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FAITH TABERNACLE SMALLPOX EPIDEMIC  
ABAKALIKI, NIGERIA

by

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I. INTRODUCTION AND BACKGROUND

During the last week in May 1967, a case of smallpox was reported in Abakaliki urban, the site of a mass smallpox and measles immunization programme in February 1967. Investigation revealed that there were other cases and that they all belonged to a small religious group that had refused to be vaccinated.

Description of the area

Abakaliki urban is an important trading town in south-eastern Nigeria and according to the 1963 census, contains 31 177 people in an area of 21 square miles.

Immune status and recent smallpox experience

The first report of smallpox in Abakaliki caused considerable concern because it had been the site of a pilot project of the Smallpox Eradication and Measles Control Programme in February 1967. During that period, 46 517 people were vaccinated and assessment studies revealed that at least 88.5 per cent. of the population had been successfully vaccinated.

Also important was the fact that there had been a large smallpox epidemic about 30 miles from Abakaliki from December 1966 to May 1967, which had produced 754 cases and 180 deaths. The epidemic, which centred around the town of Effium, finally came to a halt in early May when the programme teams vaccinated in the area.

The population at risk

Thirty of the 32 cases in this outbreak belonged to the Faith Tabernacle, a religious group that refuses any preventative or curative health services.

The Church in Abakaliki consists of about 120 members including women and children. (Faith Tabernacle churches are scattered throughout this area.) Members are closely related and do much visiting with one another. Because of their strict beliefs, they remain somewhat isolated from the rest of the community. The men are mainly occupied with trading in and around Abakaliki as are some of the women. They meet at church for worship four times

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during the week. Two of the services, held on Sunday afternoon and Wednesday evening, are well attended by most of the families including the children. The two remaining meetings, a Friday night Bible study and Saturday choir practice, are attended only by adults.

When the first case appeared, the minister instructed his parishioners not to visit in the houses of families with smallpox, but admits that this admonition went unheeded. When an individual developed smallpox, the pastor who claimed to have been vaccinated in 1923, would visit the patient alone in his home and pray for him. Since the epidemic remained concealed for about one and a half months, the first people to develop smallpox remained isolated at home for the duration of their illness.

After the health authorities discovered the first case, case number 11, all those who were still ill or who subsequently became ill with smallpox were isolated at the Infectious Disease Hospital. This was the only concession which Faith Tabernacle members made to the health authorities. They steadfastly refused to be vaccinated.

## II. EPIDEMIOLOGICAL INVESTIGATION - METHODS

The epidemic began in early April, but was not discovered until the latter part of May. Investigations were carried out during the first three weeks of June. Each patient was seen by the investigator, including those who had recovered, and scab specimens were collected from 11 for laboratory confirmation. There was never any doubt clinically that all 32 patients had suffered from variola major as judged by the type of prodrome, rash, duration of illness and sequelae. A list of all the family heads was obtained from the pastor and all members of each family were seen and interviewed. In compounds where there had been smallpox, everyone in the compound was seen and interviewed. Age, sex, vaccination history, the presence or absence of vaccination scars, and religious faith were recorded for each person seen. This, of course, required repeated visits to each family and compound. A line listing of cases is shown in Table 1.

## III. THE EPIDEMIC

On 2 April, a 10-year-old girl and her 11-year-old brother, both unvaccinated, were brought from the village of Effium to live with their stepfather in Abakaliki. The compound into which they moved was a typical one-storey cement-block house built around an open courtyard and located on the outskirts of town. It housed six families, all of which were members of the local Faith Tabernacle Church.

The girl mentioned above was febrile on the day she arrived in Abakaliki, and continued to have fever, headache and backache until 5 April when she developed a macular rash which progressed through a papular, vesicular, pustular and crusting stage over the next two to three weeks. She was isolated at home. Thirteen days later a 25-year-old unvaccinated mother living in the same compound developed a similar rash and illness. Both these people were recognized as having smallpox and were kept hidden in their rooms. By the seventh week of the epidemic, at least one member of each family had developed smallpox. The last case in compound 1 occurred during the ninth week (Fig. 1) bringing the total number of cases there to 13. Two previously unvaccinated people remained in the compound who had not had smallpox by this time and one of them, a small child, was successfully vaccinated in the absence of the parents on 2 June.

During the fifth week of the epidemic, a family seemingly free of smallpox moved from compound 1 to a new house across town (compound 2). By the end of the week, two children had clinical smallpox. This heralded the spread of smallpox outside of compound 1. By 10 June (eleventh week) a total of nine compounds had had one or more cases of smallpox. It is interesting to note that in the last seven compounds (3 through 9), the spread of disease was limited to the family in which the initial case occurred.

By 20 June (twelfth week) a total of 32 cases of smallpox had been reported and the epidemic began to wane after a peak of six cases during the ninth week of the epidemic. Of the 32 cases, seven reported having been vaccinated in the past but visible vaccination scars were present in only three. These persons had been last vaccinated, respectively, in 1948, 1963 and 1963.

Out of the 32 cases confirmed, only two did not belong to the Faith Tabernacle. The first of these, case 21, was a 26-year-old mother who lived in a compound which was about four to five blocks from compound 1. She claimed to have been vaccinated in 1958, but had no visible vaccination scar. At first both she and her husband denied knowing any Faith Tabernacle people or having contact with any of the people who previously or subsequently developed smallpox. She was a trader in the town market and had a booth where she sold plaintains. Further investigation revealed that a Faith Tabernacle lady, case 2 (from compound 1), had a similar booth directly across from hers, a distance of about six feet. This seemed to be the only contact which case 21 had with the epidemic. However, there was a 43-day time lapse between the onset of rash in case 2, on 18 April, and the onset of rash in case 21, on 31 May. This could have been the result of either of two things:

1. Case 2 remained in her home for the duration of her illness and returned to her market stall about one month after the onset of her rash. It is possible that she was still infectious when she returned to work and thus directly transmitted smallpox to her neighbour.

2. The other possibility is that there were other cases of smallpox among the women in this block of booths. The only evidence to support this was that there had been another Faith Tabernacle lady whose booth was adjacent to that of case 2 and across from that of case 21, who had been absent during the period in question. The only information that could be uncovered was that she had gone to her farm. She could have had smallpox.

The only other case of smallpox in a non-Faith Tabernacle person was that of case 28. This was a 40-year-old washerman living in compound 9 who washed clothes for people in compound 1, including those who had smallpox. Although he did the washing in his own compound, he sometimes went to compound 1 to collect the clothes while at other times they were delivered to his home. He was thus exposed through contact with infected fomites and infected individuals. He had been last vaccinated in 1964 but had no visible scar.

None of the people in these two compounds belonged to the Faith Tabernacle and nearly all were vaccinated shortly after the two cases were discovered. The result was that no secondary cases occurred in either of these two families or in their respective compounds.

Each of the first cases occurring in seven of the eight compounds subsequently infected could be traced to personal contact with an infected person in compound 1 where there was a continuous source of infection for the first nine weeks of the epidemic. Infection in the remaining compound probably resulted from contact with compound 2 with whom it shared a common yard and facilities. Seven cases of smallpox had occurred in this latter compound.

#### IV. ANALYSIS OF DATA

Three groups of people were defined for purposes of data analysis:

1. Faith Tabernacle people living in compounds where there had been smallpox.
2. Faith Tabernacle people who lived in compounds where there had never been any smallpox.
3. All non-Faith Tabernacle people who lived in the compounds where there had been one or more cases of smallpox. This group numbered 177 people.

A. Primary attack rates

The very high attack rates in infected compounds among those who belonged to the Faith Tabernacle Church contrasted to those who did not, is well illustrated in Table 2. Differences in vaccination levels as well as relative frequency of contact undoubtedly account for this.

The highest attack rates were among children, especially pre-schoolchildren (Tables 3, 4). In large part, this would appear to be due to a much larger proportion of susceptibles among children. Attack rates among susceptible children of Faith Tabernacle Church members are extraordinarily high, as shown in Table 4.

B. Secondary attack rates (Table 5)

Table 5 presents the secondary attack rates for each compound that experienced smallpox. One might legitimately question why there were no secondary cases in compounds 3, 6, 7, 8 or 9 where there were a number of susceptibles. Part of the reason is that a large proportion of those were vaccinated during the course of the epidemic. In compound 3 for instance, health inspectors successfully vaccinated four previously unvaccinated children despite the fact that they belonged to the Faith Tabernacle. (Their parents were out of the home at the time.) Also most of the people in compounds 6, 7, 8 and 9 did not belong to the Faith Tabernacle and were vaccinated during the course of the epidemic.

V. DISCUSSION

This epidemic was an offshoot of the devastating outbreak at Effium which had a reported mortality of 23.9 per cent. There are several differences between these two epidemics, the first being that no deaths were reported in the Faith Tabernacle outbreak. There must have been some deaths which were very well concealed. The second difference is that although the two epidemics were related virologically, the disease itself produced in the Faith Tabernacle epidemic was of a less severe nature than found in the Effium epidemic. This may be partly due to the fact that the Faith Tabernacle patients were in a much better nutritional state than their counterparts in Effium and continued to receive adequate nourishment during their illness.

There was no significant difference between the attack rates in males and females in any of the age categories. The highest attack rates were experienced by members of the Faith Tabernacle. Out of its entire membership, 25.1 per cent. developed smallpox during the two-and-a-half month period. The most severely afflicted subgroup was the pre-school-age children. Only 10 per cent. of these children, living in compounds with smallpox cases, had been vaccinated and the remainder had a poor chance of being vaccinated during the epidemic because of their parents' beliefs. Consequently, they experienced an over-all attack rate of 70 per cent. Their older school-age siblings were more fortunate in that 68.4 per cent. of them had been vaccinated in school at one time or another, despite their parents' beliefs. Their over-all attack rate was 36.8 per cent. Of those over 15 years of age (again referring to FT members living in compounds with smallpox), 57.2 per cent. had been vaccinated before joining the Faith Tabernacle. They experienced an over-all attack rate of 25.7 per cent.

There were two cases of smallpox in people who did not belong to the Faith Tabernacle, but neither resulted in secondary spread.

The epidemic thus occurred in a pocket of poorly protected people immersed in a well-protected urban population. Although there were numerous opportunities for transmission of smallpox at the four weekly meetings, it appears that this was not the route taken. The chain of transmission began in compound 1 where it spread among four families before spreading to compounds 2 and 3 successively. Also, the first infection in each of the other six

compounds can be directly traced to contact with one or more of the smallpox cases in compound 1, the only possible exception being that of case 21. This was the non-Faith Tabernacle lady who acquired her infection either through direct or indirect contact in the market with case 2, who lived in compound 1. There were eight FT families who did not experience smallpox. Since they contained numbers of susceptibles comparable to those in compounds 1 and 2, it would seem that many of them should have experienced smallpox had virus transmission via this type of contact been of prime importance.

Compound 1 presented a unique situation in that:

1. All its 33 occupants (six families) belonged to the Faith Tabernacle Church.
2. The epidemic was undisturbed by case isolation imposed by the authorities.
3. The epidemic was undisturbed by vaccination.

Because of this, smallpox spread through the compound in a natural manner and its epidemiology was unaltered by medical interference. Most interesting is that smallpox spread slowly from family to family with the primary case in each family appearing at fairly regular intervals over a seven week period. The second significant observation is that although virus transmission was slow, it was relentless. The secondary attack rate among susceptibles was 85.7 per cent.

It cannot be stated what the risk of getting smallpox was if a person's sole contact with the epidemic was at the church meetings. The data suggest that the risk of an individual developing smallpox was greater if a member of his family had smallpox than if his exposure was to a smallpox case within another family in the compound. However, there was no significant difference between the secondary attack rates among susceptibles in compounds and families. This is particularly evident in the case of FT compounds and families. The risk of an unvaccinated person developing smallpox was equally as great whether the exposure was to an infected member of his family or another family in the compound. On the other hand, the risk faced by a vaccinated individual was significantly greater if there was smallpox in his family. This would suggest the existence of a susceptibility threshold in previously vaccinated people exposed to smallpox. This threshold may be dependent on frequency of exposure to smallpox or the size of the inoculum which caused the infection.

## VI. SUMMARY

Transmission of smallpox can occur in a community where the over-all immune status of the population is known to be high if there remains even a small pocket of poorly protected individuals who associate together for one reason or another.

As regards the smallpox eradication programme, one cannot accept any percentage coverage of a population by vaccination as being high enough to halt the transmission of smallpox unless one can be assured that no such unprotected pockets, as described above, exist.

Transmission of disease both within and between families is comparatively slow even when families are closely associated, living in compounds.

From these data, it would seem that transmission of smallpox via contacts in gatherings such as church meetings is of secondary importance to that of family and compound contacts.

The data would suggest that there is a threshold of exposure which must be exceeded for a previously vaccinated person to develop smallpox. This threshold may be governed by the frequency of contact with smallpox virus or by the concentration of virus a vaccinated individual is confronted with.

TABLE 1. LINE LISTING OF SMALLPOX CASES

| Case No. | Age   | Sex | Onset of rash | Vaccination status<br>Dates of vacc. | Vacc. scar | Member of FTC | Compound |
|----------|-------|-----|---------------|--------------------------------------|------------|---------------|----------|
| 1        | 10    | F   | 5 April       | -                                    | 0          | Yes           | 1        |
| 2        | 25    | F   | 18 April      | -                                    | 0          | "             | 1        |
| 3        | 35    | M   | 25 April      | -                                    | 0          | "             | 1        |
| 4        | 4-1/2 | F   | 27 April      | -                                    | 0          | "             | 1        |
| 5        | 11    | M   | 30 April      | -                                    | 0          | "             | 1        |
| 6        | 1-1/2 | M   | Last of April | -                                    | 0          | "             | 1        |
| 7        | 4     | F   | Last of April | -                                    | 0          | "             | 1        |
| 8        | 8     | F   | 1 May         | 1966                                 | 0          | "             | 2        |
| 9        | 12    | M   | 5 May         | 1963                                 | +          | "             | 2        |
| 10       | 2     | M   | 10 May        | -                                    | 0          | "             | 1        |
| 11       | 35    | M   | 13 May        | -                                    | 0          | "             | 4        |
| 12       | 28    | F   | 15 May        | -                                    | 0          | "             | 5        |
| 13       | 3-1/2 | M   | 15 May        | -                                    | 0          | "             | 1        |
| 14       | 1-1/2 | F   | 17 May        | -                                    | 0          | "             | 1        |
| 15       | 2     | M   | 17 May        | -                                    | 0          | "             | 1        |
| 16       | 3-1/2 | F   | 22 May        | -                                    | 0          | "             | 1        |
| 17       | 1     | F   | 25 May        | -                                    | 0          | "             | 5        |
| 18       | 30    | F   | 26 May        | -                                    | 0          | "             | 2        |
| 19       | 4-1/2 | F   | 30 May        | -                                    | 0          | "             | 1        |
| 20       | 13    | M   | 30 May        | 1963<br>Feb. 1967                    | 0          | "             | 2        |
| 21       | 26    | F   | 31 May        | 1958                                 | 0          | No            | 6        |
| 22       | 35    | M   | 31 May        | Last one in 1948                     | +          | Yes           | 5        |
| 23       | 2     | F   | 1 June        | -                                    | 0          | "             | 2        |
| 24       | 2     | M   | 2 June        | -                                    | 0          | "             | 7        |
| 25       | 11    | F   | 4 June        | -                                    | 0          | "             | 4        |
| 26       | 1     | F   | 4 June        | -                                    | 0          | "             | 2        |
| 27       | 3     | M   | 5 June        | -                                    | 0          | "             | 2        |
| 28       | 40    | M   | 7 June        | 1956                                 | 0          | No            | 8        |
| 29       | 28    | F   | 10 June       | -                                    | 0          | Yes           | 3        |
| 30       | 27    | M   | 10 June       | -                                    | 0          | "             | 9        |
| 31       | 9     | F   | 15 June       | -                                    | 0          | "             | 5        |
| 32       | 35    | M   | 20 June       | 1963                                 | +          | "             | 2        |

TABLE 2. SMALLPOX ATTACK RATES IN FAITH TABERNACLE  
AND IN EXPOSED NON-FAITH TABERNACLE PEOPLE

| Group                | Number at risk | Smallpox cases | Attack rate |
|----------------------|----------------|----------------|-------------|
| Faith Tabernacle     | 120            | 30             | 25.1        |
| Non-Faith Tabernacle | 177            | 2              | 1.1         |
| Total                | 297            | 32             | 10.7        |

TABLE 3. ATTACK RATES FOR NON-FAITH TABERNACLE  
MEMBERS LIVING IN COMPOUNDS WITH SMALLPOX

| Age   | Vaccinated |                   |                 | Not vaccinated |                   |                 | Total |                   |                 |
|-------|------------|-------------------|-----------------|----------------|-------------------|-----------------|-------|-------------------|-----------------|
|       | No.        | No. with smallpox | Attack Rate (%) | No.            | No. with smallpox | Attack Rate (%) | No.   | No. with smallpox | Attack Rate (%) |
| 0-5   | 31         | -                 | -               | 11             | -                 | -               | 42    | -                 | -               |
| 6-14  | 37         | -                 | -               | 3              | -                 | -               | 40    | -                 | -               |
| 15 +  | 93         | 2                 | 2               | 2              | -                 | -               | 95    | 2                 | 2               |
| Total | 161        | 2                 | 1               | 16             | -                 | -               | 177   | 2                 | 1               |

TABLE 4. ATTACK RATES FOR FAITH TABERNACLE  
MEMBERS LIVING IN COMPOUNDS WITH SMALLPOX

| Age   | Vaccinated |                   |                 | Not vaccinated |                   |                 | Total |                   |                 |
|-------|------------|-------------------|-----------------|----------------|-------------------|-----------------|-------|-------------------|-----------------|
|       | No.        | No. with smallpox | Attack Rate (%) | No.            | No. with smallpox | Attack Rate (%) | No.   | No. with smallpox | Attack Rate (%) |
| 0-5   | 2          | -                 | -               | 18             | 14                | 79              | 20    | 14                | 70              |
| 6-14  | 13         | 3                 | 23              | 6              | 4                 | 67              | 19    | 7                 | 37              |
| 15 +  | 20         | 2                 | 10              | 15             | 7                 | 47              | 35    | 9                 | 26              |
| Total | 35         | 5                 | 14              | 39             | 25                | 64              | 74    | 30                | 41              |

TABLE 5. SECONDARY ATTACK RATES IN EXPOSED COMPOUNDS BY VACCINATION STATUS

| Compound no. | Number exposed* | Number infected | Secondary attack rate | Number susceptible by history | Number infected | Secondary attack rate |
|--------------|-----------------|-----------------|-----------------------|-------------------------------|-----------------|-----------------------|
| 1            | 32 (32)         | 12              | 37.5                  | 14                            | 12              | 85.7                  |
| 2            | 14 (13)         | 7               | 50.0                  | 5                             | 4               | 80.0                  |
| 3            | 9 (9)           | 0               | 0.0                   | 7                             | 0               | 0.0                   |
| 4            | 32 (3)          | 1               | 3.1                   | 2                             | 1               | 50.0                  |
| 5            | 21 (6)          | 3               | 13.6                  | 4                             | 2               | 50.0                  |
| 6            | 42 (0)          | 0               | 0.0                   | 3                             | 0               | 0.0                   |
| 7            | 19 (4)          | 0               | 0.0                   | 3                             | 0               | 0.0                   |
| 8            | 41 (0)          | 0               | 0.0                   | 5                             | 0               | 0.0                   |
| 9            | 32 (0)          | 0               | 0.0                   | 6                             | 0               | 0.0                   |
| Total        | 242             | 23              | 9.6                   | 49                            | 19              | 36.7                  |

\* Number belonging to Faith Tabernacle Church is shown in parentheses.

FIGURE 1

FAITH TABERNACLE SMALLPOX EPIDEMIC  
ABAKALI, NIGERIA

