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PERSPECTIVES

The last smallpox outbreaks in the world – eradication efforts in Somalia – selected memories of a WHO field epidemiologist

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ABSTRACT

Somalia was the last country in the world with smallpox. The government tried to control smallpox through mass vaccination in the 1970s. This was not successful. Contributing to this was a nomadic, highly mobile population and resistance to vaccination. The low vaccination coverage led to importations from neighboring countries, Kenya and Ethiopia, and increased transmission inside the country. There was a major outbreak in Mogadishu in August 1976, which continued up to January 1977. It was followed by additional outbreaks in the south of the country, mainly in the area between the Juba and Shabelle rivers, particularly in Baydhabo district. The control method was then shifted to the regular WHO approach of surveillance, containment and ring-vaccination.

A reward of 200 Somali shillings was introduced for any new reported smallpox case. Surveillance was intensified. This led to a sharp increase in reported cases in June 1977 – a peak was reached in the middle of July 1977. Then 25 experienced WHO field epidemiologists arrived. I was one of them and was posted to Gedo one of the regions, which still had smallpox. Transmission was gradually brought under control. At the beginning of August, it was clear that transmission mainly consisted of spread between small nomadic groups. These outbreaks were difficult to find and had to be located by temporary searchers sent out on foot. By the end of November there were still five pending outbreaks in Gedo. I give an account of what working in a tough, sometimes hostile area entailed and how we solved the problems encountered there. Those were the last smallpox cases in Gedo. The success was to a large extent dependent on close cooperation with the local people, particularly the camel herders. Without their engagement smallpox would not have been eradicated so quickly in Gedo and thereby not in Somalia.

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Background

Smallpox has been known to the world for more than 3000 years. Suspected pock marks have been seen on the face of a mummy of a pharaoh in Egypt from that time. People have tried different ways to control the disease including variolation and vaccination. In 1966 it was finally decided to embark on a smallpox eradication program on the basis of an old proposal from the Soviet Union. Actual eradication efforts were launched as a WHO program in 1967. According to WHO smallpox had caused 300 million deaths in the world during the 20th century and 2 million deaths in 1967 alone. That year the disease was reported in 30 endemic countries in Latin America, Africa and south Asia. There was no endemic smallpox in Europe or North America. There are two genetically different forms of smallpox: variola major and minor [1] with case fatality rate around 25-30 times higher in variola major. In the first half of the 20th century, variola major was the primary cause of smallpox outbreaks across Asia and most of Africa. Meanwhile, variola minor was more commonly found in South America, and certain parts of Africa, including the Horn of Africa.

Innovations were introduced as part of the eradication effort. These included a new freeze-dried vaccine ready

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for inoculation through the addition of a solution and administered with the use of a bifurcated needle that kept a sufficient quantity of vaccine between the two "legs of the fork". The needle was then pricked 15 times into the skin of the upper arm. Further there was a shift in strategy from the beginning of the 70s from *mass vaccination* to *surveillance* (search weeks:"active search") and *containment* (localisation of cases, isolation of the cases and vaccination in concentric circles around the cases –"ring vaccination"); further *contact tracing* was undertaken in places the infected persons had visited [2]; in addition, a *monetary reward* to the one who reported a new case was introduced. This new approach led to immediate success and smallpox was eradicated from West Africa in 1970, South America in 1973 and from Asia in 1975.

When I arrived in Somalia in July 1977, around the same time as 25 other WHO field epidemiologists, Somalia had already tried to control smallpox through mass vaccination since 1970. However, this had met with difficulties in a population that was to a large extent nomadic and where many resisted vaccinations. The low coverage of vaccination contributed to a large number of importations from neighboring countries, mainly Ethiopia and Kenya. Particularly there was a relatively large outbreak in the capital Mogadishu, which started in August 1976 with 39 identified cases. The source of infection was not found for 13 of these and the outbreak continued up to January 1977. Signs of continued transmission outside Mogadishu came from the border town of Mandera in Kenya, where an infected man was detected. He had recently stayed in Jowhar, Middle Shabelle region, Somalia. Search activity in the south of the country was then intensified and further cases were detected during the spring of 1977. A total of 140 smallpox outbreaks and 470 cases had been reported by mid-May in nine southern regions. At that time an emergency call was made to the United Nations Disaster Relief Office by the Somali government and an effective countrywide program soon became operational. It disclosed far more outbreaks. A total of 947 outbreaks and 3229 cases were reported in the country during the whole of 1977, almost all of these were from the south of the country.

Most cases were reported from the area between Juba and Shabelle rivers particularly in Baydhabo district, Bay region (Figure 1). Before that control efforts in Kenya, and Ethiopia had been intensified. The last case in Bale, Ethiopia was declared cured on 9th of August 1976 and the last case in Mandera, Kenya on 5th of February 1977. In Somalia there was a sharp increase in cases in June after more intense search efforts and the introduction of a 200 Somali Shillings reward for any new smallpox case reported [3]. This is also likely to having increased the flow of information through word of mouth, the main source of information in Somalia at the time.

The epidemic slowed down in July. There were now only outbreaks in four regions: Bay, Bakool, Gedo and Lower Shabelle (Figure 1). At the beginning of August 1977, it was clear that transmission mainly consisted of spread between small nomadic groups. This was also the case in Gedo, where I was posted. These were difficult to find and had to be located by temporary searchers sent out on foot. A meeting in Nairobi in September 1977 declared that international cooperation should be sustained "so that smallpox transmission can be interrupted in shortest possible time – the target being the end of 1977". The number of newly reported cases rapidly declined from a peak in July. At the end of September there were still 29 pending outbreaks, which declined to 12 at the end of October and finally six pending outbreaks at the end of November, five of which were in Gedo (Figure 2). The very last case was the cook at Marka hospital in Lower Shabelle region. He was declared cured on 26th November 1977 [3,4]. These were also the last smallpox cases in the world.

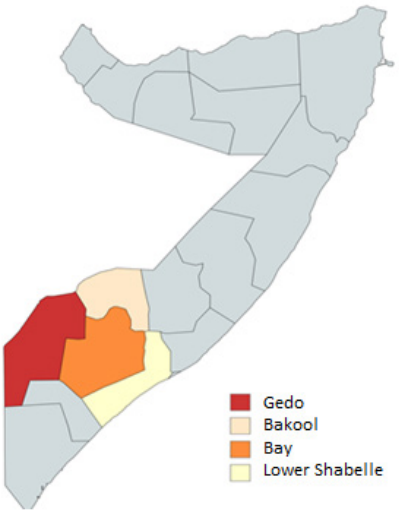

Figure 1. Regions in Somalia affected by smallpox in July 1977

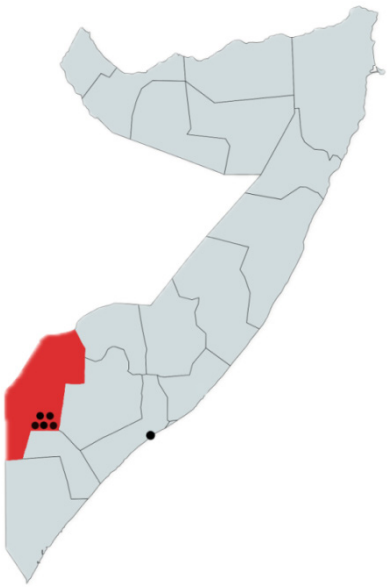

Figure 2. The six last pending smallpox outbreaks in Somalia, in November 1977; five in Gedo (marked in red) and one in Marka. (Modified from a map from Ref.3: Smallpox eradication in Somalia: report to the International Commission on the Smallpox Eradication Programme in Somalia (WHO)).

Continued surveillance in November 1977, which depended on vehicle transport, was made almost impossible by extremely heavy rains that year. However, in December a large nation-wide search operation failed to find any additional cases and Somalia was declared free of smallpox on the 31st of December 1977 [3, 4]. Efforts in the first months of 1978 were focused on confirming the smallpox-free status of the country. No more cases were found and the World Health Assembly declared the world free of smallpox in May 1980 [5].

Field work in context

When I arrived in July 1977 the epidemic was thus slowly being brought under control, but there was always the fear it could drag on as it had done before or flare up again. The ambition was therefore to finish it as soon as possible. But the task was far from easy. I, being one of the younger field epidemiologists, was assigned to Gedo region – one of the toughest regions. It had very few and poor roads and there was no map of the region. The task itself was not unfamiliar to me as I had already worked several months with variola major both in India and Bangladesh, where smallpox had been eradicated in 1975. But the task was in many ways more difficult here. Not many people I had to work closely with spoke English. Our driver spoke some Italian and I spoke some Portuguese, so we had to manage with that. I was first accompanied by a colleague to Baardheere, a small Gedo town, before continuing on my own to Garbahaarey, the regional capital. The stony road between these small towns was the worst I encountered during my whole stay – it mostly made the Land Rover jump from one rock to the other. I was housed in the regional guest house, which was situated a few meters from the tree under which President Siad Barre was born. The house was extremely hot. It was rarely below 30 degrees at night.

I now needed to understand the Somali *context* in which I was working. I was very familiar with the WHO smallpox strategy of surveillance, containment and ring vaccination, which was developed in West Africa in the beginning of the 70s [2] and practiced when smallpox was eradicated from India and Bangladesh. But it certainly had to be modified for the situation in Gedo. For this one had to understand what nomadic life was about. I will offer some anecdotal evidence (personal notes) to give an idea of what this entailed. First of all, it is self-evident that the nomadic people are very knowledgeable about their surroundings and ways of life. This knowledge helped us outline a map of the region. There was no such map when I arrived, but the camel herders knew every point in the region. The majority of the population was nomadic, some were semi-settled. There were only a few villages or towns. Garbahaarey mainly consisted of two intersecting dirt roads, a hospital and a few government buildings. It had no hotels or restaurants worth the name, but very tough boiled meat could be bought at a small stand managed by young boys at the side of the main road. To outline the map, we gathered a few camel herders. Gedo region is to a large extent covered by a thick thorny Acacia bush, but every bigger tree has a name, every bigger rock has a name, as has every hill. The camel herders knew all of these names and where they were situated. They also knew exactly in what direction any feature, such as a big tree, was located if you stood on a specific hill. Moreover, they knew how much time it would take to walk from that very hill to the selected bigger tree.

This detailed knowledge made it possible for us to outline a rough map over the region, but detailed enough for us to be able to draw up plans for surveillance and reach a reasonable regional coverage of search activities. We could now ask the temporary searchers/vaccinators to visit specific areas and ask the nomadic people, who were there at the time, after having shown them pictures of smallpox victims, if they had seen any people with such rashes. They would then come back to report their findings. We used a modified surveillance form, which only meant ticking off the places visited. Teaching them how to vaccinate with the use of the freeze-dried vaccine and a bifurcated needle was not difficult. They were instructed to vaccinate all people in the infected settlement and in adjacent settlements, if there were any.

It was also important to understand the *spirit* of nomadic life. The following examples are based on my personal notes. When travelling through the bush we often encountered nomadic groups. We used to ask them for camel milk, which for me was the main source of food for the first two months. They generously used to supply us. We also met lone wanderers such as a boy, who was on his way to Hargeysa in the north of the country with ten goats as he had heard that the price of goats was much better there, a walk of maybe one to two weeks. The car was once stopped by a young girl, who was herding her small group of goats and sheep. She wanted a ride as she was not familiar with this part of the forest and had just been followed by a hyena. Asked about how she could manage alone among the wild animals she said she could get away from the hyenas by climbing up a tree and she could run away from the elephants. If the lions came to close to her animals, she threw stones at them and they would run away. The only thing she was really afraid of was men. She was very afraid to lose her virginity before getting married. She was also afraid to get into our car, but still happy to get a ride. She was sure she would find her animals again once she got out of the car.

When I first arrived in Garbahaarey my Somali counterpart had already been there for some time. He had almost exclusively hired young literate women as temporary searchers/vaccinators. I immediately understood this could not work. At the same time he had some problem with his vehicle and presented me with a huge bill for repairs from the local mechanic. Although I was responsible for WHO´s money for the region the cost of the repair was so large that I had to ask him to go to Mogadishu to do the repair. I was then without counterpart and could carry out my plan to replace the young women with young illiterate camel herders (“geel jire”). All plans though had to be approved by the regional/district authorities. The young women could certainly fill the

surveillance forms, but they could in no way go into the bush in their long elegant dresses and the young "geel jire" certainly were familiar with the bush as well as the ways of their fellow nomads. As soon as they were presented with a reward of 200 Somali Shillings for reporting a case of smallpox, they bought a new young camel to increase their herd.

Apart from the outlining of plans for surveillance and supervision of containment the most important task for me as WHO field epidemiologist was to confirm the diagnosis of any suspected smallpox cases. As most infections in this phase of the epidemic occurred in rural nomadic areas without access by road this often meant travelling long distances by foot. These walks were made during the night to avoid the extreme heat during the day. We used to walk in one line with an experienced camel herder first in the line with a stick in his hand to sweep away any snakes that might lie on our path. I particularly remember one such night. We walked for 11 hours that night in very bright moonlight. After around half the distance we reached a dried-out riverbed and one of camel herders started digging for water. It did not take him long before water seeped out from the sand and we could quench our thirst. The water was certainly not clear but free of infection. After that we continued a few hours more before we reached the nomadic group in which a searcher had reported that there were some children with a rash. As was not infrequently the case on such confirmation walks, the patients only had chickenpox. After that we tried to get some sleep for a few hours next to the pen of the camels in the settlement. It was difficult to find any peace with the bellowing of the camels and the braying of the donkeys. Still we got a few hours rest and then early morning restarted our walk back to Garbahaarey.

Well back in Garbahaarey, I was faced with upsetting news. I was asked to vacate the regional guest house and had no place to stay. However, I was then later offered a room in the hospital. I was not given any reason for this. I did not understand what was behind it, but just accepted it. A few weeks later after we had left Garbahaarey the driver gave me the explanation. When we hired temporary searchers/vaccinators I had done this in collaboration with the doctor at the hospital. He had then selected searchers/vaccinators mainly from his own clan, not from the clan of the regional commissioner or from other clans. I had not understood that at all. Work was also made more difficult by the on-going war between Somalia and Ethiopia. This had meant air bombardments of the bridge next to the guest house in Luuq, Gedo, where I had spent two nights. Later on, the war effort led to mobilization of all young men, which meant we could no longer use them for surveillance.

The last smallpox outbreaks

During search activities near Baardheere on the 20th of September 1977 we found two settlements with on-going smallpox outbreaks. A third settlement was found two days later. From these three settlements there was further spread to two more settlements with single cases in the same area near Baardheere. Transmission had been going on in this semi-settled population, with spread between family groups, at least since the beginning of August, probably since July. The villages had in fact already been visited by my predecessor, who mistakenly had diagnosed chickenpox. When I arrived there, I saw it was clearly smallpox and we started isolation in isolation huts as usual. The patients were given food and water as well as a reward of five Somali Shillings per day while isolated. Paid guards were placed outside the isolation huts. Transmission stopped and cases were cured after a few weeks of successful isolation. These were the last 18 smallpox cases in Gedo.

At the end of October, I was transferred to Diinsoor, Bay region (Figure 1). There were no longer any known smallpox outbreaks here, but all work was focused on surveillance - to assure the effectiveness of surveillance activities mainly through reports on fevers and rashes and to find new smallpox cases. In Diinsoor the roads were sandy and much smoother than in Garbahaarey, but during the rains, which were extremely heavy that year, transport even by four-wheel drive vehicles became almost impossible in the black cotton soil. We solved this problem by inviting five to six young men into the car every morning and paid them for pushing the car forward when we got stuck. I often took over the steering wheel of the Landrover since driving in the mud resembled driving in snow and ice, which I was familiar with from Sweden. We found no new smallpox cases during the month of October in Diinsoor. Surveillance of rashes with fever then went on without any new cases of smallpox in November and December 1977. Surveillance continued during 1978 to confirm the smallpox free status of the district.

After the very last case that occurred at Marka, Lower Shabelle region, in November 1977 no more smallpox cases were found in Somalia and in 1980 the World Health Assembly declared the world free of smallpox [5].

Conclusion

The success of smallpox eradication has encouraged the international health community to also aim for eradication of other diseases. Attempts have been made to eradicate malaria and guinea worm and the world is now close to eradication of polio. Successful eradication requires certain preconditions. This includes that the target is a human-specific disease without an animal reservoir. It also demands an effective and simple to use technology, an efficient organization, sustained will and financing, a coalition of multilateral, national and private experts as well as a high likelihood of lowering the basic rate of transmission to <1 for the long term. For the smallpox eradication such preconditions were there and moreover a very strong commitment permeated all activities at all levels, from the leadership of WHO to the national level, the international staff and local searchers/vaccinators.

In Somalia it is clear that without the close collaboration with the illiterate, but knowledgeable camel herders we

would not have been able to finish smallpox in Somalia within the set target of December 1977. During the whole of my public health work, I have tried to stress the importance of community involvement and engagement, also for the control of other diseases such as HIV [6], where incidence among young women continues to be high in highly affected areas [7] but where community involvement probably still remains limited due to the politically and culturally sensitive nature of the subject – sexual relations. President Mandela of South Africa also stressed the need for a social revolution [8] to deal with the HIV pandemic. Community engagement has also been crucial for the control of Ebola [9, 10, 11] and will certainly be important for the continued limitations of the effect of Covid-19 [11] and the control of mpox. The local communities possess much of the essential knowledge. Without their engaged involvement control efforts risk to be neither effective nor successful.

Commitment at all levels is crucial – it was certainly there for smallpox - and will decide the outcome of on-going and future disease eradication efforts.

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I have no conflict of interest

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Paper context
The aim of the paper is to describe where and under which circumstances the last smallpox outbreaks occurred and how eradication was achieved – to show in more concrete detail which problems one could be faced with in the Somali context. I hope understanding the Somali contribution to Smallpox Eradication – among the greatest of all public health achievements – will encourage Somali health professionals to strengthen preventive work in Somalia maybe particularly regarding vaccination efforts and to share my conviction that listening to, understanding and engaging the local communities is crucial for this to succeed.

Summary in Somali

CINWAAN

Furuqii ugu dambeeyey ee ka dillaacay adduunka – dadaallada ciribtirkiisa ee Soomaaliya – xusuus-qoryo uu doortay khabiir baarista cudurada faafa oo ka tirsan Hey'adda Caafimaadka Adduunka (WHO) oo ka qaybgalay hoggaaminta barnaamijkaas

SOOKOOBID

Soomaaliya waxay ahayd waddankii ugu dambeeyay adduunka ee cudurka furuqa. Dawladdu waxay isku dayday inay ku xakamayso cudurka, talaalka baahsan ee furuqa sannadihii 1970-yadii. Tani may guulaysan. Waxayne ka timid reer guuraaga oo ahaa dad aad u guurguura oon aqbalin tallaalka. Hoos-u-dhacii tallaalku wuxuu u horseeday in furuqu ka soo tallaabo dalalka dariska ah, ee Kenya iyo Itoobiya iyo iney kor u kacdo faafidda cudurku dalka gudihiisa. Waxaa magaalada Muqdisho ka dilaacay furuq ba'an bishii Agoosto 1976, kaasoo socday ilaa Janaayo 1977. Waxaa xigay furuq hor leh oo ka dillaacay koonfurta dalka, gaar ahaan dhulka u dhaxeeya webiyada Jubba iyo Shabeelle, gaar ahaan degmada Baydhabo. Habka xakamaynta ayaa markaas loo wareejiyay nidaamka caadiga ah ee WHO oo ah ilaalinta/xog-ururinta, xakamaynta iyo tallaalidda dadka bukaanka la leh xiriir. 200 oo shilin Soomaali ah ayaa lagu abaalmariyey kiis kasta oo cusub oo lagu soo sheego furuqa, waxana la xoojiyay ilaalinta/kormeerka cudurka. Tani waxay u horseeday kororsiimo aad weyn kiisaska la soo sheegay bishii Juun 1977 oo heerkii ugu sarreeyay la gaaray bartamihii Luulyo 1977. Kaddib 25 khabiir oo WHO ah ayaa yimid. Anigu kooxdaas ayaa ka mid ahaa, waxaana la igu dejiyay Gedo oo ka mid ahayd gobollada, uu weli furuqu ka jiro. Fididda cudurka si tartiib tartiib ah ayaa loo xakameeyay. Bilowgii Agoosto, waxaa caddaatay in gudbinta cudurku inta badan ay ku koobneyd, ku faafitaankiisa kooxaha yar yar ee reer guuraaga ah dhexdooda. Cudurradan dillaacay way adkeyd in la helo oo waxay ahayd in deegaanka lagu hayo cudur-baarayaal ku meel gaar ah oo lug loogu diro hawlgalada. Dhammaadkii bishii 11aad waxaa Gedo ka jiray shan meelood oo furuqu ka dillaacay oo hawlgalkooda weli la sugayey. Waxaan xog ka bixinayaa hawlgalka loo baahanyahay marka laga shaqeynayo aaag adag, mararka qaarkoodna ay colaadi ka jirto, iyo sida aad u xalinaysid caqabadaha aad halkaas kala kulmaysid. Kuwaasi, waxay ahaayeen kiisaskii ugu dambeeyay ee furuqa ee Gedo. Guushu waxay ahayd mid si weyn ugu xidhnayd wada shaqaynta dhow oo lala yeeshay dadka deegaanka, gaar ahaan kuwa geela dhaqda. Furuqu la'aantood, sidaas dhaqsaha-badan Gedo loogama dabar-gooyeen, Soomaaliyana lagama cirib tireen.

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