

Cholera and Nightsoil Infection in Hong Kong, 1966

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In 1966 there occurred in Hong Kong the rare combination of, in one area, a non-imported case of cholera with no nightsoil infection and, in another area, heavy infection of the nightsoil with no cholera cases. Investigation revealed that there was no connexion between the case (in Kowloon) and the short-lived nightsoil infection (on Hong Kong Island). The hypothesis is advanced that the infection of 5 premises was due to their being visited by a ship's crew, who later left Hong Kong, without the infection spreading to the permanent residents. The authors stress that, in slightly different circumstances and without the existing system of nightsoil monitoring, this infection would not have been detected and cases of cholera might have occurred with no forewarning.

It is a comparatively rare occurrence for one non-imported case of cholera to be notified by a territory in a full calendar year. Since 1958 such reports have been made from Burma in 1960 and 1961 and from Japan and Macao in 1964, according to the information recorded in the *Weekly Epidemiological Record*. To this list can now be added Hong Kong in 1966. One case of cholera was notified in the Kowloon area of Hong Kong in November 1966. All investigations relating to it were negative but at the same time a very heavy infection of the nightsoil was detected in a localized area of Hong Kong Island without the occurrence of any cases. It is possible, therefore, that an area can become "cholera infected" and remain undetected, if cases do not occur, when there is no nightsoil or similar monitoring surveillance.

INVESTIGATIONS

Nightsoil service

The nightsoil collection service in Hong Kong and the bacteriological sampling associated with it were fully described by Van de Linde & Forbes⁴ and remain basically unchanged. There has been some reduction in the service through demolition of old buildings but approximately 12% of the urban population of Hong Kong still have the type of nightsoil disposal described earlier.

Nightsoil is collected from dry latrines between midnight and 6 a.m. daily by female coolies of the Urban Services Department, who empty the pails into collecting vehicles stopping at fixed points along a number of set routes. At the end of each route the nightsoil is discharged into barges which take it to storage tanks, from which, after maturation, it is sold to farmers. The nightsoil vehicles consist basically of a 750-UK-gallon (ca 3400-litre) tank divided into two compartments; one of 550 UK gallons (2500 litres) for nightsoil, and one of 200 UK gallons (ca 900 litres) for water. At the back of the vehicle are three hoppers of 20-UK-gallon (90-litre) capacity each: the first is for the reception of nightsoil, which is pumped to the larger tank; the second contains water, and the third 2% white disinfecting fluid. The pails of nightsoil are emptied into the first, rinsed in the second and then disinfected in the third hopper.

Tracing of sources

Tracing of positive nightsoil samples is undertaken as follows. Every night, throughout the year, samples of nightsoil are taken from the vehicle as it discharges into the barge. As each vehicle has two loads every night, two samples are taken from each vehicle. If one of these samples is positive the area which is infected is located, as the exact route of the vehicle for each load is known. The next stage is for each hopper load of nightsoil to be sampled before it is sucked into the tanker. If the sample from the hopper is found positive, the group of houses is known from which the nightsoil making up the positive hopper came. The final step is to sample the buckets making up each hopper load; and if one is positive, the exact

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⁴ Van de Linde, P. A. M. & Forbes, G. I. (1965) *Bull. Wld Hlth Org.*, 32, 515-530.

premises from which the positive bucket came is determined. Once the actual address of the infected house is known the occupants are investigated to determine who is the infected person.

If only one route is positive at a time the hopper stage can be missed and sampling can proceed direct from the vehicle to the bucket, but as this entails the use of large numbers of staff and produces so many samples, it is of limited practical value and is used only in special circumstances.

The number of nightsoil routes at present is 12 in Hong Kong Island and 9 in Kowloon.

V. cholerae-positive findings

The positive findings for *Vibrio cholerae* during the year 1966 are noted below.

On 3 January 1966 cholera vibrios were found coming from the nightsoil vehicle serving route West 1 (first load) on Hong Kong Island. This was followed by sampling of the hoppers on 5 January; these samples were all negative. Despite the negative result from the hoppers, all buckets (242 in number) were sampled on 7 January, again with negative results. No further positive nightsoil samples were reported until 30 June, when one from the vehicle serving route West 1 (second load) in Kowloon was reported positive. This was followed up on 4 July with sampling of buckets (omitting the hopper stage). The 605 buckets that made up this load were sampled, but with negative results.

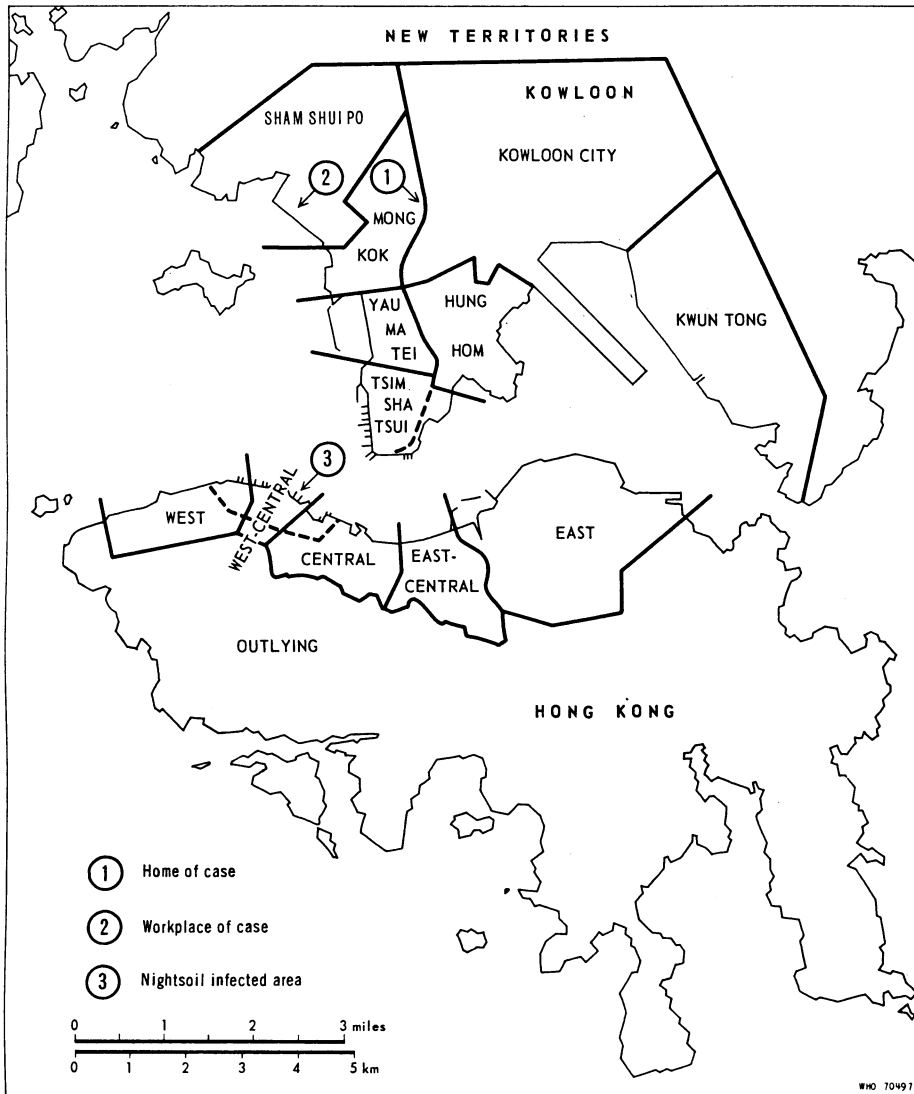
On 23 November a case of cholera was notified in Kowloon. This occurred in a 56-year-old Chinese male who lived in the Mong Kok area and worked in the Sham Shui Po area of Kowloon (Fig. 1). Before admission he had been suffering from diarrhoea for 24 hours and required 10 UK pints (ca 5.5 litres) of intravenous fluid for rehydration. By occupation this man was primarily a vegetable farmer but, to augment his income, he worked in the morning as a labourer in the wholesale fish market, delivering fish from the market to wholesale fish shops. He had been inoculated with cholera vaccine twice in the preceding 8 months. Neither the patient nor his family (a wife and 3 children) had been outside Kowloon for a considerable period. All bacteriological investigations of the patient and family and the hut in which they lived were negative. No positive nightsoil samples were detected in any of the Kowloon routes during the period (including the route serving the patient's home, in which he remained for the 24 hours of his illness before being admitted to hospital).

The same day (23 November) as the case was notified two nightsoil routes on Hong Kong Island—Central 1 (first and second load) and Central 2 (first load)—were reported positive. Further positive results were obtained until 27 November (see the table), when the infection disappeared as quickly as it had started. Following the initial positive results, route West 2 (second load) was reported positive on 24 November. On 25 November the hoppers of route Central 1 (first and second load) and route Central 2 (first load) were sampled with the alarming result of 4, 7, and 9 positive samples respectively. There is the possibility of "carry-over" contamination from one hopper load to the next, so these results could indicate as few as 3 separate sources of infection or as many as 20. On the same day further routes—Central 3 (first and second load) and West 3 (first load)—were shown to be infected for the first time. Route Central 1 (first and second load) remained positive, while route Central 2 (first load) showed a negative result despite the 9 positive hoppers detected on the same night. (This route-negative but hopper-positive finding demonstrates that, while nightsoil sampling can give an indication of infection in an area, it cannot give an absolute indication, as there must be some degree of error when only one sampling is taken from a 550-gallon load.) The next day, 26 November, the follow-up hopper sampling of route West 2 (second load) gave 2 positive results but all routes showed negative sampling results.

The results received from bucket sampling on 27 November indicated that 5 buckets from 5 separate houses on route Central 1 (first load) were positive while all the buckets from the infected hoppers of routes Central 1 (second load) and Central 2 (first load) were negative, in spite of the fact that 7 and 9 hoppers had been found positive two nights before. Other positive results found were route Central 3 (first load), plus one hopper on that route. Route Central 1 (first load) remained positive while all other follow-up samples were negative. The follow-up sampling of the buckets from the positive hoppers on route West 2 (second load) were negative on 28 November, as were the buckets on route Central 3 (first load) on 29 November.

The 5 positive buckets found on route Central 1 (first load) came from 5 separate houses, 3 of which were within 100 yards of each other while the other 2 were within 600 yards of the first three. Four of the houses were on the waterfront, while the fifth was one street inland (Fig. 2).

FIG. 1
CHOLERA CASE AND NIGHTSOIL INFECTION IN HONG KONG, 1966

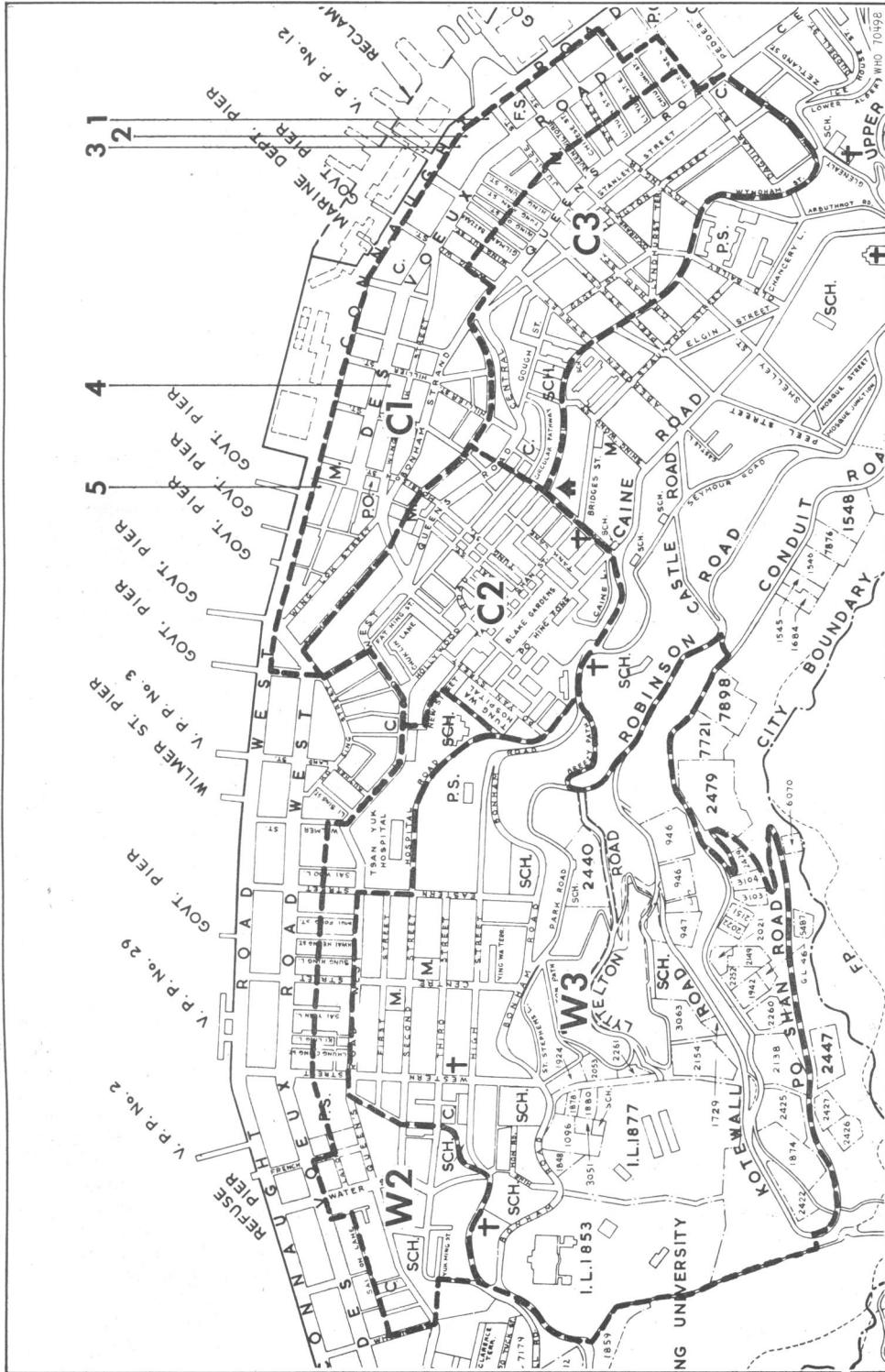


In the 5 houses there were a total of 93 occupants at the time of investigation, all of whom were traced within 24 hours; each had a rectal swab taken before administration of a course of oral streptomycin as a chemoprophylactic measure. All rectal swabs were negative. Investigation in the houses included taking swabs from latrines, chopping blocks, stored water, floor surfaces in kitchens and bathrooms, spittoons, drain traps and other moist surfaces which could pos-

sibly have been contaminated with *V. cholerae*. Again, all results were negative.

Two of the houses which were investigated, although nominally domestic premises, were not used for that purpose; one was a sailors' club and lodging-house while the other was the office of an import-export firm. Part of another house was used as transient sleeping quarters for people from the boats at the waterfront.

FIG. 2
CHOLERA-INFECTED NIGHTSOIL ROUTES AND HOUSES ON HONG KONG ISLAND



With the completion of the bacteriological examination of the occupants and the houses the investigation stopped. No further positive nightsoil samples were found and no cases of cholera occurred.

DISCUSSION

The occurrence of only one cholera case in an area is unusual, but the demonstration that an area is heavily infected with *V. cholerae*, without the presence of cases, must be considered a rarity.

It was definitely established that there was no possible connexion between the case in Kowloon and the infected area on Hong Kong Island. The occurrence of the two incidents at the same time was purely coincidental.

In the infected area a minimum of 11 separate sources of infection were detected. This number could be increased to 26 if each positive hopper or bucket were considered a separate source (see the table). Although infection could be passed from one hopper load to the next, this could not happen with buckets. It is interesting to note that the 4 positive hoppers in route Central 1 (first load) resulted in the

detection of 5 positive buckets while the 7 and 9 positive hoppers in route Central 1 (second load) and Central 2 (first load) gave no positive results.

There would appear to be only one possible explanation of the sudden appearance and equally sudden disappearance of *V. cholerae* from the nightsoil in a very localized area of Hong Kong Island—namely, the arrival of a ship's crew on 22 November, who were infected with *V. cholerae* and who visited the 5 premises, which they infected, before leaving Hong Kong on 27 November without the infection spreading to any of the permanent residents of the area. Although this is only an hypothesis, the circumstantial evidence to support it is strong in that all 5 houses are within 50 yards of the waterfront, where ships from many parts of the Far East dock and that 2, possibly 3, of the houses had definite association with the sea and sailors, while the remaining 2 were easily accessible to visitors from ships.

Without nightsoil monitoring the existence of the infection on Hong Kong Island would not have been detected and if circumstances had been other than described above, cases of cholera could have started appearing in an unsuspecting community.

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measures, the Health Inspectors of the Urban Services Department, who carried out nightsoil sampling on a large scale, and the staff of the Government Institute of Pathology, who examined the hundreds of specimens.

RÉSUMÉ

Une situation relativement exceptionnelle s'est rencontrée à Hong Kong en 1966. En effet, cette année-là, on a signalé un cas unique de choléra non importé. Il s'est produit en novembre à Kowloon, sur le continent, et toutes les recherches faites autour de ce cas sont restées infructueuses. Cependant, à la même époque, on a constaté dans une partie du territoire de l'île une forte infection des vidanges par *Vibrio cholerae*, mais aucun cas ne s'est déclaré.

Environ 12 % de la population urbaine de Hong Kong évacue ses vidanges dans des tinettes, qui sont déversées dans des véhicules de ramassage s'arrêtant à des points fixes sur des itinéraires déterminés chaque nuit. On prélève quotidiennement des échantillons au moment où ces véhicules déchargent leur contenu dans des péniches de transport. De la sorte, si l'on trouve *V. cholerae* dans

un échantillon, on sait de quel secteur il provient. La nuit suivante, les récipients provenant de ce secteur font l'objet d'un prélèvement et, comme chaque tinette porte une adresse, on peut savoir d'où provient l'échantillon positif.

Le 23 novembre 1966, un cas de choléra a été déclaré à Kowloon. Les analyses bactériologiques pratiquées sur l'entourage du malade étaient absolument négatives. Ni le malade ni sa famille n'avaient quitté le quartier depuis longtemps. Aucun échantillon de vidange n'avait été reconnu positif sur aucun itinéraire de ramassage du quartier pendant cette période. Le même jour, des échantillons contaminés ont été découverts dans l'île de Hong Kong. D'autres résultats positifs ont été enregistrés jusqu'au 27 novembre, date à laquelle l'infection a disparu aussi subitement qu'elle était venue. On a pu

remonter à la source, qui se trouvait dans cinq maisons séparées, toutes voisines des quais. Cependant, des écouvillonnages rectaux pris sur les 93 personnes trouvées dans ces maisons se sont révélés entièrement négatifs, de même que des prélèvements pris sur toutes les surfaces mouillées de ces habitations.

Il a pu être établi avec certitude qu'il n'y avait aucun rapport entre le cas de Kowloon et le secteur infecté de l'île. Cette infection s'explique peut-être par le fait que

des marins ayant touché à Hong Kong le 22 novembre ont rendu visite aux habitations en question et les ont infectées avant de repartir le 27 novembre. L'infection n'a gagné aucun des résidents permanents du quartier.

Il faut donc envisager qu'une circonscription territoriale puisse être « infectée par le choléra » sans qu'on s'en aperçoive, s'il n'existe pas de système de contrôle bactériologique des excréta.