Ascertainment of laboratoy-confirmed COVID-19 deaths in Switzerland until January 2022

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Report generated on Date: 2022-02-18 Time: 18:17

# Summary

**Background.**

**Methods.**

**Results.**

**Conclusions.**

# Introduction

* Two ways to estimate the global impact of covid-19 in terms of mortality.
* Excess mortality: assumptions, advantages and limitations
* Mandatory reporting of laboratory-confirmed deaths
* Public debate in Switzerland
* Problems with BFS method
* Aims

# Methods

## Reporting of laboratory-confirmed deaths in CH

## Statistical model

* Nature Com [1]
* 95% CrI

## Metrics

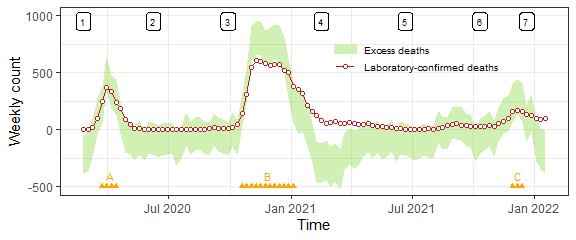
* Full propagation of uncertainty
* Define current excess (lower bound 95% CrI > 0)
* Coverage (laboratory-confirmed deaths within the 95% CrI of excess)
* Absolute difference (excess - laboratory-confirmed deaths, with 95% CrI)
* Ascertainment of deaths (laboratory-confirmed deaths / excess, with 95% CrI), assuming that excess is only due to COVID-19

# Results

t1a = summ\_phase\_base %>%   
 dplyr::transmute(phase=as.character(phase),  
 labo\_deaths,  
 excess=qsum(excess\_med,excess\_lob,excess\_upb)) %>%   
 dplyr::bind\_rows(  
 summ\_all\_base %>%   
 dplyr::transmute(phase="Total",  
 labo\_deaths,  
 excess=qsum(excess\_med,excess\_lob,excess\_upb)))  
  
t1b = summ\_phase\_temp %>%   
 dplyr::filter(phase!=7) %>%   
 dplyr::transmute(phase=as.character(phase),  
 excess\_temp=qsum(excess\_med,excess\_lob,excess\_upb)) %>%   
 dplyr::bind\_rows(  
 summ\_all\_temp %>%   
 dplyr::transmute(phase="Total",  
 excess\_temp=qsum(excess\_med,excess\_lob,excess\_upb)))  
  
dplyr::right\_join(date\_phases,t1a,by = "phase") %>%   
 dplyr::left\_join(t1b,by = "phase") %>%   
 flextable() %>%   
 set\_table\_properties(layout="autofit") %>%   
 set\_header\_labels(phase="Phase",  
 start\_date="Start",  
 end\_date="End",  
 labo\_deaths="Laboratory-confirmed deaths",  
 excess="Excess deaths (95% CrI)",  
 excess\_temp="Excess deaths, accounting for temperature (95% CrI)")

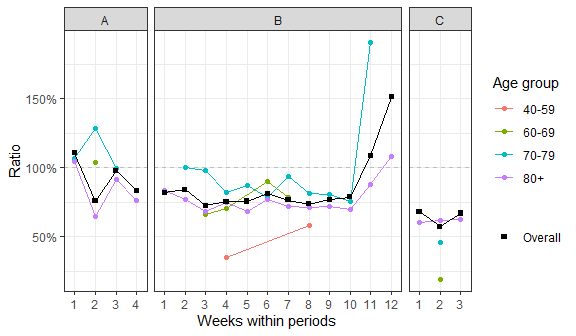
| Phase | Start | End | Laboratory-confirmed deaths | Excess deaths (95% CrI) | Excess deaths, accounting for temperature (95% CrI) |
| --- | --- | --- | --- | --- | --- |
| 1 | 2020-02-24 | 2020-06-07 | 1,683 | 566 (-1,498 to 2,624) | 554 (-1,623 to 2,798) |
| 2 | 2020-06-08 | 2020-09-27 | 97 | -1,032 (-3,066 to 945) | -1,028 (-3,160 to 1,213) |
| 3 | 2020-09-28 | 2021-02-14 | 7,159 | 7,058 (4,907 to 9,304) | 7,075 (4,634 to 9,461) |
| 4 | 2021-02-15 | 2021-06-20 | 828 | -2,875 (-5,502 to -521) | -2,942 (-5,573 to -565) |
| 5 | 2021-06-21 | 2021-10-10 | 354 | -661 (-2,613 to 1,328) | -706 (-2,795 to 1,213) |
| 6 | 2021-10-11 | 2021-12-19 | 860 | 946 (-424 to 2,301) | 906 (-559 to 2,165) |
| 7 | 2021-12-20 | 2022-01-23 | 543 | -240 (-900 to 360) |  |
| Total |  |  | 11,524 | 3,792 (-5,824 to 14,087) | 4,188 (-6,068 to 13,875) |

current\_excess = summ\_week\_base %>%   
 filter(metrics\_current\_excess==1) %>%   
 select(week) %>%   
 mutate(wave=case\_when(week<as.Date("2020-05-01") ~ "A",  
 week>as.Date("2021-02-01") ~ "C",  
 TRUE ~ "B"))  
summ\_week\_base %>%   
 ggplot(aes(x=week)) +  
 geom\_ribbon(aes(ymin=excess\_lob,ymax=excess\_upb,fill=col\_excess1),alpha=.3) +  
 # geom\_line(aes(y=excess\_med),col=col\_excess1,alpha=.3,size=1.1) +  
 geom\_line(aes(y=labo\_deaths,col="col")) +  
 geom\_point(aes(y=labo\_deaths,col="col"),shape=21,fill="white") +  
 geom\_label(data=date\_phases,aes(x=start\_date,y=950,label=phase),size=2.5) +  
 geom\_point(data=current\_excess,y=-500,colour="orange",shape=17) +  
 annotate("text",y=-400,x=as.Date(c("2020-04-04","2020-11-28","2021-12-07")),  
 label=c("A","B","C"),colour="orange",hjust=.5,size=3) +  
 coord\_cartesian(ylim=c(-500,1000)) +  
 labs(x="Time",y="Weekly count") +  
 scale\_x\_date(date\_labels = "%b %Y") +  
 scale\_fill\_identity(name = NULL, guide = 'legend', labels = c('Excess deaths')) +  
 scale\_colour\_manual(name = NULL, values =c("col"=col\_labd), labels = "Laboratory-confirmed deaths") +  
 theme(legend.position = c(.7,.75),  
 legend.spacing = unit(0,"mm"),  
 legend.text=element\_text(size=7.5),  
 legend.key.height = unit(0,"mm"),  
 legend.background = element\_blank(),  
 legend.margin = margin(0,0,0,0))



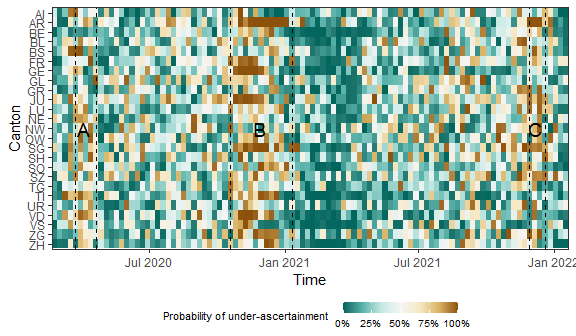
*Figure 1*. Comparing weekly counts of laboratory-confirmed deaths with weekly excess deaths over the 7 phases of the epidemic in Switzerland (shown at the top). Orange triangles on the bottom signal the three periods A, B and C of high excess mortality (defined as when the lower bound of excess mortality is greater than 0).

tmp = summ\_week\_base %>%   
 left\_join(current\_excess,by="week") %>%   
 filter(!is.na(wave)) %>%   
 group\_by(wave) %>%   
 mutate(week2=row\_number())   
   
summ\_week\_age\_base %>%   
 left\_join(current\_excess,by="week") %>%   
 filter(!is.na(wave)) %>%   
 group\_by(wave,age\_group) %>%   
 mutate(week2=row\_number()) %>%   
 filter(!is.na(metrics\_ascert\_med)) %>%   
 ggplot() +  
 geom\_hline(yintercept=1,linetype=2,colour="grey") +  
 geom\_line(aes(x=week2,y=metrics\_ascert\_med,colour=age\_group)) +  
 geom\_point(aes(x=week2,y=metrics\_ascert\_med,colour=age\_group)) +  
 geom\_line(data=tmp,aes(x=week2,y=metrics\_ascert\_med),colour="black") +  
 geom\_point(data=tmp,aes(x=week2,y=metrics\_ascert\_med,shape="Overall"),colour="black") +  
 facet\_grid(~wave,scale = "free\_x",space = "free") +  
 scale\_y\_continuous(labels=scales::percent) +  
 scale\_shape\_manual(values=c("Overall"=15)) +  
 scale\_x\_continuous(breaks=1:12,minor\_breaks = NULL,expand=expansion(add=c(.5,.5))) +  
 labs(x="Weeks within periods",y="Ratio",colour="Age group",shape=NULL)



*Figure 2*. Ratio of laboratory-confirmed deaths over median excess deaths during the three periods of high excess mortality A, B and C. Only age groups with high excess mortality during a given week (i.e. the lower bound of excess mortality is above 0) are shown.

tmp = current\_excess %>%   
 group\_by(wave) %>%   
 summarise(min=min(week)-.5,  
 max=max(week)+6.5)  
summ\_week\_canton\_base %>%  
 ggplot(aes(x=week)) +  
 geom\_tile(aes(fill=prob\_above,y=canton)) +  
 scale\_x\_date(date\_labels = "%b %Y",expand=expansion(0,0)) +  
 scale\_y\_discrete(limits=rev) +  
 scale\_fill\_distiller(palette="BrBG",labels=scales::percent) +  
 geom\_vline(data=tmp,aes(xintercept=min),linetype=2) +  
 geom\_vline(data=tmp,aes(xintercept=max),linetype=2) +  
 annotate("text",y=13,x=as.Date(c("2020-04-04","2020-11-28","2021-12-07")),  
 label=c("A","B","C"),colour="black",hjust=.5,size=5) +  
 labs(x="Time",y="Canton",fill="Probability of under-ascertainment ") +  
 coord\_cartesian(clip="off") +  
 theme(legend.position = "bottom",  
 legend.title = element\_text(size=8.5),  
 legend.text=element\_text(size=7.5),  
 legend.key.height = unit(3,"mm"),  
 legend.background = element\_blank(),  
 legend.margin = margin(0,0,0,0))



*Figure 3*. Probability that the number of laboratory-confirmed deaths is lower than the number of excess deaths in a given week by canton. The three periods of high excess mortality are highlighted.

[1] G. Konstantinoudis *et al.*, “Regional excess mortality during the 2020 covid-19 pandemic in five european countries,” *Nature Communications*, vol. 13, no. 1, pp. 1–11, 2022.

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