**Covid-19: Epidemiological basis of health policy**

Slide 1: Much has been said about Covid-19 that I shall not repeat. I’ll not talk about politics, economics, clinical medicine, or ethics (but can get into these matters in the Q&A session), but rather focus on those aspects of epidemiology that, I think, have been underemphasized. Epidemiology is the study of patterns of occurrence of disease in humans with the goal of identifying ways to prevent acquisition and promote treatment.

Slide 2: Epidemiologists compare rates of disease in various groups to test hypotheses about disease cause or treatment. Two major measures of comparison are relative risk and odds ratio.

Slide 3: Many studies are too small to yield reliable measure of differences in rates. Epidemiologists seek to overcome this problem through meta-analysis, statistically combining the results of comparable studies.

Slide 4: Diagnostic testing is a focus of epidemiological study. Tests vary in their accuracy and utility – and a given test will have different characteristics according to the threshold chosen for declaring a positive result.

Slide 5: Signal theory was explored in WWII research on radar. The ROC curve displays the characteristics of a detection method with a curve that consists of points (x, y) on the unit square, where – for each threshold for a positive signal – x represents the proportion of non-events that yield a positive signal and y represents the proportion of real events that yield a positive signal. The curve of points (x.y) arcs through the upper left of the unit square if the test yields positive information (i.e., it yields positive results more often with real events than with non-events).

Slide 6: This ROC curve displays the characteristics of two detection methods. The red one is superior, because for each level of specificity, the sensitivity of the red test is higher than that of the blue test. Conversely, for each level of sensitivity, the specificity of the red test is higher than that of the blue test.

Slide 7: Tests for Covid-19 are of three major types. The PCR is the most reliable, but recently some people (e.g., Prof. Michael Mina at the Harvard School of Public Health) have been advocating frequent use of a rapid antigen test with lower sensitivity and specificity than the PCR.

Slides 8 and 9: Bayes Theorem can be used to assess the implications of Prof. Mina’s suggestion. It allows one to determine the probability that a positive test is from a diseased person if one knows the probabilities that a diseased person and a healthy person will have a positive test and what proportion of the population is diseased.

Slide 10: These two examples show that a test with the sensitivity and specificity expected in an antigen test will perform reasonably if the disease is relatively common in a population, but will yield an overwhelming proportion of false-positive results (i.e., a low Positive Predictive Value) in a population where the disease is rare.

Slide 11: Much hope is placed in a vaccine that will effectively prevent Covid-19. That presumes that a vaccine will induce production of protective antibodies. The experience of one fishing vessel from Seattle this Spring suggests reason for optimism, as (the few) sailors with pre-existing neutralizing antibodies to Covid-19 were spared in an intense outbreak aboard ship.