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SSISI Public Policy Brief: Understanding the Covid19 Pandemic and its Consequences

Estimating the Prevalence of Asymptomatic Cases of Covid-19 in Our Communities

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1. INTRODUCTION: THE ONGOING CHALLENGE OF ESTIMATING THE SCALE AND IMPACT OF THE EPIDEMIC

Resource planning in healthcare is dependent on many factors from the scale of the health challenge to the available human and infrastructural resources. With the sudden and unforeseen scale of the Covid-19 pandemic across the globe, health ministries, policy makers and professionals were challenged to react with speed and commitment. Many rose to this challenge and the initial containment of the spread of the virus was achieved where leadership within communities was clear, consistent and most importantly well informed.

Leadership now faces the ongoing and perhaps greater challenge of protecting our communities as we move forward and estimate the scale of the impact of the virus on individuals, society and business. The aim of this policy brief is to present a solution for this challenge by providing a methodological approach to estimating the scale of the hidden number of asymptomatic individuals with Covid-19 within our communities. Such an estimate will enable us to monitor on an ongoing basis the risk of a second wave of the Covid-19 epidemic within varying age groups from the very young to our vulnerable elderly.

2. BACKGROUND: UNCERTAINTIES WITH COVID-19

Internationally, organisations from the United Nations to the Centre for Disease Control to the World Health Organisation are coming together to fight the now global and continually expanding pandemic of Covid-19. According to the European Centre for Disease Control (ECDC) clinical presentations of COVID-19 can range from no symptoms (asymptomatic) to severe pneumonia and death. There are also notifications of cases remaining asymptomatic throughout the full duration of laboratory and clinical monitoring. Furthermore, no significant difference in viral load in asymptomatic and symptomatic patients has been reported, indicating the potential of virus transmission from asymptomatic patients. Asymptomatic cases in infants and children have also been reported (ECDC, 2020a). In EU/EEA countries with available data, 30% of diagnosed COVID-19 cases were hospitalised and 4% had severe illness and hospitalisation rates were higher for those aged 60 years and above. Currently the UN has also expressed fears for vulnerable children around the globe (https://www.un.org/coronavirus). Clearly asymptomatic cases and age are of concern at a global level.

In their April 2020 update the ECDC reiterated the levels of uncertainly across the globe of the epidemiology of Covid-19 and stated that while population-based sero-epidemiological estimates studies are happening a consistent picture is emerging , suggesting significant underreporting, under-ascertainment, or asymptomatic infection across multiple locations in Europe and North America and there remain substantial uncertainty regarding the epidemiological characteristics of the virus and its spread (ECDC, 2020b). The importance of measuring the impact of asymptomatic transmission is clearly identified within the ECDC research needs where they state, '*In particular, the following questions need urgent attention: …The proportion of asymptomatic cases and their role in transmission. (ECDC, 2020a, p19).*

[1] This planned research will be funded by the Health Research Board.

3. METHODS: ADDRESSING UNCERTAINTY, LEARNING FROM THE PAST, PREDICTING FOR THE FUTURE

Mathematical and statistical models of back-projection have been used successfully both internationally and in Ireland to produce estimates of the scale of a hidden infected population within HIV/AIDS, heroin use and more recently bioterrorism, where the comparatively short incubation periods are particularly applicable to Covid-19 (Cox, 1988; Comiskey and Ruskin, 1992; Dempsey and Comiskey, 2014; Egan and Hall, 2015). Working with observed symptomatic cases and the known incubation period, these models predict through the incubation period distribution the total numbers of infected and asymptomatic cases these observed cases arose from.

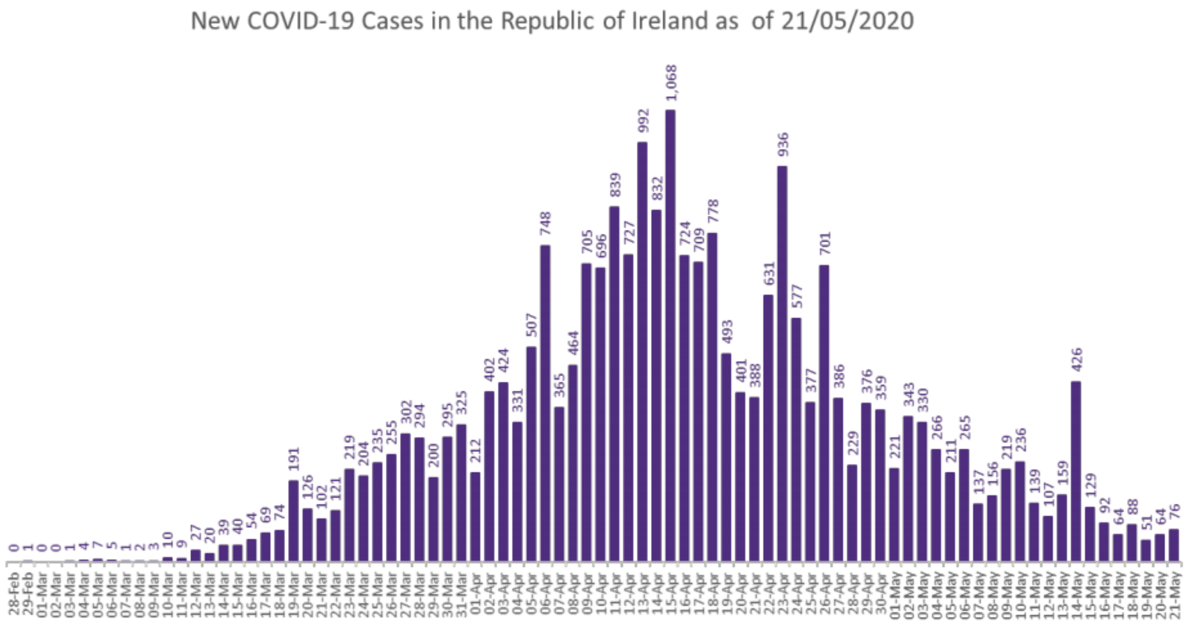
In its simplest form the back-calculation model is given by,

$$C_T(t) = \int_0^t C_U(t-s) f(s) ds$$

Where $C_T(t)$ is the known Covid-19 cases, $f(s)$ is the incubation period distribution and $C_U(t)$ is the untreated Covid-19 cases we wish to solve for.

Given varying forms in the growth of the treated cases $C_T(t)$ and the incubation period $f(s)$ the back-calculation model can be solved analytically as in Dempsey and Comiskey (2014) or numerically as in Comiskey and Ruskin (1992). To date while we wish to estimate the unknown number of cases $C_U(t)$ we can from case notifications estimate the form of $C_T(t)$ from the known number of cases. We have from the reports of Irish Health Service Executive, HSE (2020) the daily known incidence in Figure 1 and the cumulative incidence in Figure 2 and we can fit various models to figure 2 in order to establish an appropriate form for $C_T(t)$.

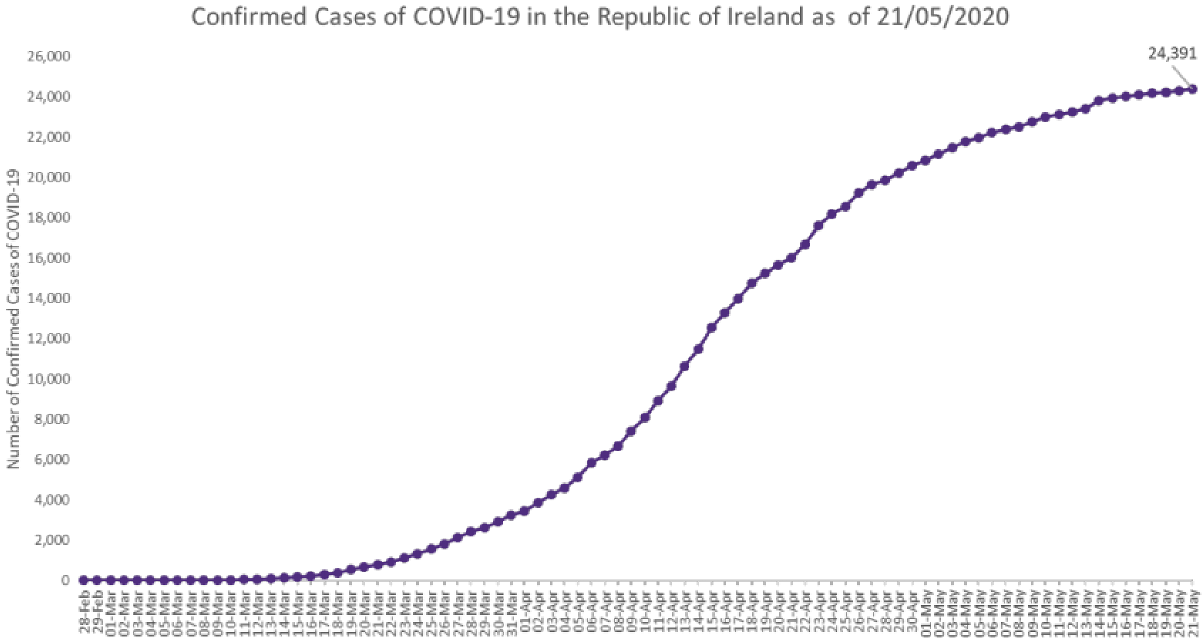
Figure 1: Daily Incidence of Confirmed Covid-19 Cases



Source: The Health Service Executive, HSE[2]

[2] https://www.hse.ie/eng/services/news/newsfeatures/covid19-updates/covid-19-daily-operations-update-21-may-2020.pdf

Figure 2: Cumulative Incidence of Confirmed Covid-19 Cases



Source: The Health Service Executive, HSE[3]

In terms of $f(s)$ the incubation period distribution it is expected that a Gamma distribution or similar may be fitted. The data can initially be adjusted for reporting delays (Comiskey and Ruskin, 1992). Data from the Irish database can then be used to provide an estimates of the parameters of the distribution based on the method of moments previously used by Dempsey and Comiskey (2011, 2014). The incubation period $f(t)$ may be described by the Gamma distribution given by $\Gamma(\alpha, \lambda)$ where

$$f(t) = \frac{\lambda(\lambda t)^{\alpha-1}\exp(-\lambda t)}{\Gamma(\alpha)},$$

with $t \geq 0$ and mean $\mu = \frac{\alpha}{\lambda}$.

Once $C_T(t)$ and $f(s)$ are derived we may solve for the unknown number of Covid-19 cases $C_U(t)$ and in so doing provide an estimate of the scale of the hidden asymptomatic cases. This approach can then be developed and applied to varying age groups if required and can contribute to providing ongoing estimates of the proportions required to be immunised once a vaccine has been developed.

4. CONCLUSION

We have seen that in the early stages of a new epidemic where no vaccine is available all persons are susceptible. As the epidemic progresses and the number of infected people increases the number of susceptible individuals will decrease. However when an epidemic can produce both asymptomatic and symptomatic cases the identification of the numbers infected becomes more challenging. Yet it is the estimates of this very number that is required to enable decisions on when a community has reached its critical threshold point be that through recovery from infection or immunisation. By working with epidemic modellers and by using the method of back-calculation policy makers and planners can be provided with an estimate of the true scale and impact of Covid-19 infections in our communities and leadership can confidently advise on school openings, safety for nursing homes and protection of the vulnerable communities.

[3] https://www.hse.ie/eng/services/news/newsfeatures/covid19-updates/covid-19-daily-operations-update-21-may-2020.pdf

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