**Comparison of Covid 19 associated health risks**

**with other viral, occupational hazards**

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**Caveat**

Having worked in an emergency, the literature review has been superficial. We were unable to present the bibliography in a scientific manner. Online articles were accessed between May 1 and 10, 2020. We apologize to our readers for possible errors in the document.

**Abstract**

The European Commission periodically classifies viruses on their occupational hazards – the risks that they entail for workers. This classification defines the level of health and safety protection from exposure to viruses at work that workers are entitled to claim. Viruses belonging to group 3 can cause severe human disease and hazard to workers, a risk of spreading to the community but there is usually effective prophylaxis or treatment available. Group 4 viruses are similarly defined except that there is usually no effective prophylaxis or treatment available. The last classification dates October 31st, 2019. The European trade unions and the Commission are negotiating the classification of the Covid 19 virus (CV19 below) along these two categories. This paper weighs the reasons to classify it in category 3 or 4 while comparing CV19-associated risks to the most important viroses classified in these two categories.

Methodologically wise, we compared the mortality, morbidity, and transmission in general population and workers of Covid 19 to those of viruses belonging to the classes 3 and 4 having sufficient public health importance to deserve a chapter in 2 handbooks of infectious diseases and tropical medicine. We also examined the hypothesis that contaminated workers in contact with the public increase the Covid 19 transmission and case fatality rate in their work environment but importantly in the community.

Among the studied diseases, only Covid 19, hepatitis B and C, H2N2 and AIDS represent a public health risk to EU citizen. The others are either absent or exceptional in Europe until now. HVB, H2N2 and AIDS have an effective treatment and/or prophylaxis but not Covid 19. Remdesivir would reduce the sickness episode duration but it has a very moderate effect on the risk of dying. By contrast, three of the 4 diseases belonging to group 4 have an effective treatment and/or vaccine. None of them represents a public health risk in Europe. Contaminated workers in contact with the public play an important role in disseminating the virus. Workers and professionals in hospitals, nursing homes and in other essential services, importantly increase the overall case fatality rate.

Covid 19 characteristics justify its classification in category 4. By strongly protecting workers and professionals in hospitals and age residential homes, and all the workers in contact with the public, the EU would not only improve health in work environment but also activate a mechanism key to reduce Covid 19 transmission, morbidity and mortality in the general population. Admittedly, the availability of a new effective vaccine or treatment would imply a change in the proposed classification.

**Introduction**

The European Commission periodically classifies viruses on their occupational hazards – the risks that they entail for workers. This classification defines the level of health and safety protection from exposure to viruses at work that workers are entitled to claim. Viruses belonging to group 3 can cause severe human disease and hazard to workers, a risk of spreading to the community but there is usually effective prophylaxis or treatment available. Group 4 viruses are similarly defined except that there is usually no effective prophylaxis or treatment available. [[1]](#footnote-1) The last classification dates October 31st, 2019. [[2]](#footnote-2) The European trade unions and the Commission are negotiating the classification of the Covid 19 virus (CV19 below) along these two categories. This paper weighs the reasons to classify it in category 3 or 4 while comparing CV19-associated risks to those of the most important viroses classified in these two categories.

**Methodology**

We compared the mortality, morbidity, and transmission in general population and workers/professionals exposed to Covid 19 virus to those of viruses belonging to the classes 3 and 4 having sufficient public health importance to deserve a chapter in 2 well known handbooks of infectious diseases [[3]](#footnote-3)and tropical medicine. [[4]](#footnote-4) We also examined the hypothesis that contaminated workers in contact with the public not only increase the Covid 19 transmission and case fatality rate in their work environment but also, importantly, in the community.

Effective treatment reduces suffering, sequellae and case fatality rate. Prophylaxis reduces incidence and particularly R0 [[5]](#footnote-5) in case of human-to-human transmission, and sometimes case fatality rate as well.

Transmissibility is measured by the household secondary attack rate (SAR). The SAR is the probability that an exposed susceptible person develops disease over the duration of infectiousness in a case of patient. The R0 basic reproduction number of an [infection](https://en.wikipedia.org/wiki/Infection) is the [expected](https://en.wikipedia.org/wiki/Expected_value) number of cases directly generated by one case in a population where all individuals are [susceptible](https://en.wikipedia.org/wiki/Susceptible_individual) to infection.[[6]](#footnote-6) R0 is the product of virus transmissibility by the number of contacts over contagiousness period by the duration of this period. The proportion of population to be vaccinated to achieve herd immunity is given by the following formula

PT to be vaccinated = (1 - 1/R0) X 100

R0 is the index at the start of the epidemic at time t0 when collective immunity is zero. Then we talk about Re at time t. For example for COVID, R0 was between 2 and 3 and now between 0.5 and 0.7 in Belgium following confinement. [[7]](#footnote-7)

The (population based) disease specific mortality is the product of case fatality rate by the incidence.

We aimed at assessing the public health importance of the considered diseases in Europe, and particularly their direct importance for workers and professionals, and the indirect importance of their infection for community health while testing the hypothesis that workers in contact with the public increase the Covid 19 R0 and its case fatality rate in specific milieux or/and the community.

The most important criterion is the existence of effective prophylaxis and treatment. The second is virus presence in Europe. The third is its population-based mortality. Then come the others. Since all viruses can contaminate lab workers, their case is not discussed here.

**Results**

Epidemiological comparison of Covid 19 with the other viroses of EC categories 3 and 4 of significant public health importance

For each disease, we examine the prevention, the R0, the incidence, the case fatality rate, the general mortality, the occupational concentration and the importance in Europe.

1. Covid 19

* No vaccine is available. The prevention relies on the use of masks, [[8]](#footnote-8) testing, tracing contacts and isolation. With regard to treatment, Remdesivir would reduce the sickness episode duration but its effect on the risk of dying was not demonstrated in one study [[9]](#footnote-9) and according to another, this effect would be moderate. [[10]](#footnote-10) Hydroxychloroquine in hospitalized patients with CV19 would not be effective [[11]](#footnote-11) but it is too early to hold definitive conclusions as it is a combined treatment (hydroxychloroquine + azythromycin) that would have yielded the results in Marseilles and furthermore, it has been advocated for early uses.
* It is too early to determine the maximum R0 of the epidemic. (Figure 1)
* As of 10 May 2020, they were 3986119 cases and 278814 deaths [[12]](#footnote-12)
* The CFR was quite variable, from 4.24% in Germany to 13.76% in Italy. Inter-country comparisons are misleading, especially between small and large countries
  + because in large countries, the epidemic concentrates regionally; [[13]](#footnote-13)
  + and because of large differences in testing capabilities, leading to the impossibility of knowing the actual numbers of cases, most of them being asymptomatic

Early testing, tracking, contact tracing, isolation and quarantine explain part of the impact in Germany, as do the number of ICU beds per 100,000 population ((33,9 in Germany, 15,9 in Belgium, 12,5 in Italy and 9,7 in Spain). [[14]](#footnote-14) Hypothetically, this difference could explain why nursing home residents were more easily hospitalized in Germany: the proportion of Covid 19 deaths in nursing homes would increase when the capacity of ICUs is reduced.

* As with CFR, it is too early to compute the disease specific mortality rate. However, it can already be observed that mortality in the countries where it is the highest is explained by poorer planning of epidemic control (tracing, testing, isolation, masks) but also by a hospital system and nursing homes whose resources have been cut by austerity policies or which are insufficiently accessible because of the commercial financing of health systems [[15]](#footnote-15) – good planning possibly compensating partially for the other factors. Geographical, demographical, social and cultural variations from country to country can also explain part of the differences in the epidemic transmission (R0), therefore affecting incidence and mortality.
* What are the reasons to believe that workplaces are important to the dissemination of Covid 19 in the general population? Health care [[16]](#footnote-16) and nursing home workers are well known disseminators in high-risk populations. 61% of people with Covid 19 investigated in New Zealand clusters were in work environment clusters (Table 1). [[17]](#footnote-17) In Belgium, as of the 5th of May, 53% of deaths occurred in age residential homes, against 47% in hospitals. [[18]](#footnote-18) Besides, the case fatality rate in age residential home was 54,7%. While the government restricted parents’ access to these homes, it allowed positive tested workers and professionals to continue working there. The distribution of cases in Germany (see figure 2) shows a higher incidence in the population in work age than in the 60-80-age group and a steep increase in the age groups accessing retirement homes. The moderately higher incidence in females could mirror their higher presence in social services. Finally, there is a large array of publications suggesting that there is a disproportionate Covid 19 burden on working classes, in France for instance. [[19]](#footnote-19)
* With 1534605 cases and 151429 deaths at May 10, Europe had the world highest burden of CV19.

1. Rift Valley Fever (RVF) [[20]](#footnote-20)

* Surveillance, tracking, contact tracing and isolation are effective.
* R0 is low, the human-to-human transmission being quite limited.
* The biggest epidemics were comparatively modest (Sudan, 2007, 738 cases) because epidemics tend to be self-limiting.
* CFR was 4% in Sudan.
* Mortality is low
* Disease specific mortality mainly concerns workers in contact with dead animals.
* RVF does not occur in Europe. Although currently confined to Africa and the near-East, this disease causes concern in countries in temperate climates where both hosts and potential vectors are present, such as the Netherlands. [[21]](#footnote-21)

1. Rabies [[22]](#footnote-22) [[23]](#footnote-23)

* Post-exposure vaccination and immunoglobulin are effective. Prevention with dog immunization is effective
* There is practically no human-to-human transmission
* Worldwide, the disease burden is important, with 15 million cases / year.
* Without treatment, rabies is always fatal (CFR = 100%).
* Worldwide, mortality was 17400/year in 2015.
* There are no occupational clusters.
* In 2013, no cases were reported in the EU but 3 in EEA (Russian Federation) [[24]](#footnote-24)

1. SARS [[25]](#footnote-25) [[26]](#footnote-26)

* No vaccine and treatment exist. Tracing, tracking and quarantine are effective.
* The R0 is 3.5 [[27]](#footnote-27) (2 – 4 then 0.4 in 2003)
* During the 2003-2005 epidemic, they were 8422 cases, all in Asia.
* The CFR is 11% for all age group but 55% after 65.
* Mortality: 925 during the epidemic. The case fatality rate was 9.6% [[28]](#footnote-28)
* Occupational concentration: probable in health and social services
* No cases occurred in Europe.

1. MERS [[29]](#footnote-29)

* There are no treatment and no vaccine.
* The R0 is 2.5-7. [[30]](#footnote-30)
* During the 2012-2013 epidemic, 75 severe cases were recorded. The number of mild cases was unknown
* The CFR was 65%.
* There were 49 deaths during the 2012-2013 epidemic. [[31]](#footnote-31)
* Occupational concentration in health and social services could be expected.
* There has never been MERS cases in Europe.

1. Poliomyelitis type 1,2,3 [[32]](#footnote-32)

* The vaccine is effective
* Poliomyelitis is a highly contagious disease (R0 = 6) 27
* The type 2 was declared eradicated in 1999. There are no type 3 cases since 2012. 175 cases of type 1 were reported in 2019. 1/200 leads to irreversible paralysis.
* 5 – 10% of those with paralysis die
* There are no occupational clusters
* Europe was declared polio free in 2002 [[33]](#footnote-33)

1. Hepatitis B [[34]](#footnote-34)

* The vaccine and Tenofovir treatment are effective.
* HBV is highly contagious. Its R0 is 5 when there is no intervention.
* 257 million were infected worldwide in 2015 of which 27 million were diagnosed and 4.5 million treated.
* 4,2/°° of acute viral hepatitis died in Italy between 1995 and 2000.[[35]](#footnote-35)
* Worldwide 887000 die yearly. Between 1993 and 2012, age-standardised HBV-related liver mortality rates declined from 0.2 to 0.1 per 100 person-years (PY) (P < 0.001)[[36]](#footnote-36)
* Incidence is higher in health care workers than in general population because of exposure to blood products
* In Europe, 1.6% of the population is infected. In 2017, 30 EU/EEA member states reported 26907 cases. The crude incidence rate was 6.7 cases/100000 population. Re is below 1 as the number of new cases continues to decline. In Europe It causes 56000 deaths/year [[37]](#footnote-37)

1. Hepatitis C [[38]](#footnote-38) [[39]](#footnote-39) [[40]](#footnote-40)

* “Increased access to highly effective direct-acting antivirals (DAAs) for the treatment of infection with the hepatitis C virus (HCV) is revolutionizing the prospect of ending HCV epidemics.” (WHO, March 2018). There is no vaccine.
* Transmission is mainly transmitted during injections, in health care settings, and transfusion of unscreened blood, but some sexual transmission occurs and it can be passed from infected mother to her infant. HCV becomes chronic in 50% of cases.
* 71 million people have been infected with HCV. Chronic hepatitis results in at least 75% of patients.
* Today, case fatality rate is low. From 2003 to 2013, CFR ranged from 0,3% over 5.7 years to 9.2% over 8.2 years of follow up in community samples. Among treated patients achieving SVR, liver-specific case fatality was low: up to 1.4% over 11.5 years of follow-up. [[41]](#footnote-41) In the USA, mortality rate began to decline in 2014. [[42]](#footnote-42) New treatments can cure more than 95%.
* 399000 die each year. This number is likely to be largely underestimated.
* Health care workers are especially at risk (after needle sticks involving HCV positive blood.
* In Europe, 14 million are chronically infected, and 112,500 die per year from HCV related cancer and cirrhosis.

1. Dengue [[43]](#footnote-43)

* A vaccine is available for 9-45 year-old people with a previous episode.
* Aedes Egypti, a mosquito, transmits the disease
* There are 390 million cases worldwide yearly, of which 96 million are symptomatic. Less than 1% is considered severe case. 70% cases are in Asia.
* The CFR is below 1%.
* Worldwide, 4032 cases died in 2015.
* There is no occupational concentration.
* In Europe, the disease is exceptional. Fourteen autochthonous dengue cases were reported from continental Europe (France, 8 cases, and Spain, 6 cases).[[44]](#footnote-44)

1. Japanese encephalitis [[45]](#footnote-45)

* Immunization is effective.
* Children are the main transmitters.
* Worldwide, there are 68000 cases/year.
* CFR: 30% of severe cases
* Mortality: 13600-20400/year
* Occupational concentration: no
* Europe: no

1. West Nile virus [[46]](#footnote-46) [[47]](#footnote-47)

* The physical protection of workers is effective. There are no treatment (but supportive) and no vaccine
* Dead birds transmit the disease. No human-to-human transmission.
* Incidence: 1/150 case is severe.[[48]](#footnote-48) [[49]](#footnote-49)
* CFR: 4-14% (14% in severe cases, in the elderly)
* Mortality: 50 deaths in Europe between 1 Jan and 30 Nov 2019
* Workers in contact with dead animals are the main victims of the virosis.
* 1548 cases were reported in Europe in 2018.

1. Yellow Fever [[50]](#footnote-50)

* The vaccine is effective. No antiviral therapy is available but supportive treatment is relatively effective. Aedes Egypti control is effective but difficult.
* There is no human-to-human transmission. Epidemics are related to mosquitoes.
* There were worldwide 84000-170000 severe cases in 2013
* CFR is 15-50% [[51]](#footnote-51)
* Mortality: 29000-60000 deaths per year
* Occupational concentration: no
* Europe: Exceptional. For 2017, EU/EEA countries reported one case of yellow fever. The travel-related case was reported by the Netherlands with exposure in Suriname.[[52]](#footnote-52)

1. Influenza H7N7 [[53]](#footnote-53)

* Prevention consists of surveillance. There is no vaccine and the only available treatment is supportive.
* The risk of transmission to the community is low. [[54]](#footnote-54)
* Incidence is extremely low. 89 cases in the Netherlands in 2003
* CFR: 1/89 in 2003.
* Mortality is very low
* Occupational concentration occurs amongst poultry workers, farmers and veterinarians.
* 3 cases were declared in Europe in 2013

1. AIDS [[55]](#footnote-55)

* The prevention is effective. Diagnosis, treatment and supportive care are available
* R0 was 4.6 in Africa [[56]](#footnote-56) In Albania the R0 was 3 for HIV-1A and 1.5 for HIV-1B with, respectively, an average duration of infection of 3 years while it was 8 and 2.1 with duration of 10 years. [[57]](#footnote-57) R0 = 0 when the patient is treated and uses condoms. The 90–90–90 target in Europe aims at 90% of people living with HIV knowing their HIV status, 90% of diagnosed people living with HIV receiving treatment, and 90% of people on treatment achieving viral suppression. R0 in Europe is below 1 since incidence is going down year after year (figure 3).
* There was 1.7 million newly infected in 2018 of which 2/3 in Africa. New infections fell by 45% between 2000 and 2018. In Europe, there were 141552 new infections in 2018[[58]](#footnote-58)
* CFR varies according to access to care and care continuity.
* Worldwide, by the end of 2018, 37,9 million had died since the eighties. 770000 died in 2018. Deaths fell by 45% between 2000 and 2018. “3235 diagnoses of AIDS were reported by 30 EU/EEA countries in 2018 – a crude rate of 0.6 cases per 100000 population” 58 822 deaths due to AIDS related causes were declared in 28 EU/EEA countries (all but Denmark, Italy and Sweden) in 2018
* Sex workers are the main disease occupational victims. In LMICs, prevalence was lower amongst health care workers than in the general population. Only 58 cases of confirmed occupational HIV transmission to health care personnel had been reported in the United States until 2019. An additional 150 possible transmissions have also been reported to CDC. [[59]](#footnote-59)
* Europe: “In 2018, 141552 newly diagnosed HIV infections were reported in 50 of the 53 countries in the WHO European Region, including 26164 from the EU/EEA. This corresponds to a crude rate of 16.2 newly diagnosed infections per 100000 population. HIV prevalence was highest in the East of the Region (44.8 per 100000 population), lower in the West and in the EU/EEA (6.0 and 5.6 per 100000, respectively) and lowest in the Centre (3.3 per 100000). The number of people newly diagnosed with HIV in the WHO European Region has increased by 22% over the last decade, while the number of new diagnoses among countries in the EU/EEA has declined by 17% since 2009. In 2018, just over half (53%) of those diagnosed with HIV in the European Region were diagnosed at a late stage of infection.” 58

1. Influenza H2N2 (Singapore influenza)

* A vaccine has been discovered in 1957 [[60]](#footnote-60)
* R0 was 1.68 27 and would be < 1.2 in case of epidemic today [[61]](#footnote-61)
* The incidence of 1957-59 epidemics is speculative. Even its mortality is.
* The 1957 H2N2 influenza pandemic infection-fatality-ratio (IFR) would be a quarter of Covid 19 (roughly 9.4 per 1000), albeit with broad uncertainty.[[62]](#footnote-62)
* The estimated number of deaths was 1.1 million worldwide and 116,000 in the United States.[[63]](#footnote-63) On average during 1957-1959, the pandemic-associated excess respiratory mortality rate was 1.9/10,000 population (95% confidence interval [CI], 1.2-2.6 cases/10,000 population).[[64]](#footnote-64)
* Healthcare and social workers are probably high-risk categories.
* The pandemic mortality rate was the lowest in Europe.

1. Influenza H5N1 (avian flu) [[65]](#footnote-65) [[66]](#footnote-66)

If there is no available vaccine, the oseltamivir treatment is effective, as is surveillance. Mortality remains high because delayed initiation of treatment appears to be a key factor, as exemplified by the most recent analysis of data from Indonesia, experience in Egyptian patients and pooling of results for the years 2004–06 from Vietnam, Thailand, Indonesia and Turkey [[67]](#footnote-67)

* R0 is very low.
* As far as incidence is concerned, only 861 cases were recorded worldwide between 2003 and 2020.
* The CFR is 60%.
* Between 2003 and 2020, mortality reached only 455.
* Workers in contact with birds (farmers, workers in poultries, veterinarians) are the most susceptible to be contaminated.
* In Europe, no cases were declared between 2003 and 2020.

1. Chikungunya [[68]](#footnote-68)

* There is neither prevention nor treatment available.
* The disease is transmitted by an Aedes type mosquito. There is no human-to-human transmission.
* Overall, 1,9 million cases were declared in Asia since 2005
* The CFR is 0 but the disease is a death cofactor in elderly.
* Mortality is almost zero.
* Occupational concentration: no
* Europe: not present [[69]](#footnote-69)

1. Ebola [[70]](#footnote-70)

* Prevention: vaccine rVSV-ZEBOV was successfully used in the RDC 2018-19 outbreak. Surveillance, contact tracing and quarantine are effective. A multidrug therapy is being tested. Supportive treatment is moderately effective.
* R0 has been 1 to 1.3 [[71]](#footnote-71) and even 1.5 [[72]](#footnote-72) [[73]](#footnote-73)
* With regard to incidence, 29000 cases occurred in Sierra Leone, Liberia and Guinea during the 2014-2016 epidemic. 27% of infections were asymptomatic. [[74]](#footnote-74)
* CFR is 50% (25-90%).
* There were 11500 deaths during the Sierra Leone, Liberia and Guinea 2014-2016 epidemic
* The greatest risk of secondary attack is nursing care and in general, health care services.
* Only a few imported cases occurred in Europe (mainly health professionals contaminated in Africa and treated in Europe).

1. Marburg hemorrhagic fever [[75]](#footnote-75)

* There is no prevention and no treatment.
* The R0 is 1.59. [[76]](#footnote-76) Mainly bats transmit the disease, but there is some human-to-human transmission.
* 29 cases occurred in Germany in 1967 – due to laboratory contamination initially. During the Angola epidemic, 374 cases were declared in 2005. Epidemics in humans are rare because of the relatively small reproduction number and long generation time.
* CFR is 80%
* Mortality: 1 death in Germany in 1967, 329 deaths in Angola in 2005
* Occupational concentration occurs mainly amongst healthcare workers.
* In Europe, there has been no case over more than half a century.

1. Smallpox [[77]](#footnote-77)

* The vaccine is effective.
* The disease had a mainly inter-human transmission but it could be spread also through direct contact with infected bodily fluids or contaminated objects such as bedding or clothing. R0 was 4.5
* Incidence: last case in Somalia (1977). Declared eradicated in 1980
* CFR was 4.5
* Mortality
* Occupational concentration: no
* Europe: no

1. Lassa Fever [[78]](#footnote-78)

* There is no vaccine. Ribavirin is an effective treatment if taken early.
* Infection is acquired through contact with infected rodent but person-to-person transmission is possible (R0: 1.06-1.62, Nigeria, 2018) . [[79]](#footnote-79) Lab infections exist.
* The virosis is endemic in West Africa, with 100-300.000 cases per year [[80]](#footnote-80) of which 15% are severe cases (of which 25% are deaf if they survive).
* CFR: 1%
* Mortality: 5000 deaths per year worldwide 80
* Occupational concentration: healthcare workers
* Europe: not present

**Discussion**

The list of studied viral pathologies may be incomplete from their public health importance viewpoint. The provided statistics only give an order of magnitude, and this is how we used them to draw our conclusions, especially since it is too early to estimate the R0 and CFR of the Covid 19. In addition, countries declare the disease heterogeneously. Some demand a test, others suggestive symptoms, while others do not count deaths in nursing homes.

To enable inter-country comparisons, the Covid 19 mortality will have to be assessed through excess mortality rates, by comparing overall country specific monthly mortality rates to the previous five-year average mortality rate of the same month. Pooled mortality estimates from the EuroMOMO network continue to show a markedly increased level of excess all-cause mortality overall for the participating European countries, coinciding with the current COVID-19 pandemic. This overall excess mortality is driven by a very substantial excess mortality in some countries, while other countries have had no excess mortality. The mortality excess is primarily seen in the age group of ≥65 years, but also in the age group of 15-64 years. For the EuroMOMO network as a whole, from week 10, 2020 and as of week 18, there were 149,447 excess deaths estimated in total, including 137,524 in the age group ≥65 years and 11,573 in the 15-64 years age group. This time period includes part of the influenza season as well as the start of the COVID-19 pandemic. [[81]](#footnote-81)

Comparisons between mortality of epidemic diseases (like CV19) and chronic ones (like HCB or HCV) can be misleading, especially because we do not know yet if CV19 will provoke new waves, or possibly mutate and be periodically recurrent.

In general, data quality is much lower in LMICs, as is CFRs because of limited access to good quality healthcare. Some diseases, such as HVB and HVC, are known to be heavily under-diagnosed.

**Conclusion**

Table 2 summarizes our findings.

Among the studied diseases in category 3, HVB and HVC (hepatitis B and C), H2N2 and HIV (AIDS) represent a public health risk to EU citizen. The others are either absent or exceptional in Europe. HBV, HBC, H2N2 and HIV, however, have an effective treatment and/or prophylaxis – unlike Covid 19. On this criterion, the key one that distinguishes categories 3 and 4, Covid 19 should be classified in category 4.

Another key reason is that it represents a bigger public health threat to EU workers, professionals and population: in Europe, Covid 19 has killed in three months more than 65 times the yearly number of people killed in one year by AIDS, 3 times more than HBV and 2.3 times more than HBC. H2N2 is silent since 60 years. All category 3 viruses, present in Europe or not, have a total mortality inferior to Covid 19. Poliomyelitis, HBV and AIDS have a higher R0 in the rest of the world but not in Europe. Untreated, five type 3 viroses have a case fatality rate higher than Covid 19.

By contrast with Covid 19, three of the 4 diseases belonging to group 4 have an effective treatment and/or vaccine. On this criterion alone, Covid should be classified within group 4. Furthermore, the CV19 R0 exceeds the Ebola R0 in early epidemics that is, in situations unaffected by prophylactic interventions.

What would be the consequences on Covid classification if Ebola, Lassa and Marburg fevers were actually found in Europe? Basically our conclusion would remain valid because the Covid 19 R0 is superior to the R0 of these pathologies and their incidence is so low that although their CFR is superior, the mortality of these 3 diseases would remain vastly inferior to the CV19 mortality.

While most of the studied viruses concentrate on healthcare workers, and those in contact with animals, CV 19 has a wide distribution which concerns jobs in essential sectors (nurses, midwives, physicians, caregivers, child minders, home helpers, paramedical professions, social work and guidance professionals, army, police, firefighters, cashiers in food distribution,…). Many more are at risk in non essential sectors.

In conclusion, Covid 19 characteristics justify its classification in category 4. Furthermore, and importantly, with an effective protection of workers and professionals (particularly in healthcare services, nursing homes, and social services but not only) the EU would not only improve health in work environment but also activate a mechanism key to reduce Covid 19 transmission, morbidity and mortality in the general population. In public health terms, the strongest workers protection would be a highly cost-effective intervention. In economic terms, it would probably be a highly cost-beneficial intervention.

Admittedly, the availability of a new vaccine or treatment would imply a change in the proposed classification.

**Acknowledgement**

Dr Raphael Lagasse, Professor of Epidemiology Em., Université Libre de Bruxelles, provided useful comments and insights. No error can be attributed to him.

Table 1 Significant clusters being investigated in New Zealand as at 5 May 2020

(New Zealand MoH) [[82]](#footnote-82)

|  |  |  |  |
| --- | --- | --- | --- |
| Non work environment | | Work environment | |
| Wedding | 98 | Marist College | 94 |
| Private Function | 39 | Hospitality Venue | 76 |
| Community | 30 | Aged residential care facility | 55 |
| Ruby Princess Cruise Ship Cluster | 23 | Aged residential care facility | 43 |
| Group travel to US | 16 | World Hereford Conference | 38 |
| Group travel to US | 16 | Aged residential care facility | 20 |
| Wedding | 13 | Aged residential care facility | 15 |
|  |  | Aged residential care facility | 13 |
|  |  | Workplace | 10 |
|  |  |  |  |
| Total | 235 |  | 364 |

Table 2 Summary of viroses characteristics comparison to Covid 19 features

Diseases in black belong to the EC risk category 3, and those in red to category 4

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Prev  Treat | R0 | Incidence | CFR | Mortality | Occupational  Concentration | Cases in Europe |
| Covid 19 | - | 2.5 -> 0.3 | 3623803 cases world  1429897 cases, Europe | 4.24-13.76 | 256880  deaths world 143898 deaths Europe | Social services  Other work clusters | + |
| Rift valley fever | - | 0 | Max 738/epidemic | 4% |  | Farmers, veterinarians | - |
| Rabies | + | 0 | 15M/year | 100% | 17400/y (2015) | - | - in EU |
| SARS | - | 3.5 -> 0.4 | 8422 in 2002-4 epidemic | 11% 55%>65y | 925 during 2002-4 epidemic | Unknown | - |
| MERS | - | < 1 | 75 severe cases in 2012-13 | 65% | 49 in 2012-13 MR=34%? | - | - |
| Polio 1, 2, 3 | + | 6 | 175 cases P1 in 2019 (1/200) | 5\_10% of paral. | 0 | - | - |
| Hepatitis B | + | 5 | 275M 2015 | 0.1/100PY | 887000/y  56000 deaths/Y in Europe | HCW | + |
| Hepatitis C | + | ? | 71M worldwide  14M in Europe | 0,3-9,2% (2003-2013) Today, under treatment, <1.5% | 399000/y worldwide 112,500 in Europe | HCW | + |
| Dengue | +/- | 0 | 96M/y symptom. | <1% | 4032 (2015) | - | exceptional |
| Japanese  Encephalitis | + |  | 68000/y | 30% of severe cases | 13600-20400/y | - | - |
| West Nile fever | - | 0 | ? | 4-14% | 50 deaths in Eur. 2019 | Contact with dead animals | 1508 (2018) |
| Yellow fever | + | 0 | 84-170000 severe cases 2013 | 15-50% | 29000-60000/y | - | exceptional |
| Influenza H7N7 | - | <1 | 89 cases in Holland 2003 | 1.12% Holland 2003 | 1 death in Holland | Farmers, workers in poultries | exceptional |
| AIDS | + | <1 in Eur  4.6 in  (Afr) | 1.7M 2018 2/3 Africa  141552 EU | variable | 770000 deaths 2018  2176 deaths in 2014 | Sex workers | + |
| Influenza H2N2 | + | 1.2-1.68 | 1957 epidemic. N=? | ? | 1.1M deaths worldwide  19/100000 | - | + |
| Influenza H5N1 | + | 0 |  | 60% | 455 deaths 2003-2020 | Contact with birds | - |
| Chikungunya | - | 0 | 1.9M in Asia since 2005 | 0 | 0 | - | - |
| Ebola | + | 1-1.5 | 29000 in 2014-16 epidemic | 50% | 11500 in 2014-16 epidemic | HCW | - |
| Marburg  Hem. fever | - | 1,59 | 374 cases Angola 2005 | 80% | 329 deaths Angola 2005 | - | - |
| Smallpox | + | 4.5 | - | 65% in unvaccinated | - | - | - |
| Lassa fever | + | 1.06-1.62 | 100-300000/y | 1% and | 5000/year | HCW | - |

Notes

* M = million
* Diseases in red belong to category 4. The others to category 3.
* Incidence data: plain numbers express the worldwide number of cases in one year unless indicated otherwise
* Treatment prevention is noted (–) when only surveillance, detection, contact tracing and isolation are effective but no vaccine or treatment is.

Figure 1 Basic reproduction numbers of selected diseases. [[83]](#footnote-83)

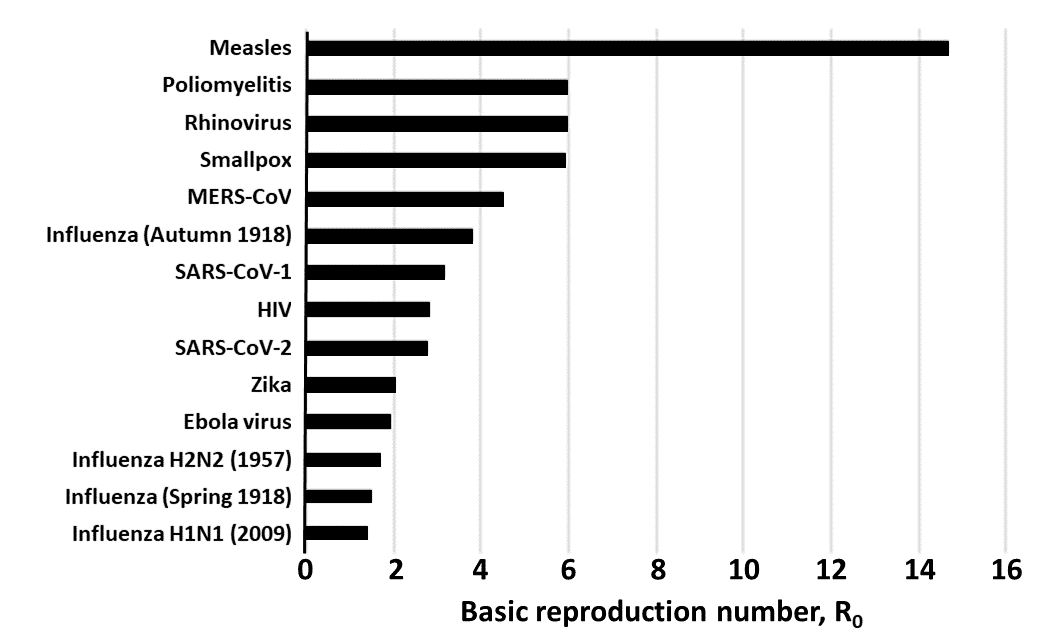


Figure 2: Electronically reported COVID-19 cases/100,000 population in Germany by age group and sex (n=154,565) for cases with information available (27/04/2020, 12:00 AM) From: Coronavirus Disease 2019 (COVID-19) Daily Situation Report of the Robert Koch Institute, 27/04/2020 - UPDATED STATUS FOR GERMANY[[84]](#footnote-84)

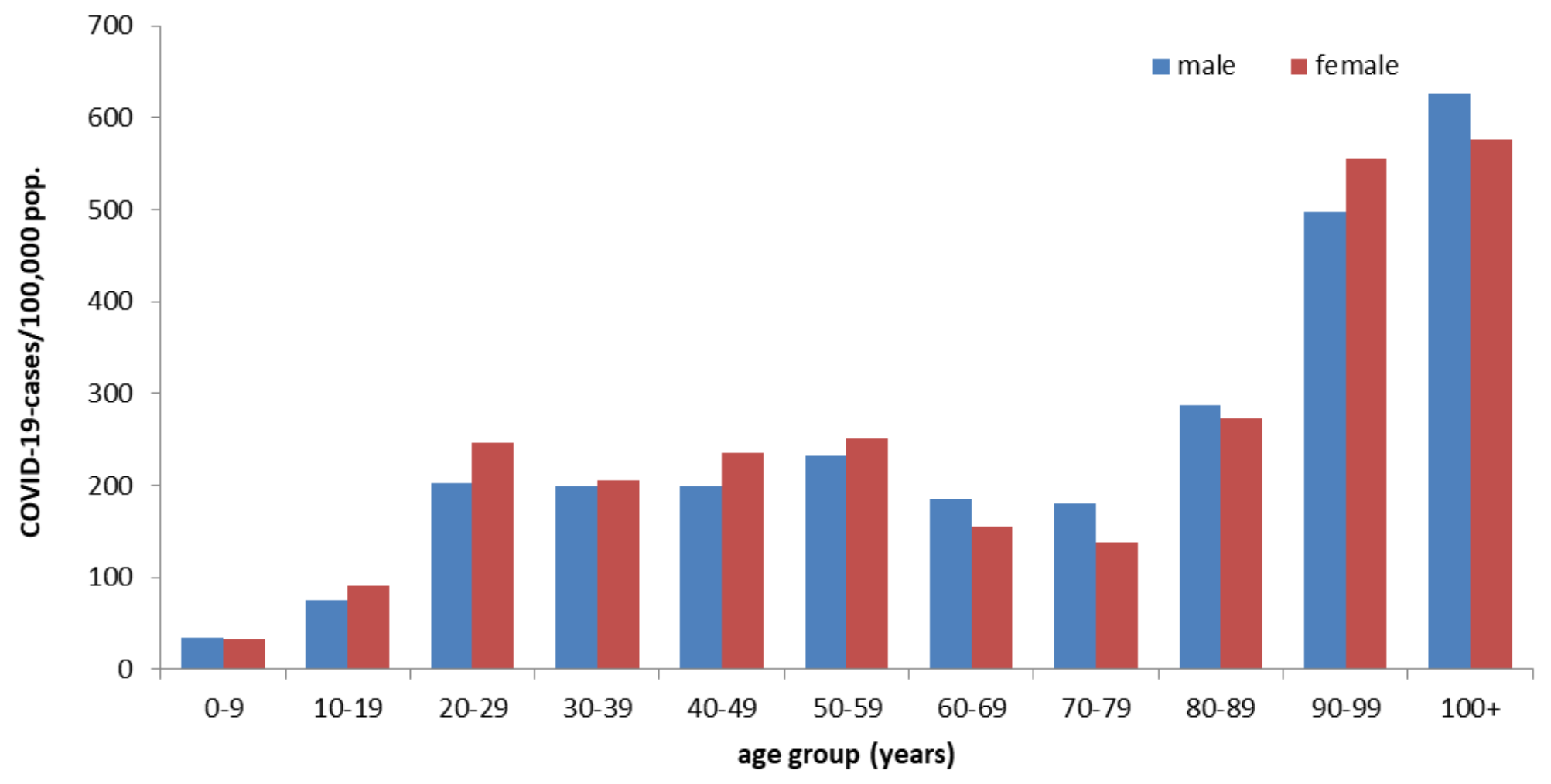
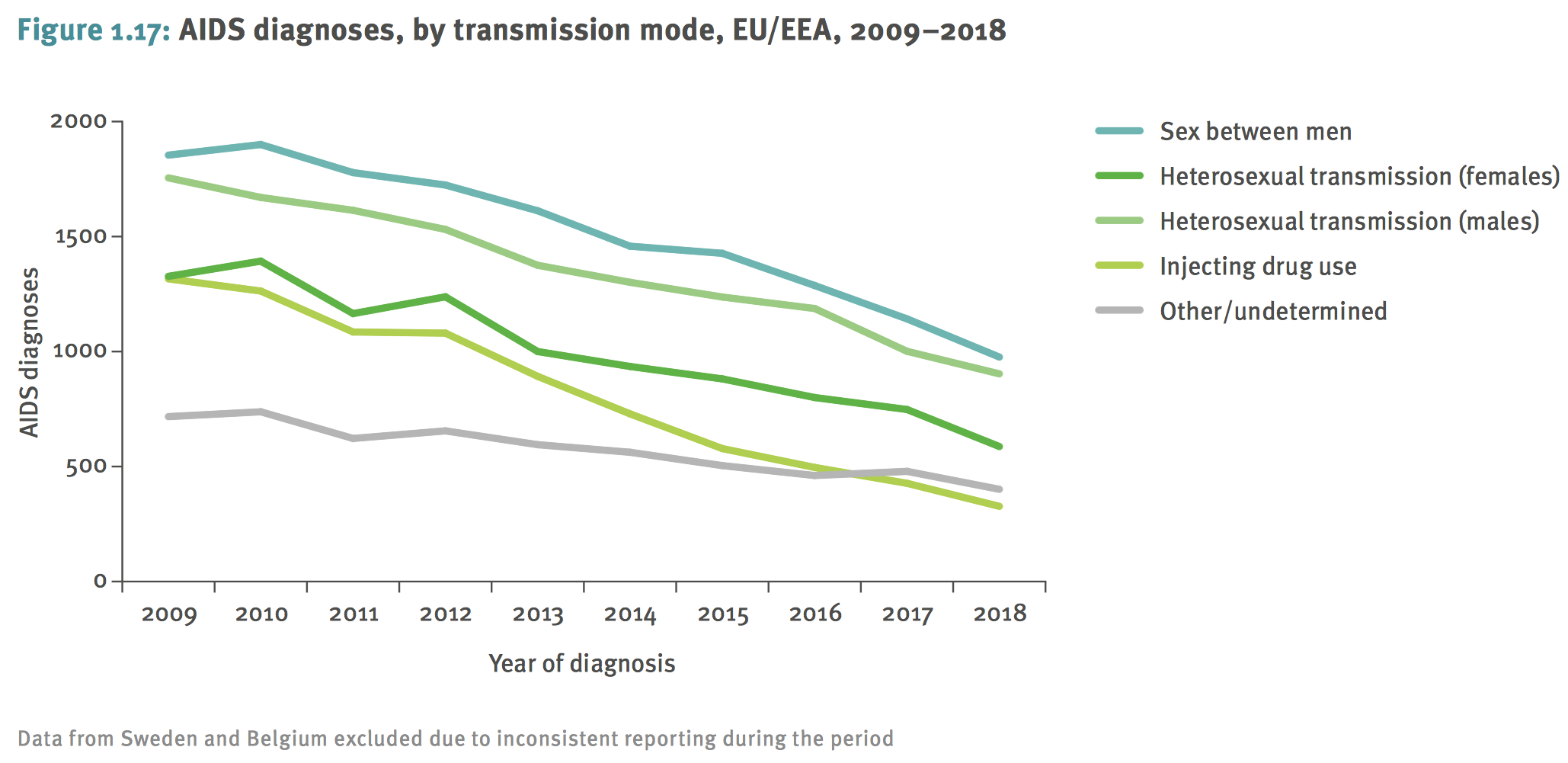


Figure 3 AIDS diagnoses, by transmission mode, EU/EEA, 2009-2018 (data from Sweden and Belgium excluded). From: HIV/AIDS surveillance in Europe 2019 (2018 data), WHO Regional Office for Europe, and European Centre for Disease Prevention and Control.



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