11-19), [19-65), and 65+ years old (children, adolescents, adults, seniors). A reduced susceptibility was considered for children and adolescents, along with a reduced relative transmissibility of children, following available evidence from household studies, contact tracing investigations, and modeling works. More details are provided in Ref.[3].

The model was validated region by region against the estimates of three independent serological studies conducted in France after the first wave[3].

Parameterization and calibration. For each region, the model integrates estimates on the number of individuals at workplaces over time, based on Google mobility data[4] and Orange cellphone mobility data[5,6] (**Figure 1**), accounts for students going back to school at the start of the school calendar on Sept 1, for school holidays in w43-44, and integrates data on the adoption of preventive measures over time[3,7].

The model is fit to the different epidemic phases (pre-lockdown, lockdown, exit, summer, rentrée) using hospital admission data by region. More details on the model and calibration are provided in Refs.[1,3]. **Results in this report account for the epidemic situation up to week 45, including the effect of school holidays and curfew in w43-44.**

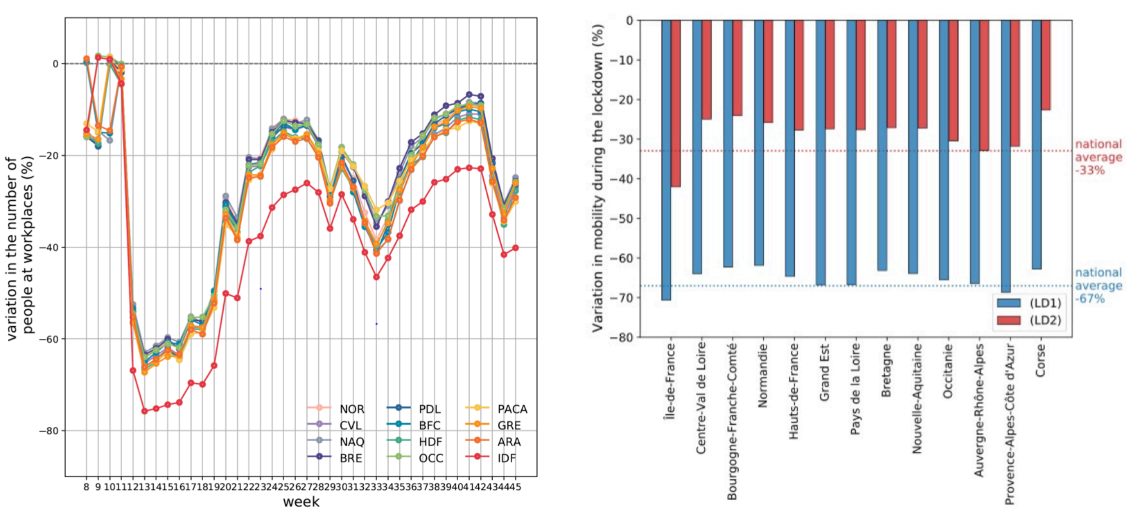

Figure 1. Estimated presence at workplaces by region and over time and observed mobility reduction on first day of lockdown. Left: Weekly estimates by region of presence at workplaces are based on Google mobility data[4] and confirmed independently with mobility data obtained from Orange cellphone data[5]. The variation is computed with respect to pre-epidemic conditions, in the months of January-February (level corresponding to zero on the vertical axis). Variations reported in weeks 8-10 refer to school holidays, similarly to variations recorded in weeks 43-44 for the start of the 2-week All Saints' holiday. Right: Variation of mobility inside each region recorded during the first week of the first lockdown (in blue, LD1) and the first week of the second lockdown (in red, LD2)[6,8]. Estimates are based on mobility fluxes extracted from mobile phone data (collaboration with Orange Research Dept). The average variation at the national level in November was -33% wrt pre-pandemic conditions, vs. -67% recorded in the first lockdown.

Lockdown scenarios. Lockdown is implemented on October 30, at the end of w44. Projections are obtained under a set of scenarios:

- **No-change scenario**, i.e. the epidemic continues to evolve as estimated in w42, as no interventions were implemented.
- **LD2 (LD2=mild lockdown, informed by mobility in 2nd lockdown) with all schools open**, assuming a mild lockdown to simulate the restrictions currently in place in France, where a larger number of production sectors remain open compared to the first lockdown. To inform this scenario, we used the mobility reduction estimated in the first week of lockdown (Report #22) thanks to a collaboration with Orange Research Dept[5], analogously to what we did during the first lockdown[1]. The efficacy of the lockdown varied by region, following the efficacy estimated in the first lockdown and accounting for the recorded mobility reduction. In this scenario, all schools are open, as currently in place. More details are in Report #19, Report #21.

Further, we consider the following exit scenarios:

- **Exit on December 2 assuming the conditions of w42**, i.e. considering the epidemic conditions in each region prior to the implementation of interventions.
- **Exit on December 2 assuming the conditions of w44**, i.e. considering the effects of school holidays and curfew.
- **Exit on December 21 assuming the conditions of w42**, i.e. considering the epidemic conditions in each region prior to the implementation of interventions.
- **Exit on December 21 assuming the conditions of w44**, i.e. considering the effects of school holidays and curfew.
- **Exit on December 21 assuming the conditions of w44 and 10% less people at work**, i.e. considering the effects of school holidays and curfew, but assuming that presence at work is 10% less than what registered in w44.

Universities are assumed to remain closed during all scenarios and adopt remote learning, as currently done.

RESULTS

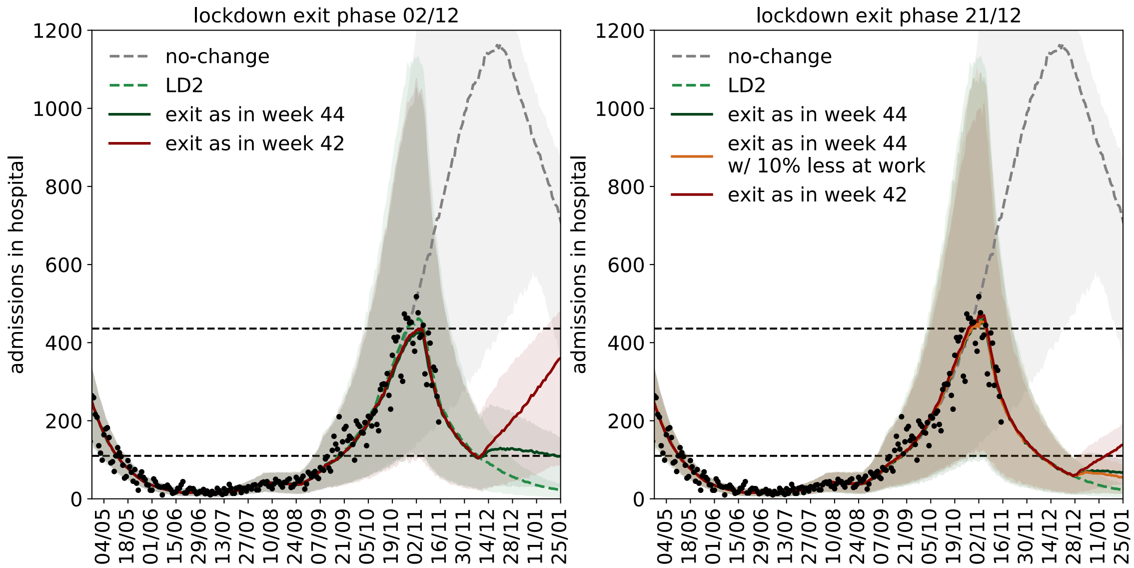

Figure 2. Epidemic trajectories for daily hospitalizations with a mild lockdown with all schools open and different exit strategies. Left: exit on December 2. In each plot, each curve corresponds to a different scenario: grey for the *no-change scenario*, i.e. if the situation is unchanged and the epidemic continues along the tendency estimated for w42; green (dashed line) for *LD2 w/ all schools open*, i.e. applying indefinitely the mild lockdown with all school levels in session; dark red (continuous line) for the lockdown scenario followed by an *exit on December 2 with conditions as in w42* (pre-interventions); dark green (continuous line) for the lockdown scenario followed by an *exit on December 2 with conditions as in w44* (school holidays and curfew). Right: exit on December 21, at the start of school holidays. In each plot, each curve corresponds to a different scenario: *no-change scenario* and *LD2 w/ all schools open* are as in the left plot; dark red (continuous line) for the lockdown scenario followed by an *exit on December 21 with conditions as in w42* (pre-interventions); dark green (continuous line) for the lockdown scenario followed by an *exit on December 21 with conditions as in w44* (school holidays and curfew); orange (continuous line) for the lockdown scenario followed by an *exit on December 21 with conditions as in w44 and 10% less people at work* (school holidays and curfew). The two dashed horizontal lines correspond to the levels of hospital admissions registered at the entry into the first lockdown on March 17 (top line) and the exit from the first lockdown on May 11 (bottom line). Black dots represent hospitalization data.

KEY FINDINGS

- The model is not fit to w45 of hospitalization data, however the data nicely follow the predicted course of the epidemic trajectory under the mild lockdown with schools open.
- Phasing out lockdown without a strategy (i.e. going back to the pre-curfew conditions, as in w42) leads to a rapid rebound.
- Exiting under the conditions experienced in w44, i.e. school holidays and curfew, leads to a median value of the effective reproductive number R_{eff}~1. Assuming that 10% less people would go to work under these conditions (e.g. in the first week of school holiday preceding Christmas day) would not lead to substantial changes in the short term. Fluctuations around these scenarios are to be expected.

- As the analysis on disentangling school holidays and curfew effects in w43-44 is still ongoing, the exit scenarios with conditions as in w44 include the closure of the school. While this is consistent with the school calendar for an exit on December 21, it is not consistent with an exit on December 2. The scenario exiting on Dec 2 with curfew effects but schools open is to be expected between the continuous red and dark green curves in the left plot of Figure 2.

MAIN LIMITATIONS

- These findings apply to the regions considered here and cannot be transposed to other regions, because of (i) the epidemic situation prior to intervention, (ii) the fraction of infected population, (iii) the region-specific adoption of preventive measures, (iv) the region-specific reduction of mobility during lockdown, (v) the implementation of the curfew in specific cities. Analyses for other regions will follow.
- The limitations in the definition of the lockdown scenario still apply (see Report #21).

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