SUPPLEMENTARY MATERIALS

Resource allocation model

Consider a population of size *N*, comprising N_y and N_o young (<70 years old) and elderly (70+ years old) respectively. At a given time, each individual has a status as a mask-wearer (*m*) or a non wearer (*n*). For each age group *x* (*x*=*y* for young, *x*=*o* for elderly), and status *s* (*s*=*m* for mask wearer, *s*=*n* for non wearer), let S^{xs}, E^{xs}, be the number of susceptible and exposed (but not infectious) individuals. Let I_P^{xs}, I_A^{xs} and I_S^{xs} be the number of pre-symptomatic, asymptomatic/mildly symptomatic and fully symptomatic individuals respectively. Finally, let R^x and D^x be the number of recoveries and deaths. Fully symptomatic cases are associated with an infection rate of β_S, while pre-symptomatic and mildly/asymptomatic cases have a lower infection rate β_A; we assume $\beta_S = 2\beta_A$. Progression from exposed to pre-symptomatic occurs at rate α_1, and progression to either I_S or I_A occurs at rate α_2. The probability of developing only mild symptoms or no symptoms among age group *x* is P_{ax}. Removal occurs at rate γ_S and γ_A respectively. The proportion of fatalities among fully symptomatic cases in age group *x* is assumed to be p_{xD}. Dynamics are governed by the following system of differential equations:

$$\frac{dS^{xn}}{dt} = -\frac{S^{xn}}{N}(\beta_a(I_P^{\cdot n} + I_A^{\cdot n} + r_t(I_P^{m} + I_A^{\cdot m})) + \beta_s(I_S^{\cdot m} + r_t I_S^{\cdot m})) \tag{1}$$

$$\frac{dS^{xm}}{dt} = -\frac{S^{xm}}{N} r_s(\beta_a(I_P^{\cdot n} + I_A^{\cdot n} + r_t(I_P^{\cdot m} + I_A^{\cdot m})) + \beta_s(I_S^{\cdot m} + r_t I_S^{\cdot m})) \tag{2}$$

$$\frac{dE^{xn}}{dt} = \frac{S^{xn}}{N}(\beta_a(I_P^{n} + I_A^{n} + r_t(I_P^{\cdot m} + I_A^{\cdot m})) + \beta_s(I_S^{\cdot m} + r_t I_S^{\cdot m})) - \alpha_1 E^{xn} \tag{3}$$

$$\frac{dE^{xm}}{dt} = \frac{S^{xm}}{N} r_s(\beta_a(I_P^{n} + I_A^{n} + r_t(I_P^{\cdot m} + I_A^{\cdot m})) + \beta_s(I_S^{\cdot m} + r_t I_S^{\cdot m})) - \alpha_1 E^{xm} \tag{4}$$

$$\frac{dI_P^{xs}}{dt} = \alpha_1 E^{xs} - \alpha_2 I_P^{xs} \tag{5}$$

$$\frac{dI_A^{xn}}{dt} = P_{ax}\alpha_2(1 - \delta m^*) I_P^{xn} - \gamma_A I_A^{xn} \tag{6}$$

$$\frac{dI_A^{xm}}{dt} = P_{ax}\alpha_2(\delta m^* I_P^{xn} + I_P^{xm}) - \gamma_A I_A^{xm} \tag{7}$$

$$\frac{dI_S^{xn}}{dt} = (1 - P_{ax})\alpha_2(1 - \delta m^*) I_P^{xn} - \gamma_S I_S^{xn} - \gamma_{xD} I_S^{xn} \tag{8}$$

$$\frac{dI_S^{xm}}{dt} = (1 - P_{ax})\alpha_2(\delta m^* I_P^{xn} + I_P^{xm}) - \gamma_S I_S^{xm} - \gamma_{xD} I_S^{xm} \tag{9}$$

$$\frac{dR^x}{dt} = \gamma_S I_S^{x\cdot} + \gamma_A I_A^{x\cdot} \tag{10}$$

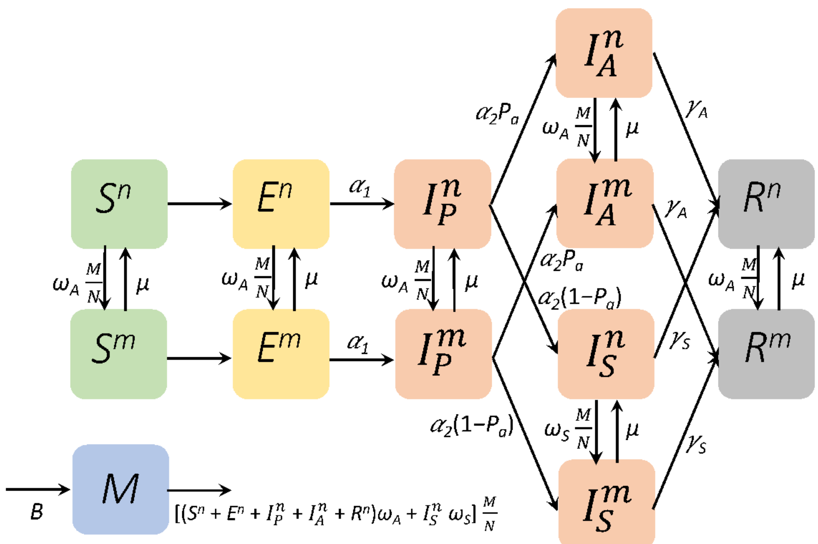
$$\frac{dD^x}{dt} = \gamma_{xD} I_S^{x\cdot} \tag{11}$$

where *m** is an indicator function equal to 1 when there is a remaining supply of masks *M*, and is the probability of detecting mild/asymptomatic infections. As masks are provided to newly diagnosed cases, supplies are depleted at the following rate:

$$\frac{dM}{dt} = -\alpha_2(P_a \delta m^* I_P^{xn} + (1 - P_a) I_P^{xm})$$

Monotonically declining until zero is reached, at which point, no further masks are provided for detected cases.

Supply & demand model



$$\frac{dS^n}{dt} = -\frac{S^n}{N}\big(\beta_A(I_A^n + I_P^n + I_A^m r_t + I_P^m r_t) + \beta_S(I_S^n + I_S^m r_t)\big) + \mu S^m - \omega_A \frac{M}{N} S^n$$

$$\frac{dS^m}{dt} = -\frac{S^m r_s}{N}\big(\beta_A(I_A^n + I_P^n + I_A^m r_t + I_P^m r_t) + \beta_S(I_S^n + I_S^m r_t)\big) - \mu S^m + \omega_A \frac{M}{N} S^n$$

$$\frac{dE^n}{dt} = \frac{S^n}{N}\big(\beta_A(I_A^n + I_P^n + I_A^m r_t + I_P^m r_t) + \beta_S(I_S^n + I_S^m r_t)\big) + \mu E^m - \omega_A \frac{M}{N} E^n - \alpha_1 E^n$$

$$\frac{dE^m}{dt} = \frac{S^m r_s}{N}\big(\beta_A(I_A^n + I_P^n + I_A^m r_t + I_P^m r_t) + \beta_S(I_S^n + I_S^m r_t)\big) - \mu E^m + \omega_A \frac{M}{N} E^n - \alpha_1 E^m$$

$$\frac{dI_P^n}{dt} = \alpha_1 E^n + \mu I_P^m - \omega_A \frac{M}{N} I_P^n - \alpha_2 I_P^n$$

$$\frac{dI_P^m}{dt} = \alpha_1 E^m - \mu I_P^m + \omega_A \frac{M}{N} I_P^n - \alpha_2 I_P^m$$

$$\frac{dI_A^n}{dt} = \alpha_2 I_P^n P_a + \mu I_A^m - \omega_A \frac{M}{N} I_A^n - \gamma_A I_A^n$$

$$\frac{dI_A^m}{dt} = \alpha_2 I_P^m P_a - \mu I_A^m + \omega_A \frac{M}{N} I_A^n - \gamma_A I_A^m$$

$$\frac{dI_S^n}{dt} = \alpha_2 I_P^n (1 - P_a) + \mu I_S^m - \omega_S \frac{M}{N} I_S^n - \gamma_S I_S^n$$

$$\frac{dI_S^m}{dt} = \alpha_2 I_P^m (1 - P_a) - \mu I_S^m + \omega_S \frac{M}{N} I_S^n - \gamma_S I_S^m$$

$$\frac{dR^n}{dt} = \gamma_A I_A^n + \gamma_S I_S^n + \mu R^m - \omega_A \frac{M}{N} R^n$$

SUPPLEMENTARY FIGURES

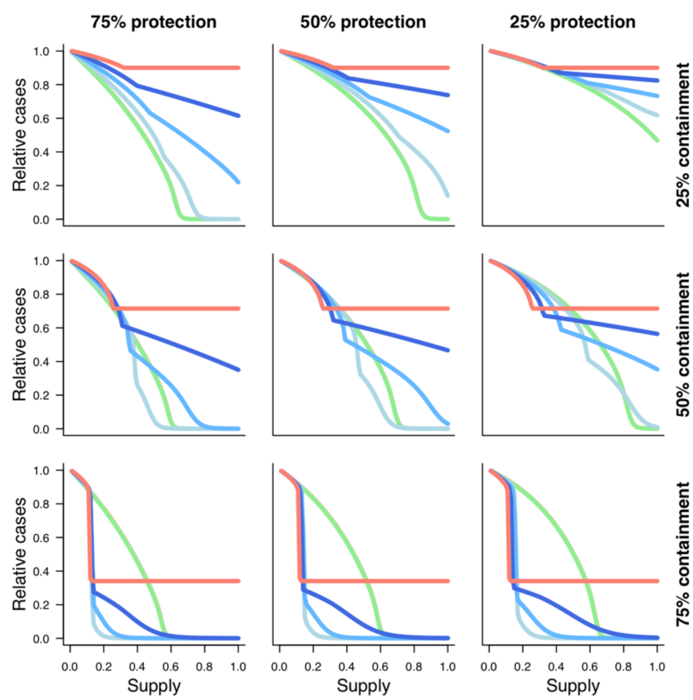


Figure S1. Reduction in total infections under each of the described resource allocation strategy for a range of resource availability levels. Corresponds to Figure 2. Each panel represents intervention effectiveness in terms of relative susceptibility and transmissibility, with the bottom left panel denoting the most effective intervention (75% reduction in susceptibility and transmissibility) and the top right panel representing the least effective intervention (25% reduction in susceptibility and transmissibility). Resources are provided naïvely (pink), prioritized to the elderly (green), saved for detected cases (red), or balanced at different levels between healthy individuals, prioritizing the elderly, and detected cases (blue). 30% of cases are assumed to be undetected. See *Methods* for further details.

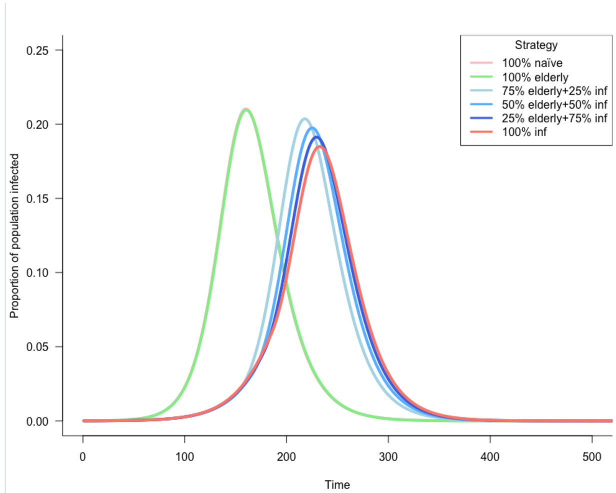


Figure S2. Optimizing mask distribution strategy can delay epidemic peak. We demonstrate that, even low coverage (5% of the population) of a mask offering no protection and 40% containment, the epidemic peak can be delayed when retaining resources for detected cases.

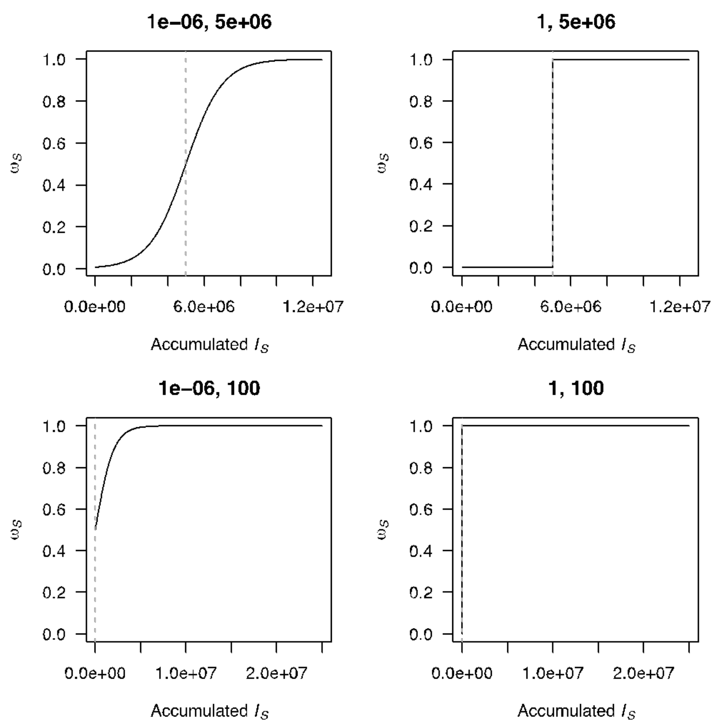


Figure S3. Different parameterizations of demand dynamics. Different values of k_1 and k_2, provided as the title for each panel, result in different demand responses to increasing numbers of reported cases. A panic buying scenario can be approximated in the bottom right panel, where demand is maximal very early in the epidemic. A gradual increase in demand is shown in the top left panel, in which 50% of the population seek masks if and when cases reach 5 million.

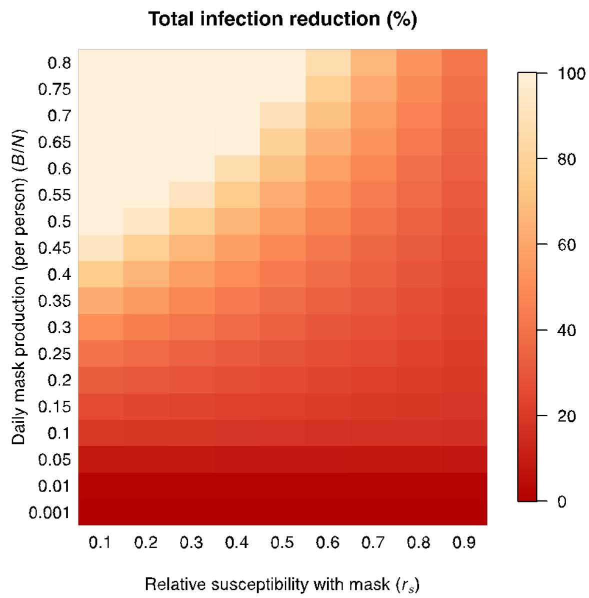


Figure S4. Impact of mask production rates on final number of infections. For different levels of mask protection and mask production, to reduction in total numbers of infections.

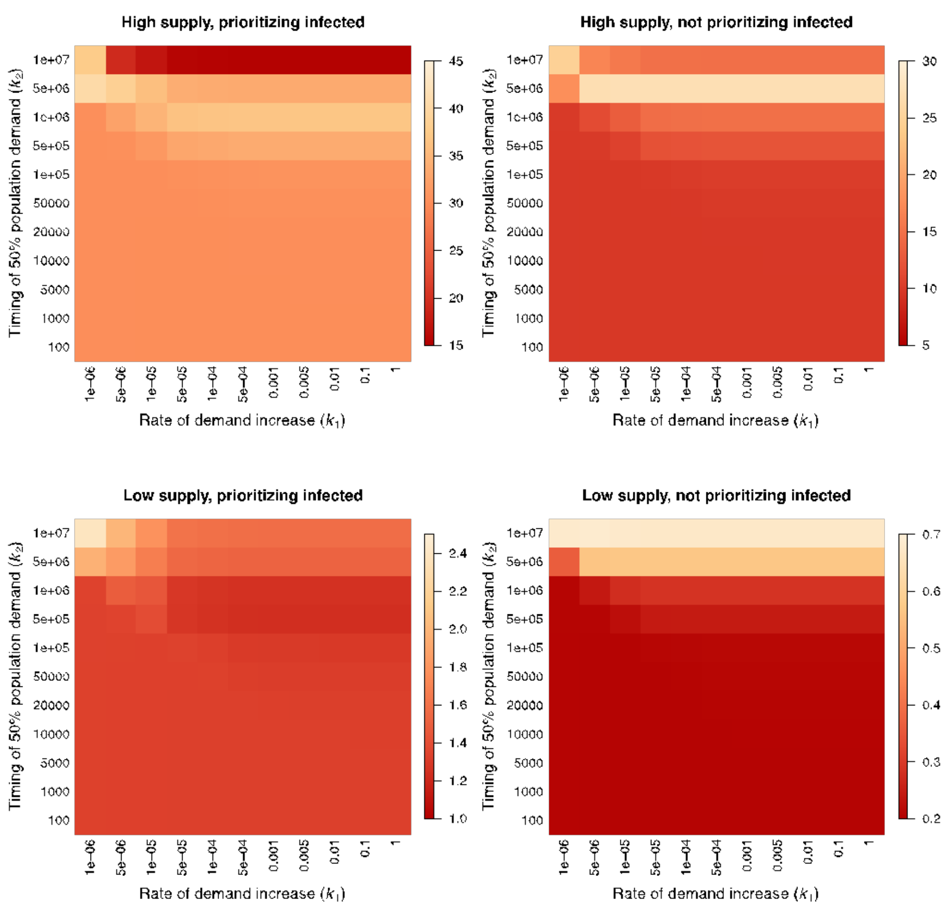


Figure S5. Levels of reduction in total infection numbers compared to no mask condition under different demand functions. The level of total infection reduction (%) varies with the timing of 50% population demand on masks (k_1) and the rate of demand increase (k_2) given high (top; B/N= 30%) or low bottom; B/N= 1%) mask production when prioritizing (left) or not prioritizing (right) masks for infectious cases. Generally, 'panic buying' is detrimental and prioritizing to infectious cases (setting ω_S>ω_A) is beneficial.

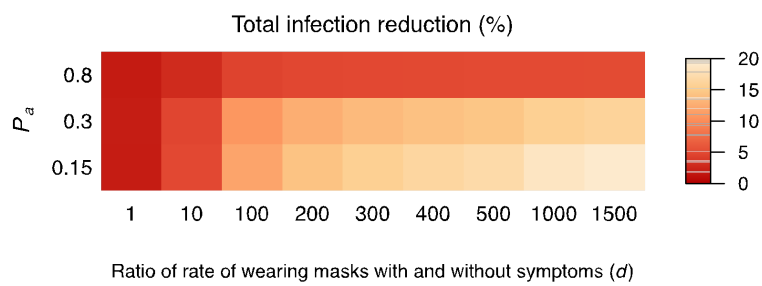


Figure S6. The effect of prioritizing masks to infectious cases is less apparent if the proportion of asymptomatic infections is high.

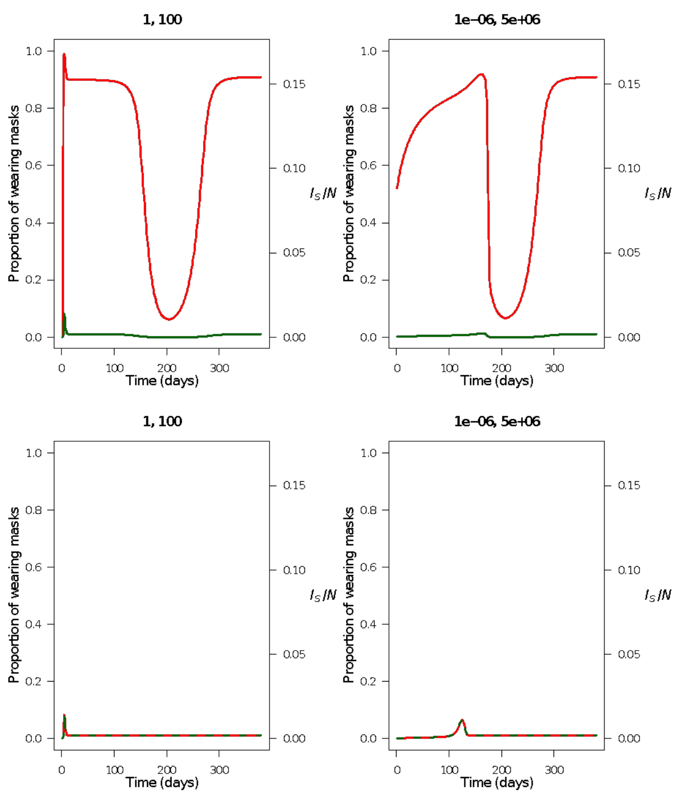


Figure S7. Low mask production rate can limit the advantage of building up supplies. Epidemic curves (pink) under a 'panic buying' demand curve (left), and a more gradual managed demand curve (right) when prioritizing (top) and not prioritizing (bottom) masks for infectious cases. Demand is shown as a dashed grey line, while the relative available mask supply is shown in blue. The proportion of the susceptible and symptomatically infected population wearing masks are shown as green and red lines, respectively. (k_1, k_2) are shown on the top of each subfigure. While supplies are built up in the early phase of the epidemic, shortage still occurs during the outbreak if mask production rate is low (B/N = 1% here).

SUPPLEMENTARY TABLE

Parameter	Definition	Baseline value	References
R_0	Basic reproduction number for symptomatic individuals	2.5	[6] [34] [26]
$1/\alpha_1$	Time from exposed to pre-symptomatic	1	[6]
$1/\alpha_2$	Time from pre-symptomatic to symptomatic/ asymptomatic	5	[6]
P_a	The proportion of asymptomatic infections	30% (varied in simulations)	[30]
$1/\gamma_A$	Time to recovery for asymptomatic infections	14	[6][27]
$1/\gamma_S$	Time to recovery for symptomatic infections	14	[6][27]
r_t	Relative transmissibility with mask	Varied in simulations (=0.5 if not specified)	
r_s	Relative susceptibility with mask	Varied in simulations (=0.6 if not specified)	
Resource allocation model			

N_{70}	Proportion of people age 70+	7.6%	Taiwan as an example: census.dgbas.gov.tw
	Death rate among symptomatics in 70+ Death rate among symptomatics in <70	9.7% 1.3%	[32]
	Detection rate of non-severe infections	44% [Japan]	[35]
Supply & demand model			
$1/\mu$	Average time of wearing disposable mask	1	
B	Daily mask production	Varied in simulations	
d	The ratio of rate of wearing mask between symptomatic infected individuals and others (ω_S/ω_A)	Varied in simulations (=1000 if not specified)	