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### **Measuring and controlling the Covid-19 pandemic**

**ABSTRACT.** A system has been devised to measure the social distancing index (SDI)—also known as the basic reproduction number—on a daily basis, as well as the R-rate and the number of active infections. The predictor–corrector measurement tool, which incorporates both a single cohort and a two-cohort model of the Covid-19 epidemic, has been applied to England. The measurements have been corroborated against spot figures calculated from data for England from the Office of National Statistics Coronavirus Infection Survey Pilot. They give comparable accuracy and are available 10 days earlier. Accurate measurement has required the development of a correction factor to be applied to the Cases by Date Reported based on the number of tests carried out. Proper comparability is now possible for the first time between daily numbers of cases on different dates. It has been necessary, in addition, to account for the level of prior immunity in the population due to T-cells. Recent research showing that roughly 1 in 8 people carries such immunity is confirmed by the validation of the predictor–corrector model against ONS survey data on active infections. The measurement system has shown that England’s R-rate was either approaching or below 1.0 at the time the country entered its second lockdown on 5 November 2020. The action of the government in imposing the lockdown suggests it might not have been aware of this situation. The capability of the new measurement system to provide timely feedback to decision-makers allows them the freedom for the first time to control the SDI to a setpoint of their choice. Policymakers need no longer see their choices of Covid-19 strategies as binary: either lock down or let the virus rip. The predictor–corrector measurement system allows a third way, whereby the SDI is controlled to a series of setpoints chosen to minimize the overall harm to the nation’s health and economy. The point is illustrated with two scenarios that consider the effects of mass vaccination of the English population from December 2020 to the end of the epidemic in late 2021. The R-rate is kept below 1.0 at all times in the first scenario, whereas in Scenario 2 the SDI is set initially at the value, 1.5, it had just before England went into the first set of Tiers on 17 October 2020. However, the R-rate quickly falls below 1.0 because of the immunity from various sources: from T-cells, from Covid-19 recovery and from vaccination. The total number of deaths is predicted to be similar under both scenarios, but the second allows somewhat greater economic freedom at the start.

**Keywords:** basic reproduction number, coronavirus, Covid-19, epidemic, exit strategy, lockdown, measurement, R-rate, social distancing index, vaccination

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