黎明前的黑暗：在疫苗来临之前

The darkness before dawn: before the vaccine comes

After implementing a strict epidemic prevention strategy, as early as July this year, mainland China announced the full resumption of work. Due to various reasons, the Hong Kong area was not able to withstand the third wave of the epidemic well, and the people of Hong Kong suffered the peak of the second diagnosis. This is really sad. Fortunately, medical resources are now sufficient to fight the epidemic, and domestic doctors are also experienced. The highly anticipated COVID-19 vaccine will also be fully available in early 2020. During the period before the vaccine came out, how to control the epidemic and restore the economy was the top issue for Hong Kong. Here, we hope to use our mathematical model to provide some suggestions for epidemic prevention and control and testing in Hong Kong.

Testing 10,000 people does not require 10,000 tests. Based on the randomization process and probability theory, we creatively designed a group inspection strategy optimized by the enrichment method. Divide the test subjects into several groups, extract a part of each person's saliva sample, mix them and test them uniformly. The Lancet claims that this method is feasible and can greatly improve efficiency. At the end of the article we have attached a specific grouping procedure. You only need to provide the total number of people to be tested and the approximate disease ratio, and we will provide you with the most optimized grouping method. Based on the current number of confirmed confirmed cases in Hong Kong, it is conservatively estimated that our method can increase the efficiency by at least 10 times.

The third wave of epidemics is characterized by strong transmission capacity but weaker pathogenicity. This also means that asymptomatic infections will become a difficult problem for epidemic prevention. To this end, we have established an SIR (infectious disease) model. Be careful! An undetected asymptomatic infection can usually infect 6 to 20 people. To completely eliminate these threats, on the one hand, we must strengthen the control of external sources of infection, on the other hand, we must accelerate the pace of comprehensive nucleic acid testing and antibody testing. In addition, the model also shows that isolating potentially ill groups and protecting healthy groups through home isolation and wearing masks are very effective methods of epidemic prevention. If one less person is infected today, there may be dozens of fewer troubles in the future, which can save a lot of social resources. The Hong Kong Department of Health is also requested to strengthen anti-epidemic propaganda and let the people of Hong Kong know the benefits.

Fighting the epidemic is a war. In the face of the powerful enemy of the virus, the people of the world should unite. Finally, I wish Hong Kong's epidemic prevention work an early success！

Sincere,



在执行了严格的防疫策略后，早在今年七月，中国大陆宣布全面复工。由于种种原因，香港地区没能很好的抵御第三波疫情，香港人民遭受了第二次确诊的高峰，这真是令人痛心。所幸如今抗击疫情的医疗资源充足，国内的医生们也都经验丰富，而众望所归的COVID-19的疫苗也将在2020年初全面问世。在疫苗问世前的这段时间里，如何控制疫情，恢复经济，当是香港的首要问题。在此，我们希望能用我们的数学模型，为香港的疫情防控和testing提供一些建议。

测试10000个人并不需要10000次测试。以随机化过程和概率论为基础，我们创造性的设计出了浓缩法优化下的群组检验策略。将待测者分为几组，提取出每个人唾液样本的一部分，将他们混合并统一检验，《柳叶刀》称这种方法切实可行，且可以大大提高效率。在文末我们附上了具体的分组程序。您只需要提供待测者总人数和大致的患病比例，我们将为您提供最优化的分组方法。根据香港目前的确诊人数推算，保守估计，我们的方法能将效率提高至少10倍。

第三波疫情的特点是传播能力强，但致病性更弱。这也意味着无症状感染者将成为一个防疫的难题。为此，我们建立了SIR（传染病）模型。要当心！一个未经发现的无症状感染者通常能够感染6到20人。要彻底排除这些威胁，一方面要加强对外来的传染源的控制，另一方面也要加快全面核酸检验与抗体检验的步伐。此外，模型还显示，隔离可能的患病群体，用居家隔离和戴口罩等方式保护健康群体都是非常有效的防疫方法。今天少感染1个人，未来或许就少了数十次的麻烦，能够节省大量的社会资源。还请香港卫生署加强防疫宣传，让香港人民知晓其中的利害。

抗击疫情是一场战争。在病毒这个强大的敌人面前，世界人民应该团结起来。最后，也祝香港的防疫工作早日取得成功！