Annex VI

Third Coordination Meeting of WHO Collaborating Centres
in Radiation Emergency Medical Preparedness and Assistance
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ACCIDENT IN EL SALVADOR*

Irradiation Facility, Technology and Training of Personnel

The accident occurred in a privately owned plant that manufactures and sterilizes surgical and medical equipment and gera for Central America. For some of the sterilization processes it uses a ^{60}Co-irradiator, model JS6300, manufactured by Nordion International and installed in 1974. The product to be sterilized is loaded into tote boxes and transported by pneumatic cylinders around a centrally located vertical rectangular source rack. The rack is made up of two vertical modules, each of them with 54 steel pencils; 28 of them had been loaded in 1975 with 4.0 PBq (108000 Ci) of ^{60}Co encapsulated in slugs. Towards February 1989 this activity had decayed to 0.66 PBq (18,000 Ci). To ensure full sterilization of the products, the minimum dose of radiation given was 18 kGy ; the nominal dose being 20 kGy. The time needed for each container to change position was, at the time of the accident, 140 min.

The source rack is attached to a cable that holds it in irradiation position by a hydraulic system and returns it to the storage water pool - 5.5 m deep - by gravity. Safety interlocks were designed to prevent the source from being raised when personnel are in the irradiation room and prevent access when there are abnormal radiation levels in the room. Automatic safety features were also installed to lower the source and shut down the irradiator in the event of an electromechanical malfunction or when power is cut off.

Workers interviewed at the plant after the accident explained the routine operation of the irradiator as follows. Before going to the control panel, they activated a switch inside the "monitor cabinet". This switch had been originally installed in the irradiation room as a "safety" key switch with a delay timer, but then it was transferred to the monitor cabinet near the control panel to avoid entering the room each time the irradiator had to be started up. It is noteworthy that the week prior to the accident the reinitiation was necessary, on average, 8 times a day, mostly due to power shut offs. After activating the switch, the workers moved to the control console, where they turned the "power" key switch through the "on" position to the "reset" position with the "master" key and they released it. A yellow "reset" pilot light in the control panel would then illuminate and extinguish. They checked that the green light indicating "source down" was on, and they set the "master" and "overdose timers". Then they removed the "master" key from "power" key switch (leaving the key switch in the "on" position) to the "start" position.

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They could now release the key, which returned to the "On" position, and the "Machine On" pilot light became lit. The source alarm bell would commence to sound and the red "Source Up" and green "Source Down" lights would extinguish until the sources reached irradiation position, at which point the red "Source Up" light would come on. Then the product conveying system would begin to operate automatically. Had a problem, such as an electromechanical failure to a power outage, returned the sources to the pool in the middle of a cycle, a re-initiation process had to be implemented. To check on the containers, which could require manual repositioning - especially if the failure had been caused by a piston malfunction - it was necessary to enter the irradiation room. With the "Master key" inserted in the entry door of the irradiation room, they pressed the "Monitor Test" button rapidly several times. This produced pulses that were picked up by the radiation monitor circuit and "interpreted" as background radiation pulses, thus activating the door solenoid and permitting the key to turn and open the entry door. All the workers interviewed thought that this was the normal entry procedure and that the door could never be opened if the sources were not in the down - safe - position.

The workers all seemed familiar with the significance of the various lights in the control panel, but none remembered having seen anything attached to the cables in the irradiation room. These were the cables to which the radiation monitoring probe should have been attached. Many workers acknowledged that the bulb of the "Danger - High Radiation Area" sign over the door had been burnt for an indeterminate period of time, but they all insisted that the "real" danger sign indicating the presence of radiation was the red "Source Up" light on the control console, that showed that the ^{60}Co sources were in the irradiation position.

None of the interviewed workers had any formal training in radiation protection. Radiation risks and effects were explained to them verbally, upon joining Del-Med, by a former employee of the company, who apparently was in charge of operator training and irradiator maintenance. The workers seemed to be more concerned about the ozone - that they had all smelled some times - than of radiation - which they had never "perceived". Some believed that after the sources had been safely returned to the pool, there was radiation still "lingering" in the room, and that the time delay required to enter the irradiation room after a radiation process had terminated, was to let the ozone and this "residual" radiation dissipate.

Some acknowledged they had not seen the Del-Med Geiger until a few months before the accident. Others insisted they always used it when entering the irradiation room. Some described using it around the entry door to see if the sources were up or down, and they all seemed familiar with the sensitivity of the two scales on the instrument. None wore personnel dosimeters, as no legislation in El Salvador required it.

There were no safety drill within the plant and the interlocks and security systems were not tested periodically. All the workers knew that entering the irradiator plant could be life threatening, but in a country with 10 years of civil war, this was a risk they were used to face, and the perception of danger had lost the usual meaning.

Events initiating the accident

At 18.15 on Saturday 4 February 1989, Worker A began a night shift as operator of the facility. That evening, as usual, he had to deal with a number of power failures and problems with the pistons, but he managed to restart the operation each time. At about 02.00 on Sunday 5 February (Day 1), while he was taking a coffee break, a fault condition occurred which caused the source rack to be lowered automatically from the irradiation position. On returning from his coffee break, he heard the source transit alarm ringing, indicating that the source was neither fully up nor fully down. He went to the control panel and followed the reset procedure. When this failed to stop the alarm and release the door, he walked through a gate to the other side of the facility and climbed the ladder to the roof where the source hoist is mounted. There, he first followed the

procedure recommended by Nordion for releasing the air from the pneumatic system with the intent of forcing the sources to fall by gravity. As this did not work, he followed a procedure adopted at the plant which consisted in detaching the normal pressurized air supply and applying an overprices to force the source into the fully up position, in the hope that this would free the source rack and permit its descent to the shielded position.

This attempt was also unsuccessful. Since the source transit alarm continued to sound and the hoist cable was still not under tension, he forcibly pulled the cable fully out of the hoist mechanism by hand and then fed it back down through the shield. This had the same effect on the microswitch of the hoist cable as if the source rack were in the fully down storage position and finally stopped the alarm. Worker A descended and returned to the control panel. He found that the (red) general failure light and the source up light were on. He went back to the roof and managed to manipulate the source down microswitch so that when he returned to the control panel he found the source down green light on. In its original design, the facility had a fixed radiation monitor in the radiation room which would have detected radiation from the source rack still raised and prevented unlocking of the personnel access door. However, this monitor probe had been removed more than five years before and had not been replaced. To unlock the door, Worker A followed another 'usual' procedure at the facility (not recommended by the supplier). He was rapidly cycling the buttons on the radiation monitor panel (simulating detection by the fixed monitor of normal background radiation in the irradiation room) while turning the key in the door switch. At about 02:30 he succeeded in opening the door. Established practice then required waiting for some minutes for ozone to be ventilated from the radiation room. He did so and then switched off the power supply to the facility.

The First Entry

Having switched off the power supply, Worker A entered the radiation room with a torch. He did not check the radiation level with the portable radiation monitor. He examined the pistons around the lower of the two levels of the product transport mechanism, noticing nothing out of order. He then removed two fibreglass product boxes from normal positions on the product entry side of the lower level. In the second row, adjacent to the source rack, he found five boxes jammed into the space for four; that is, a nominal total length of boxes of 200 cm in a floor length of 190 cm. Earlier in the shift, when repairing one of the pistons for this second row, he had found that two boxes had cracks, but since they could still hold the products he had not removed them. These deformed boxes may subsequently have disrupted the system for detecting the positions of the boxes, causing the five boxes to be squeezed into the space for four. The deformation of these boxes probably buckled the metal product guides on the conveyor preventing the source rack from being lowered.

He broke the jam by removing two of the five compressed boxes and noted the excess cable on the fixed product guide just above the upper level floor. Unable to free the rack by himself, Worker A left the irradiation room probably about five minutes after his initial entry. He switched the electrical power back on. The failure light (red) was on and the source down light (green) was intermittent. There was no alarm sounding. He then went to seek help.

The Second Entry

Shortly afterwards, at about 03.00, Worker A returned with Workers B and C, from another department, who had no experience of the irradiation facility. On being asked about any hazard, Worker A assured the others that there was no danger since the machine was switched off. The three men entered the irradiation room and proceeded to remove product boxes from the third row on the upper level (adjacent to the source) so that the source rack could be freed from above. To free the rack they first had

to raise it (a mass of about 60 kg) by all three pulling on the hoist cable. Eventually the three men were standing broadly in line on the upper level. Worker A was in a crouching position with his legs slightly apart and his right leg forward directly in front of the rack. To his right, Worker B had his left leg nearer the source. (The leading leg of each man was subsequently amputated first). Worker C was standing behind Worker B. He pulled the hoist cable free while Workers A and B raised the rack. The three men then paid out the cable over the top of the source rack framework to lower the source rack into the pool. After about two metres of cable had been paid out, the source rack reached the surface of the water, and the men saw the blue glow due to Cerenkov radiation. Worker A was surprised at this and, on fully lowering the source rack, he told his helpers to withdraw quickly. At this point, apparently, he began to suspect that there was some kind of hazard, but not how lethal it was. On leaving the irradiation room, Worker B noticed the portable radiation monitor some distance away from the irradiator and asked what its purpose was. Worker A replied that it was used for measuring radiation, but that had not been necessary.

Worker A began vomiting within minutes of leaving the irradiation room with the others. He had been initially exposed about an hour earlier and was the most exposed of the three. He felt increasingly ill. At about 03:30 he began to vomit blood and the workers went to seek medical help. Since the guard at the gate to the facility was not permitted to leave his post, Worker B helped Worker A about 100 metres to the main road, where they took a taxi to the emergency unit of the Primero de Mayo Hospital. Worker B then began vomiting. Worker C also began to vomit after returning to his work area, and he too went to the Primero de Mayo Hospital.

Over a period of about one week postexposure, the patients developed signs and symptoms of acute local radiation injury, hematopoietic depression, and enteritis. Based on the severity of hematopoietic depression and in anticipation of related medical management problems, the patients were transferred from San Salvador to Mexico City for continuing care.

As was estimated later on, during a 3 to 10 minute period (average about 5 minutes) in the facility, the workers received from 3 to 8 Gy whole body equivalent doses. Two of the three received significant doses to the feet and lower extremities. Exposure geometry was from the feet upward. The onset of nausea and vomiting occurred less than one hour for the most exposed worker A, about one hour for worker B and within three hours for worker C with the lowest dose.

Further Exposures of Other Workers at the Facility

At 06.00 on Day 1 (5 February), Worker D reported for duty on the day shift at the facility. He found the main door open, the facility shut down and the product boxes in disorder. Worker D straightened the boxes and started up the facility. When Worker A did not arrive for duty on the night shift at 18.00, Worker remained and operated the facility for another shift. On Day 2 at 06.00, he reported the matter to the maintenance manager.

The company was aware of the receipt of sick notes for the absent workers; however, these notes stated that the men were suffering from food poisoning. The company remained unaware that the accident on 5 February had caused any radiological injury to workers until contacted by medical staff of the Primero de Mayo Hospital on Day 4. However, the significance of the injuries was still not appreciated. For the rest of the week the facility was operated more or less normally; that is, with a typical number of shutdowns for repairs, usually requiring entry to the irradiation room. A notable exception was on Day 4 at 13.55, when the source rack became stuck but was released by the 'usual' overprices technique.

Subsequent examination by representatives of the supplier showed a downward bending of the top and bottom horizontal bars of the lower source module and of the bottom bar of the upper module. This deformation had probably occurred in the accident on Day 1 and may have worsened when the source rack again became stuck on Day 4. Then on Day 5 or 6

some pencils fell from the upper source module into the pool. Their absence was discovered on Day 6 after quality assurance dosimetry had indicated a non-uniform dose distribution in the dosimetres included in the product boxes.

Upon learning this, the maintenance manager and the quality assurance specialist entered the irradiation room at 12:00. They observed from the Cerenkov glow that some source pencils from the upper source module were lying on the bottom of the pool, and that two of the remaining pencils in the centre of the upper source module had become crossed. In all probability this meant that at least one of the pencils was protruding from the rack. However, it seems that at that time it was not appreciated that a projecting pencil might catch on one of the crosspieces of the fixed rack positioner when the rack was raised. Since the ambient radiation level in radiation room was normal, it was decided to continue operation but with longer exposures to compensate for the reduced source strength.

At 16:00 that afternoon (Day 6), operation of the irradiator was halted by an 'electromechanical' failure. The operator was unable to return the source rack to the storage position, and called on the head maintenance technician, Worker X, to help. The two workers somehow managed to lower the source rack (probably by the overprices method), as was indicated by the source down light. In the course of lowering the rack, they heard a noise. This was probably when the remaining pencils were knocked out of the upper module of the source rack. As the radiation monitor beep rate was low, the workers believed that all the sources were in the safe position. They opened the door with the key in the "usual" way. The operator and two other workers, X and Y, entered the irradiation room. Having found nothing wrong they got the maintenance manager to take a look. He took the monitor and, reaching into the maze, found that the dose rate was above normal. He closed the door and had the source rack raised and lowered to see if it made any difference. It moved without difficulty. He again checked for and found radiation. After repeating this process twice more with the same results, he concluded that something was amiss and at 16.35 he ordered the unit closed, sending the staff off to other areas of the plant.

Four of the pencils from the top module, one active source pencil and three dummy pencils, were subsequently found to have fallen into the irradiation room; the others had fallen into the pool. It is conceivable that some of the workers did enter the room, unaware that a source was up. None of the workers wore personal dosimeters. Their exposures were discovered only later after cytogenetic tests were made on all workers who might have been exposed as a result of the accident. These tests indicated that these four persons probably received doses beyond the annual dose limits. (See Table I).

Had the elevated radiation level in the irradiation room due to the active source pencil remained undetected, personnel could have accumulated much higher, possibly even lethal, doses through uncontrolled exposure.

Table I. Results of cytogenic analyses made by the National Atomic Energy Commission of Argentina through the WHO Collaborating Centre on Radiation Emergencies: Doses received by "other" workers on day 6

Worker	Dose estimate (Gy)	95% confidence interval (Gy)
Maintenance manager	0.22	0.0-0.38
Worker X	0.09	0.0-0.26
Worker Y	0.16	0.0-0.33
Worker Z	0.16	0.0-0.33

Medical Management in Mexico City

Upon arrival at the hospital Angeles del Pedregal in Mexico City, the three patients were examined and medical histories recorded. The patients were found to be exhibiting signs and symptoms of total body and local radiation exposure, and two of the three were in very serious condition. Following admission, each patient was placed in isolation in a private room in order to effect infection control. Biological samples were obtained from each patient for hematological and cytogenetic analysis and for routine patient assessment.

The priorities during this critical period of the patients' care included:

(a) managing the hematological derangements caused by acute radiation exposure;

(b) treating the local radiation injuries;

(c) preventing and/or controlling infection, and

(d) providing supportive care.

To meet these priorities, a medical team with specialities in hematology, bone marrow transplantation, infection control, endocrinology, nutrition, plastic/vascular surgery, nuclear medicine, and psychiatry was formed. In addition, staff nurses with extensive experience were assigned to each patient.

Patient A (i.e. worker A) had the highest estimated dose (8 Gy), Patient B had 4 Gy and Patient C had the lowest estimated dose (3 Gy).

Treatment of the Acute Radiation Syndrome

The general condition of the patients, the degree of hematological depression (as determined by complete blood counts, differentials, and platelet counts) and the results of cultures of body fluids were used in guiding initial therapy. When indicated, transfusions of irradiated platelets and red cells were administered in order to keep counts at acceptable levels. Cultures of blood, skin, body orifices, and radiation induced skin lesions were obtained using standard methodologies. Based upon results of these cultures, appropriate topical or systemic therapeutic agents for bacterial, viral, fungal, and parasitic infections were administered. Human recombinant granulocyte macrophage colony stimulating factor (rHuGMCSF) was administered via indwelling central lines in all three patients in an attempt to stimulate granulocyte production. The administration of GMCSF began upon patient admission (range 3-4 weeks postirradiation) and continued for about 1-2 weeks following the initial treatment. The patient with the highest estimated whole body dose equivalent (about 8 Gy), Patient A, received GMCSF for 12 days; the other two patients were treated for a shorter period of time. Two of the three patients exhibited no side effects from GMCSF administration. One patient (Patient A) experienced tremors and weakness.

For all three patients, the administration of GMCSF was commenced at a two hours until the total neutrophil count (TNC) had increased to at least 1500 μl^{-1}. The numbers of days required for TNC and for hematological recovery are indicated in Table II.

TABLE II. HAEMATOLOGICAL RECOVERY FOR PATIENTS A, B, AND C

Patient	Number of days for recovery[a] of total neutrophil count (TNC)		Number of days for recovery of platelets		Number of days for recovery of haemoglobin	
	Since accident	Since first intake of GMCSF[b]	Since accident	Since first intake of GMCSF[B]	Since accident	Since first intake of GMCSF[B]
Patient A	44	20	132	108	-	-
Patient B	36	10	42	16	80	56
Patient C	43	9	41	7	48	14

a The criterion for recovery of the total neutrophil count is defined as an increase in the count of 1500 μl^{-1} over the lowest value recorded.

b rHuGMCSF was first administered to Patients A, B and C on Day 24 (28 February), Day 26 and Day 33 respectively

The medical team at the hospital Angeles del Pedregal considered that the increase in TNC was due to the administration of GMCSF in view of the following observations:

(a) The nadir of cytopenia after whole body irradiation was evident in the three patients upon admission to the hospital Angeles del Pedregal, with spontaneous recovery expected only after at least three weeks.

(b) The number of days required for the TNC to increase to 1500 was 20 for Patient A, 10 for Patient B, and 9 for Patient C from commencement of the course of GMCSF. The hemoglobin and platelet values were 80 $g.l^{-1}$ and 11,000 μl^{-1} for Patient A, 90 $g.l^{-1}$ and 76,000 μl^{-1} for Patient B; and 78 $g.l^{-1}$ and 133,000 μl^{-1} for Patient C. The patients were dependent on transfusions at this time.

(c) The spontaneous recovery of hemoglobin and platelet counts was greater than that of TNC, which bears out the fact the GMCSF stimulates granulocyte precursors only.

(d) Bone marrow aspiration when TNC reached 1500 μl^{-1} showed increased granulocyte mass and decreased red blood and megakaryocyte precursors.

(e) The increase in eosinophils in Patients A and B also suggested indirect effects of GMCSF.

Blood was obtained for cytogenetic dosimetry analysis at REAC/TS. Subsequent blood samples obtained for repeated cytogenetic analysis at REAC/TS and in Mexico City were in good agreement (Table III).

TABLE III RESULTS OF CYTOGENETIC ANALYSES MADE BY THE ANGELES DEL PEDREGAL HOSPITAL, MEXICO CITY, AND REAC/TS, OAK RIDGE, USA, FOR PATIENTS A, B AND C

Patient	Angeles del Pedregal Hospital		REAC/TS	
	Dose estimate (Gy)	95% confidence interval (Gy)	Dose estimate (Gy)	95% confidence interval (Gy)
Patient A	8.19	7.62--8.59	7.97	7.29--8.65
Patient B	3.58	3.40--3.72	3.77	3.52--3.96
Patient C	2.96	2.73--3.17	2.92	2.74--3.10

INITIAL ESTIMATES OF DOSE TO THE LOWER LIMBS AND EQUIVALENT WHOLE BODY DOSE MADE ON DAY 32 BY REAC/TS, OAK RIDGE, USA, FOR PATIENTS A, B AND C

Patient	Dose to lower limbs (Gy)	Whole body dose (Gy)
Patient A	100	6--8
Patient B	100	6--8
Patient C	10	2--4

VITAL HAEMATOLOGICAL VALUES FOR PATIENTS A, B AND C UPON ADMISSION TO THE ANGELES DEL PEDREGAL HOSPITAL

Patient	Haemoglobin ($g.l^{-1}$)	White blood cells (μl^{-1})	Total neutrophil count[a]	Platelets (μl^{-1})
Patient A (Day 24)	60	200	0	20,000
Patient B (Day 26)	86	700	56	54,000
Patient C (Day 33)	84	2300	437	35,000

a Total neutrophil count is calculated as count per unit blood volume multiplied by estimated blood volume.

Observations of skin lesions, hyperpigmentation of the skin, and patterns of epilation were used in the initial radiobiological estimates of whole body dose equivalent. All the clinical and dosimetric data indicated that bone marrow transplantation was not required for any of the three patients.

By 60 days post irradiation, Patients B and C had recovered from their hematological depression. Patient A expressed a delayed recovery pattern as evidenced by platelet and white blood counts in the low/normal range. (Platelets and white blood counts returned to expected normal values in Patient A approximately five months post-irradiation). The overall medical management strategy for the acute radiation syndrome is summarized in the following:

1. the use of private rooms with reverse isolation precautions;

2. parenteral and/or enteral nutritional support or diet controlled to minimize enteric colonization;

3. meticulous skin, oral, and nasal hygiene;

4. administration of appropriate pharmacological agents to control infection;

5. use of GMCSF in an attempt to increase granulocyte levels, and

6. administration of irradiated platelets and red cells to maintain acceptable levels.

Acute Local Radiation Injury

Severe radiation induced injuries to the skin and underlying tissues of the lower extremities of two patients (Patients A and B) were manifest by swelling, erythema, hyperpigmentation, epilation, and dry and wet desquamation. The time frame and the evolution of early signs and symptoms (i.e. erythema, swelling, blistering) of acute skin injury was accelerated in both patients. Patient A experienced blister formation on day 3 postexposure. Patient B was readmitted to a hospital in San Salvador on day 9 with complaint of severe foot pain.

Treatment of acute local radiation injury consisted of usual wound care procedures. Areas of wet desquamation were treated by antiseptic and analgesic solutions and topical antibiotics. Cultures from areas of wet desquamation were found to be colonized by both Staphylococcus and Pseudomonas which, however, presented no particular difficulty in wound management. Areas of dry desquamation were observed and allowed to evolve through an expected clinical course of sloughing and re-epithelialization. By early June, the extensive dry desquamation experience by Patient A had evolved its clinical course and, with the exception of the patient's hands, skin appeared normal. The hands of Patient A were partially depigmented and covered by thin, fragile epithelium. The hands were fully functional and not painful.

By early June only partial healing of high dose areas (i.e. feet and lower legs) was evident in both patients. The patients were unable to stand and were experiencing moderate to severe levels of pain. Pain was controlled by appropriate medication and amniotic membranes used to cover the plantar surface of patients' feet.

Lower extremity blood flow was evaluated by blood pool imaging, Doppler tests, and magnetic resonance imaging. No significant circulatory embarrassment or deep tissue necrosis was revealed. Nevertheless, progressive dry gangrene occurred in the right foot of Patient A which ultimately resulted in amputation above the knee on day 132 post accident. A similar but delayed process was evident in Patient B resulting in amputation of the left leg on day 161. In late July, Patients A and B were transferred from the hospital Angeles del Pedregal to a medical facility in San Salvador. Patient C was released from the hospital Angeles del Pedgral on day 55 postexposure and returned to San Salvador.

General Support and Psychological Care

Patients A and B sustained considerable weight loss early in their illnesses, probably due to the following factors:

(a) anorexia associated with whole body irradiation;

(b) occasional bouts of gastrointestinal infection resulting in anorexia, nausea, and diarrhea;

(c) anorexia secondary to pain due to skin lesions;

(d) general catabolic effect of radiation injuries and subsequent energy requirements of the healing process;

(e) psychological factors (i.e. depression, alterations in diet, eating pattern, and culture);

(d) use of pharmacological agents that contribute to anorexia and/or nausea, vomiting, diarrhea (i.e. analgesics, antibiotics, GMCSF);

(g) presence of acute mucositis.

Nutritional needs of patients A and B were met through use of parenteral nutrition followed by enteral nutrition and subsequent usual diet therapy. Both patients with severe lower extremity injury were gaining weight prior to discharge from the hospital Angeles del Pedregal.

The assessment and management of other physical problems manifest or identified during hospitalization in Mexico City, such as endocrine imbalance, liver dysfunction, congenital anomalies, etc. were handled by consultants according to local medical customs.

Psychological and emotional support by physicians, nurses, and family members was essential in the care of all three patients. When necessary, psychiatric consultation was utilized, along with appropriate therapy to deal with the depression, fears and anxieties occurring as a result of the prolonged confinement, fear of death, incapacitating pain, fear of amputation and isolation from family and friends.

Follow-up in San Salvador

Patient A returned to San Salvador on day 173 postexposure. Although a candidate for amputation of his left leg, his overall condition deteriorated and he contracted pneumonia on day 191. He died on day 197 with no autopsy being performed. The most likely cause of death was infection, pneumonitis, and pneumothorax (due to insertion of venous catheter).

Patient B returned to San Salvador on day 173 postexposure. His general condition was good with exception of his right leg, requiring amputation on day 202. Following amputation of the right leg, his general recovery was more rapid. The patient continues to improve with rehabilitative support.

Patient C returned to San Salvador on day 55 postexposure. He remained on sick leave until day 199 and has returned to work with little restriction.