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Component 4, Part 6
Atomic Bomb Injuries/Casualties and Long-term Effects

The populations of both Hiroshima and Nagasaki were drastically decreased due to the atomic bombing of these cities. Table 1 (Radiation Effects Research Foundation, 2003) shows the estimated population sizes of Nagasaki and Hiroshima pre and post bombings (post is within four months of the bombings).

Table 1

City	Estimated city population at time of the bombings	Estimated number of acute deaths
Hiroshima	310,000 persons	90,000-140,000
Nagasaki	250,000 persons	60,000-80,000

Table Credit: Radiation Effects Research Foundation

Figure 1 Graphic credit: Radiation Effects Research Foundation

Almost everything and all people located at the hypocenters of the bombs was immediately **vaporized** due to the extremely high temperatures (up to 20 million degrees Fahrenheit) generated by the explosions. Moving in a radius outward from the hypocenters into the blast areas, injuries suffered by individuals were heat-related (burns), caused by collapsing buildings and flying objects (from shockwave) and related to acute, high level radiation exposure (Radiation Effects Research Foundation, 2006). Outside the blast areas, individuals suffered heat, radiation, and fire related deaths and injuries. On the outer fringes of the affected areas, casualties resulted from longer-term health problems. Figure 1 (Radiation Effects Research Foundation, 2003) depicts the types of injuries received based on distance of individuals from the hypocenters.

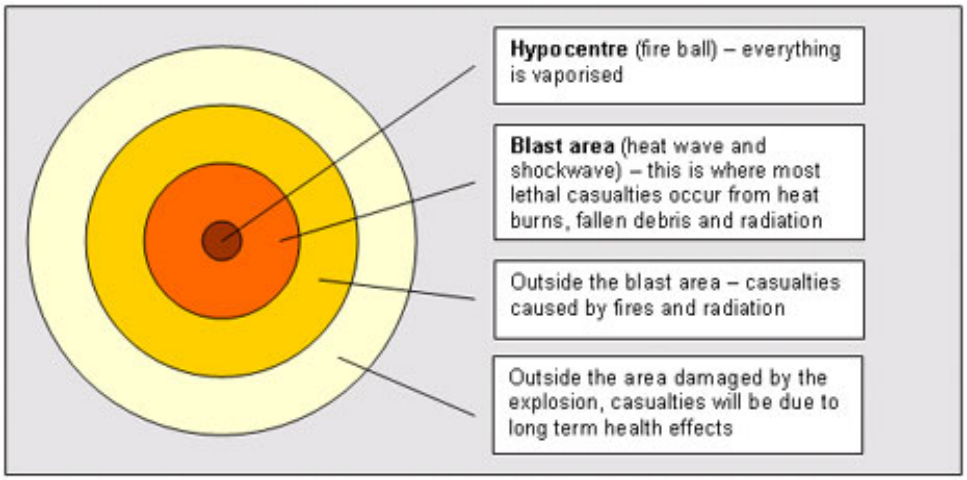

Figure 1 Graphic credit: Radiation Effects Research Foundation

For an animated timeline of symptoms experienced by individuals in the blast areas from August until December, 1945 click here: http://www.pcf.city.hiroshima.jp/virtual/cgi-bin/e/symp_e.htm

Burns

Most casualties to inhabitants resulted from flash burns from primary heat waves emanating directly from the explosions (Atomic Bomb Website, 2006). During the explosions, along with extreme heat waves, intense light was emitted (about ten times brighter than the sun). Figure 2 is a photograph depicting the clothing patterns burned into the back of a Hiroshima woman.

Figure 2-4
Graphic credit: Gensuikin

Figure 3 is a photo of the burns suffered by a boy who was sixteen and riding his bicycle to deliver a telegram message at the time of the bombing (about 2 kilometers from the hypocenter). He did not suffer fatal injuries but spent over three years in a hospital.

To read his personal account of the day of the bombing and what happened to him, click on the following link:http://www.gensuikin.org/english/photo.html. Most fatalities, according to Japanese estimates, resulted from flash burns (the Japanese report 75 percent, while other reports hover around 50 percent) (The Avalon Project at Yale Law School, 2006). Figure 4 is the photograph of the burned corpse of a young boy, believed to have been a Nagasaki mobilized student worker.

Mechanical Injuries
The intensity of the blasts, and the resulting shockwaves and accompanying wind forces resulted in collapsed roofs, walls, and flying glass and debris which resulted in many mechanical injuries to individuals in the blast areas. These people suffered a variety of injuries including broken bones, lacerations, and abrasions; many of these injuries were fatal (The Avalon Project at Yale Law School, 2006).

Radiation Injuries
All radiation injuries occurred within the first minute of the explosions. Degree of radiation exposure was dependent upon each individual's location from the hypocenters, and degree of shelter, if any, one was experiencing at the moment of the explosions (whether or not one was in a building and what the building was composed of versus being out in the open) (Schull, 1995). The early symptoms of ionization radiation exposure reported included **epilation** (hair

loss), **petichae**(bleeding into skin), mouth and throat lesions, vomiting, diarrhea, and fever (The Avalon Project at Yale Law School, 2006). Figure 5 is a photograph of a young girl's hair loss (epilation) following her exposure from within a wooden structure a little over two kilometers from the hypocenter.

Figure 6 is a photograph of an 18-year old woman located 1.1 Km from the Nagasaki Hypocenter.

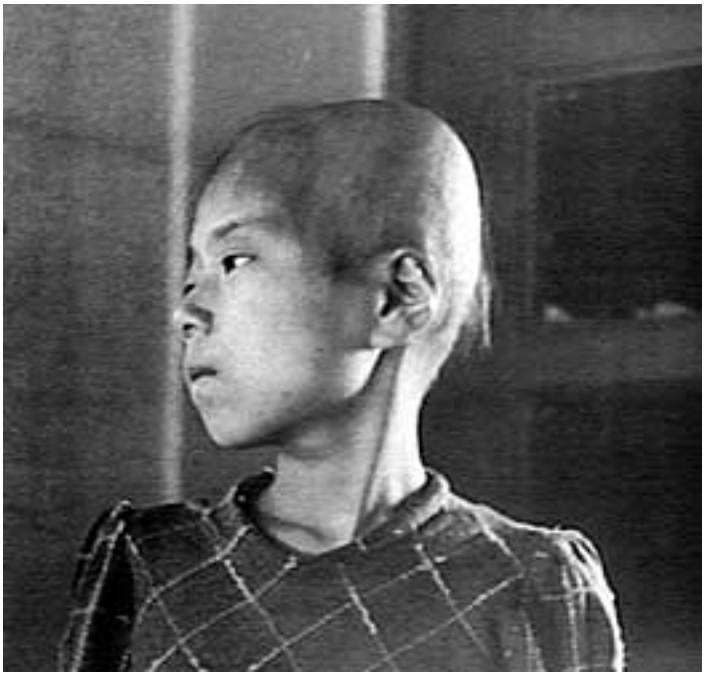

Figure 5 Graphic credit: Gensuikin

Figure 6 Graphic credit:

Scientific Data Center for the Atomic Bomb Disaster, Nagasaki University

Long-term Effects
Radiation Cataracts: A thin layer of transparent **epithelial** cells located on the capsule that covers the lens of the eyeball divides as it grows, thus providing function to the lens. Since dividing cells are particularly susceptible to radiation damage, these cells were adversely affected in many individuals present in Nagasaki and Hiroshima at the time of the bombings. These damaged cells typically move toward the rear of the eye and then congregate near the center, blocking the movement of light directly into the eye. This results in opacity. Symptoms of this disease generally began appearing in survivors two to three years after the bombings (Radiation Effects Research Foundation, 2003). Figure 7 is a graph that shows radiation dose versus number of individuals with radiation cataracts, or lens opacity.

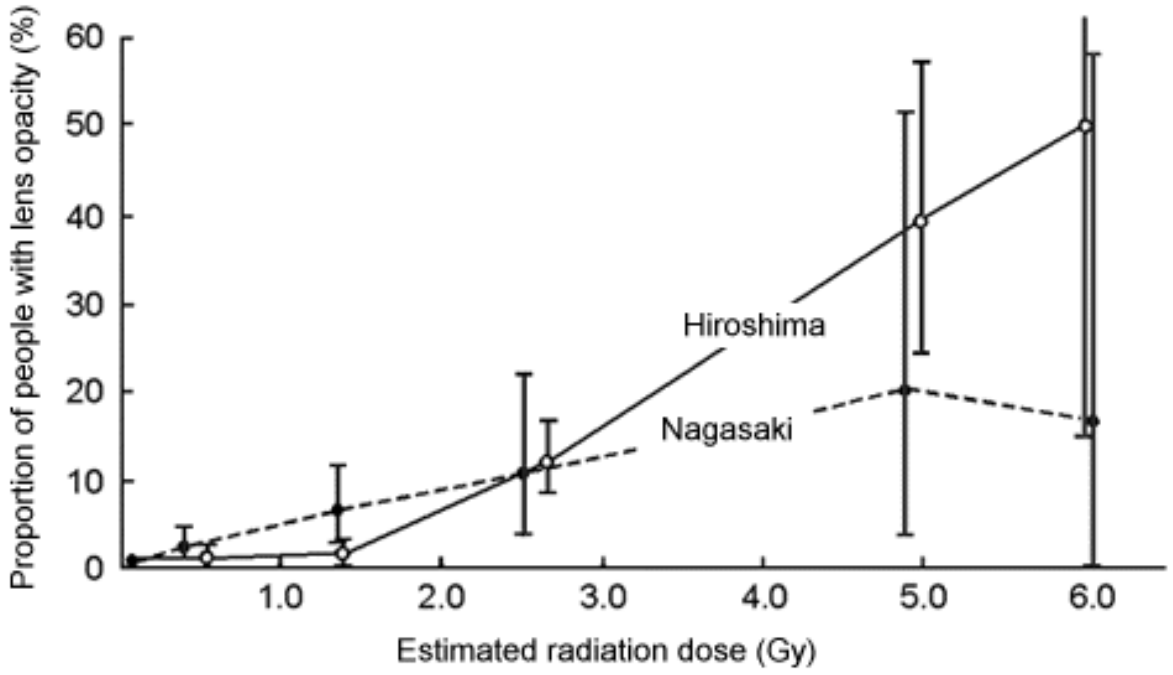

Figure 7 Graphic credit: [Radiation Effects Research Foundation]

Figure 8 is a photo of an eye affected with radiation cataracts. Note the cloudiness of the center eye area.

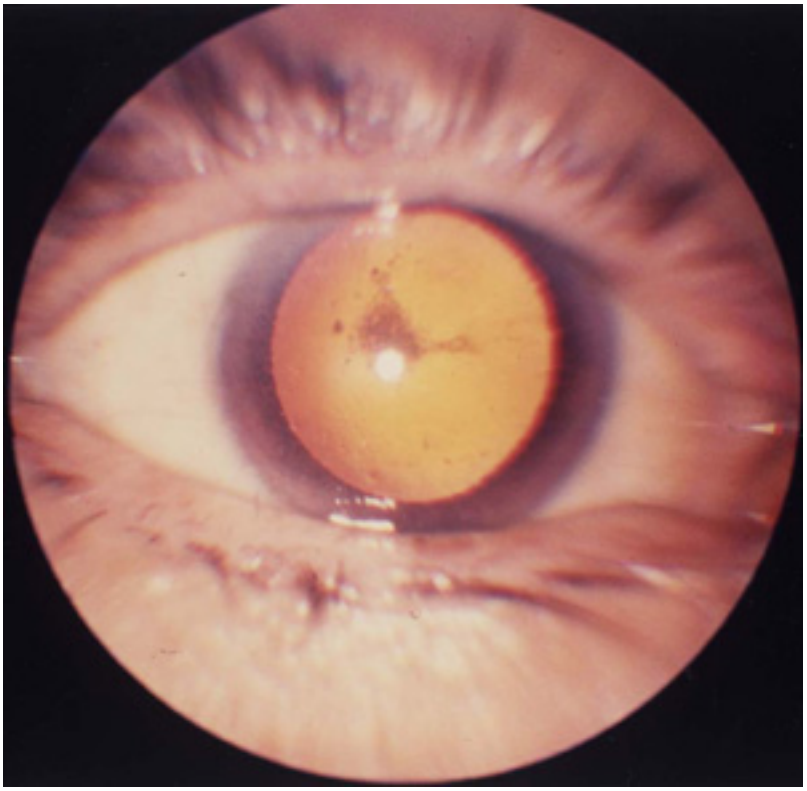

Figure 8
Graphic credit:

Hiroshima Peace Site

Non-leukemia Cancers: Research has indicated that atomic bomb survivors have demonstrated an increased risk of cancer occurrences, initially exhibited anywhere from five to ten years following exposure. According to the Atomic Bomb Casualty Commission - Radiation Effects Research Foundation Life Span Study, by 1990, 4,687 deaths from non-leukemia cancers had been reported of the 50,113 Life Span survivors receiving significant radiation exposures during the bombings. It is estimated that had the bombings not taken place, 4,306 deaths from cancer would have occurred (Radiation Effects Research Foundation, 2003). The most prevalent cancers reported (not including leukemia) included thyroid, breast, and stomach (Scientific Data Center for the Atomic Bomb Disaster, Nagasaki University, 2006).

Leukemia: Leukemia is considered to be the most apparent long-term effect of radiation exposure from the bombings of Hiroshima and Nagasaki. As of 1990, there have been 176 leukemia deaths of individuals receiving significant exposure (of the 50,113 life span survivors previously mentioned). Of the total cancer deaths within the Hiroshima/Nagasaki survivor population, leukemia accounts for 20 percent. In the general population, leukemia accounts for approximately four percent of cancer deaths. To read the personal story of a young girl (Sadako Sasaki) who was exposed to the bombing of Hiroshima at the age of two and who later developed leukemia, click on this link:http://www.pcf.city.hiroshima.jp/kids/KPSH_E/frame/hirotop1.html.

Keloids: Within about two years of the bombings, those who suffered burn injuries began experiencing abnormal growth of scar tissue in the burn areas. Specifically, 50-60 percent of those within a two mile radius of the hypocenters who suffered severe burns developed **keloids** (irregular masses of rapidly reproducing scar tissue). These abnormal growths created a great deal of physical pain (especially if they occurred at a joint area) and emotional distress as they were quite disfiguring. Figure 9 is a photograph of a young girl with keloids on her backside and arms. Figure 10 shows the neck and shoulder keloid scars of another survivor.

Figure 9
Graphic credit:

Figure 10
Graphic credit:

Scientific Data Center for the Atomic Bomb Disaster, Nagasaki University

Note To Teacher

Key Words

1. Vaporize: to turn into vapor or gas
2. Epilation: hair loss
3. Petichae: bleeding into skin
4. Epithelial: surface layer of cells
5. Opacity: cloudy, nontransparent
6. Leukemia: cancer of the blood or bone marrow, usually characterized by the abnormal proliferation of white blood cells.

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Component 4, Part 7
Personal Stories of Nagasaki and Hiroshima—Victims and Survivors

In Japan, survivors of the bombings are called *Hibakusha*. The literal English translation is explosion-afflicted people. Japan's Atomic Bomb Survivor's Relief Law defines Hibakusha as:

1. People who were within a few kilometers of the hypocenters
2. People who were within two kilometers of the hypocenters within two weeks after the bombings
3. People who were exposed to radiation from fallout
4. Babies carried by pregnant women in any of the above categories

As of March 2005, 266,598 Hibakusha were still alive. The large majority of Hibakusha live in Japan although some are in Korea and elsewhere. The average age of the atomic bomb survivor is now 72 (Atomic Bomb Survivors Affairs Division Health And Welfare Department Nagasaki Prefectural Government, 2006). It is clear that Hibakusha are aging and soon there will be few left to tell their stories. In an effort to ensure the accurate documentation of the experiences of the remaining survivors, some organizations are re-evaluating their archives of survivor-related testimonials, re-videotaping many of them and making special efforts to obtain additional survivor information and testimonials. One such effort has resulted in the collection of several videotaped survivor accounts of the atomic bombings (Voice of Hibakusha) and can be accessed via the following link: http://www.inicom.com/hibakusha/.

In Nagasaki's Museum of the Atomic Bomb, visitors can sit in front of computer screens and watch Hibakusha tell their stories. At the Hiroshima Peace Park website, video/audio recorded testimonies of survivors are available to the public. At the Atomic Bomb WWW Museum, textual interviews of Hibakusha are available. Katsuji Yoshida (13 years old at the bombing), of Nagasaki, relates his personal account of the Nagasaki bombing at the Nagasaki Peace Declaration Web site at http://www1.city.nagasaki.nagasaki.jp/abm/abm_e/heiwa/yosida.html. An excellent recorded video/audio collection of the testimonies of 50 Hibakusha (edited to 20 minutes each) is available