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ROLE OF THE HOSPITAL IN SMALLPOX
TRANSMISSION

by

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The hospital not infrequently plays an important role in the dissemination of smallpox to both staff and patients and sometimes throughout a community. Due to the potential importance of hospitals in the spread of infection, they should receive substantial attention by those concerned with the surveillance of smallpox. To better define the role of the hospital, observations are presented regarding the frequency of hospital associated outbreaks of smallpox and the pattern of spread during these outbreaks. Control measures are also suggested which have been found useful.

Incidence of Hospital Associated Smallpox

Between 1950 and 1968, 46 smallpox outbreaks were reported from Canada and 15 European countries⁽¹⁾. Altogether, 974 cases were recorded in these outbreaks. Of these, 358 cases (37%) were hospital associated cases (table 1).

Table 1. Hospital Associated Cases in 46 Smallpox Outbreaks in Non-Endemic Areas, 1950 - 1968

<u>Total No. of Cases</u>	<u>No. of Hospital Associated Cases</u>	<u>Other</u>
974	358	616
(100%)	(37%)	(63%)

Further analysis of these 358 smallpox cases shows that 84 (23%) occurred in either physicians or nurses working in the hospitals involved; a total of 187 cases (52%) occurred among patients hospitalized for reasons other than smallpox (table 2).

Table 2. Status of Hospital Associated Cases when Infected

<u>Status when Infected</u>	<u>No. of Cases</u>	<u>%</u>
Patient	187	52
Nurse	51	14
Physician	33	9
Other*	87	25
<u>TOTAL:</u>	<u>358</u>	<u>100</u>

*Families who stayed with patients, visitors to hospital, etc.

It is also important to note that of these 358 hospital associated cases, 56 (16%) were first generation cases, infected directly from the first imported

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case in the hospital and the area (table 3).

Table 3. Hospital Associated Cases by Generation

	<u>No. of Cases</u>	<u>%</u>
Infected from Imported Cases (1st generation)	56	16
Other generations	296	83
Unknown	6	1
<u>TOTAL:</u>	<u>358</u>	<u>100</u>

The hospital outbreaks noted above all occurred in smallpox-free countries but similar episodes have been recognized in endemic areas. In 1959, a general hospital in Santa Casa, Brazil, recorded 7 hospital associated cases which originated from a patient with undiagnosed smallpox⁽²⁾. Between January and December 1967, 51 cases occurred in a children's hospital in Vitoria, Espirito Santo, Brazil; investigation revealed that 35 of these 51 cases were patients infected by undetected smallpox cases in the hospital⁽³⁾. In Madras, India, one of 4 cases imported during the past year was a patient who was infected while hospitalized in another city for chickenpox⁽⁴⁾, and an additional episode involving 7 cases was reported from Brazil during 1969⁽⁵⁾. These are but a few examples of what, undoubtedly, is a not uncommon occurrence.

Pattern of Hospital Outbreaks

To illustrate the pattern of smallpox transmission within hospitals, five hospital associated outbreaks have been selected and summarized in Table 4. Brief descriptions of these hospital outbreaks are as follows.

Episode No. 1.

In 1947, a total of 12 cases occurred in New York, 6 of which were hospital associated cases. A person travelling from Mexico City to New York became ill and was admitted to an infectious disease hospital in New York. A diagnosis of drug allergy was made and 5 days after admission, the patient died. This patient was not recognized as smallpox until after death and the occurrence of additional cases. Three other patients in the same ward became infected (first generation) during contact with this initial case. One of these three patients was admitted to another hospital with a diagnosis of chickenpox and transmitted the infection to 3 additional patients in that

hospital. Thus the initial case resulted in 6 additional cases among other patients in two separate hospitals. The first recognized cases were two patients of the first generation. By the time they had been diagnosed as smallpox, the patients of the second generation were already several days into the incubation period. A period of 32 days occurred between the onset of the imported case and the correct diagnosis of the first recognized smallpox case. Of the total of 12 cases, 5 with contact outside the hospital, only 3 had been vaccinated within the previous 40 years.

Episode No. 2.

In 1959, a patient was admitted with a diagnosis of leishmaniasis to a general hospital in Santa Casa, Brazil. The patient was noted to have pocks on admission but these were attributed to other causes. This unrecognized smallpox case infected 4 persons (first generation) in the same hospital ward. One of these 4 cases infected 2 patients (second generation) and one of these 2 individuals infected an additional person (third generation). Thus, a total of 7 hospital associated cases resulted from the admission of an undetected smallpox case. It should be noted that these patients all had typical signs and symptoms of smallpox. Attention was drawn to the outbreak when a patient of the first generation died and the possibility of smallpox was considered. A period of 28 days elapsed between the date of onset of the initial case and the date of diagnosis of the first unrecognized smallpox case. Of the 8 cases recorded, only 2 had scars indicating successful primary vaccination at some time in the past.

Episode No. 3.

In 1961, 13 cases occurred after a Pakistani girl entered a hospital in Bradford, United Kingdom, with an admission diagnosis of malaria. This patient died one week after her admission. The correct diagnosis of smallpox in this patient was not suspected until specimens from a secondary case were subsequently examined by a pathologist. By that time, at least 8 additional patients had already developed the disease during the first generation of this outbreak. These patients included 5 children hospitalized in the same ward with the imported case, the pathologist who had performed the post mortem ~~examination and two other hospital workers.~~ A period of 16 days elapsed between the date of onset of the initial case and the date of definite diagnosis of the first recognized subsequent smallpox case. Only one of these patients had a history of vaccination before exposure.

Episode No. 4.

In 1963, 27 cases of smallpox occurred in Stockholm after the return of a Swedish sailor who became infected during a trip to an endemic area. Of these cases, 13 were regarded as hospital associated. Altogether, 4 hospitals were involved. The diagnoses of the unrecognized smallpox cases on admission were: drug allergy (hospital no. 1), chickenpox (hospital no. 2), aplastic anaemia (also hospital no. 2), vaccination reaction (hospital no. 3), erysipelas (also hospital no. 3), and thrombocytopenia (hospital no. 4). Two hospital nurses became infected and they, in turn, infected one patient. One hospital worker developed the disease after contact with the linen of a smallpox patient. The worker then transmitted the infection to another hospital. The first recognized case was a patient of the second generation of cases who died with a diagnosis of aplastic anaemia, but was later suspected to have had smallpox. A period of 37 days elapsed between the date of onset of the imported case and the date of diagnosis of the first recognized smallpox case. This Stockholm outbreak continued for six generations. Of 27 cases, 19 had primary vaccination scars, 5 had a history of revaccination, and only 3 had no history of vaccination.

Episode No. 5.

In 1967, 41 cases of smallpox occurred in Kuwait. Of these, 32 cases were hospital associated cases. Two hospitals were involved. A Pakistani woman was admitted to the first hospital with a diagnosis of chickenpox. This initiated a chain of transmission involving 22 hospital associated cases during four generations. One of the third generation cases was referred to the second hospital and was diagnosed as 'drug allergy'. The patient died but infected 9 other patients during hospitalization. The first recognized case was a fatal case in the second generation. A period of 37 days elapsed between the date of onset of the imported case and the diagnosis of the first case recognized as smallpox. Of 41 cases, only 8 cases had definite histories of vaccination before exposure.

The usual pattern of smallpox transmission in hospitals is evident from these illustrations:

1. An unrecognized smallpox case is admitted to a hospital with an erroneous diagnosis and close contacts in the hospital ward become infected. In these five episodes, involving smallpox introductions into 10 hospitals,

chickenpox was the admitting diagnosis on three occasions. The remaining patients were variously diagnosed as drug allergy, thrombocytopenia, aplastic anaemia, vaccination reaction, malaria, leishmaniasis or erysipelas. The latter three diagnoses appeared to be correct, but a combined infection with smallpox was overlooked. It is notable that, of the several diagnoses, only chickenpox cases are apt to be isolated from other patients and thus there is a ready opportunity for transmission.

2. In these 5 outbreaks, the first recognized cases represented the first or second generation of cases, but with the exception of the English episode, the delay in reaching the correct diagnosis was at least one month. When the first smallpox case was recognized in a particular generation, the cases in the subsequent generation were usually well along in the incubation period.
3. In 3 of the 5 outbreaks, smallpox was not suspected until one of the patients died.
4. Often, multiple hospitals are involved as a patient is discharged from one hospital after being infected and subsequently admitted to a second hospital when the rash and fever occur.

Control Measures

A vaccination survey of employees in various hospitals in 1962 in the USA revealed, at that time, that an average of only 25% had been vaccinated within the previous three years⁽¹⁰⁾. Although these data are not necessarily applicable to other countries, it is common experience that hospital staff are often poorly protected. National health authorities should organize vaccination programmes to ensure that hospital staff are routinely vaccinated every three years with potent vaccine.

When smallpox is suspected in a hospital in a smallpox-free area, particular attention should be paid to the following actions, in addition to the already established measures for outbreak control, i.e. surveillance and disease containment^(11, 12).

1. The following persons should be immediately vaccinated regardless of their vaccination history:
 - a) All patients and hospital personnel (including workers dealing with

laundry or contaminated material) in the hospital where a smallpox case has been recognized.

- b) The same category of persons mentioned in a) in other hospitals in the area, since experience shows that secondary cases are frequent in these other hospitals whether or not they are infectious disease hospitals.
 - c) Families of the persons mentioned in a) and b).
2. All patients and hospital staff in all hospitals in the area at risk should be screened regarding possible signs of the disease, such as acute febrile disease and development of a rash. Attention should be paid to deaths in cases of chickenpox, drug allergy and blood disease with haemorrhagic diathesis. During an outbreak, a patient once discharged but returning to the hospital with a fever should be carefully evaluated.
 3. Contacts of cases or suspected cases should be traced, immediately vaccinated and placed under close surveillance to detect initial signs of smallpox, such as fever and aching pains in the muscles. Any contact reporting such symptoms should be isolated immediately until it can be determined definitely whether or not he has smallpox. In tracing contacts, particular measures should be taken to trace early contacts in the hospital who may have already been discharged after exposure. If hyper-immune gammaglobulin or anti-viral drugs, such as methiazone, are available, it may be desirable to use these products in contacts who have not been vaccinated before exposure but vaccination should be performed irrespective of any other treatment given.

With regard to endemic areas, control measures are essentially the same as mentioned above. However, it is further recommended that routine procedures be established for the vaccination of all patients on admission to hospitals in an endemic area. This will reduce the possible high risk of exposure to smallpox in hospitals in an endemic area. Also, hospital visitors, particularly in infectious disease hospitals, should be vaccinated.

References

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Table 4. Smallpox Outbreaks Reported from Hospitals

Place and Year	Total Cases	Total No. of Hospital Associated Cases	Hospitals Involved	Diagnosis of Unrecognized Initial Case in Hospital	No. of Secondary Cases in Hospital	Ref No.
New York 1947	12	6	No. 1. Communicable Disease Hospital	Drug allergy (died)	3	(6)
			No. 2. General Hospital	Chickenpox	3	
Santa Casa, Brazil 1959	8	7	General Hospital	Leishmaniasis	7	(2)
Bradford, UK 1961	13	8	Children's Hospital	Malaria (died)	8	(7)
Stockholm 1963	27	13	No. 1. Communicable Disease Hospital	Drug allergy	3	(8)
			No. 2. General Hospital	Chickenpox (died) Aplastic anaemia*	3 1	
			No. 3. Mental Hospital	Vaccination reaction Erysipelas*	3 2	
			No. 4. Clinic for Infectious Diseases	Thrombocytopenia (died)	1	
Kuwait 1967	41	32	No. 1. Communicable Disease Hospital	Chickenpox	23	(9)
			No. 2. General Hospital	Drug allergy (died)	9	

* Second introduction.