Radiological Health Response Plan

A. General

Nuclear Detonation

A nuclear detonation is the most serious radiological event potentially resulting in tens of thousands of deaths. A detonation involves an explosion of fissionable material with blast injuries, thermal injuries and radiological injury. Because of the creation and scatter of hundreds of radioisotopes into a cloud of fallout material, internal and external contamination are expected, requiring decontamination, treatment with multiple agents to decrease internal contamination, prophylaxis with potassium iodide and population monitoring. Removal of injured and exposed persons from the hot zone to hospitals followed by immediate treatment of life threatening injuries caused by blast and thermal energies would take precedence over treatment of radiation exposure.

Radiological Dispersion

Radiological dispersions could occur through the detonation of conventional explosives which scattered radiological material (dirty bomb) or through the unintended dispersion of radiological material (e.g., Brazilian event resulting from dispersion of radioactive cesium from a clinic's nuclear medicine device, transportation accident involving radiological material.) Contamination would arise from a single isotope in most scenarios. External contamination and internal contamination would be expected with inhalation of radioactive dust from a radiological dispersion device and potentially ingestion. Removal of injured and exposed persons from the hot zone to hospitals followed by immediate treatment of life threatening injuries caused by blast and thermal energies would take precedence over treatment of radiation exposure.

Radiological Exposure

Isolated radiological exposure without contamination might occur if a radiological source material were present in physical location which could irradiate nearby individuals. Thousands of individuals could be exposed with radiation dose dependent on the amount of time and proximity to the radiological source material.

B. Scope. The purpose of this annex is to define the health and medical response to a radiological incident.

C. Legal Basis

The State Health Officer has broad authority to act to protect human health in the absence of activation of the North Dakota Disaster Act. However, in the event of a major radiological event, activation of the North Dakota Disaster Act would allow the implementation of emergency procedures which would facilitate the response based on executive orders from the Governor.

D. Planning Assumptions.

- Any substantial radiological incident would activate a federal response.
- North Dakota health care facilities and providers have little experience with a radiological event; consequently, real time technical assistance for patient management would be required.
- Unlike a chemical event, radiological contamination brought by patients to a health care facility would be expected to pose little risk (albeit not zero) to health care workers and should not impair the response to treatment of life threatening conditions more likely to arise from blast and thermal energy. However, controlling the spread of contamination will remain part of the health care response.
- Removal of clothing from a contaminated person would likely remove 90% of external contamination.
- Because the symptoms of radiation exposure are easily confused with exposure to other more common agents, in a covert exposure scenario, substantial delay is possible before detection of radiation.
- The state will have limited supplies of DTPA located in Bismarck which is useful for treating internal exposure to some radionuclides. Other treatments including Prussian Blue, potassium iodide and colony stimulating factor would not be available until arrival of the SNS. Dependence on SNS for potassium iodide makes it unlikely that population prophylaxis could occur during the window that the preventive is likely to be effective.
- A radiological event would result in substantial population anxiety, especially in geographic proximity to the exposure site. This would result in a large burden of assessment of the worried well.
- Following a radiological event in which their were injuries, the first people presenting to health facilities would self report and have relatively minor injuries and lower potential for contamination than those transported to the site by EMS.
- Radiological events will be local although subsequent spread of radiological material, particularly in an event which was not recognized quickly, might involve much broader areas of the state.

E. Public Health Preparedness

The activation of emergency response to a radiological event would occur when radiation exposure is suspected as the cause of human illness or environmental contamination. The response would vary according to type of radiation event. The roles for state and local public health agencies would be:

ROLE	LEAD ROLE: STATE OR LOCAL
Alerting and response activation	STATE
Epidemiological investigation	STATE
Disease Surveillance	STATE
Public information	STATE
Support of health care delivery system	
Professional information and training	STATE

Activation and management of SNS resources	STATE
Coordination of federal public health response with state and local response	STATE
Coordinating laboratory specimen movement to labs with radiological testing capacity	STATE
Environmental scanning and contamination remediation	STATE
Immediate and long term disease surveillance	STATE
Management of patient tracking	STATE
Provision of guidance on worker safety and health	STATE
Provision of guidance and oversight of disposal of radioactive waste	STATE
Identification of water contamination and availability and restoration of clean water sources	STATE AND LOCAL
Identification of contaminated food and availability of clean food	STATE AND LOCAL
Assessment of health threat and recommendations on evacuation and sheltering-in-place	STATE AND LOCAL
Mass fatality management	STATE AND LOCAL
Population needs assessment including mental health	STATE AND LOCAL
Support of shelters for persons evacuated	STATE AND LOCAL
Distribution of prophylaxis	LOCAL
Population monitoring (e.g., mass screening)	LOCAL

Public health preparedness includes

- *Support of hospital development of plans for response to radiological incidents*

When hospitals identify radiation contamination or are notified of incoming patients with radiation contamination, they need to activate a radiation response plans which includes the following:

  - Activation of radiation safety personnel including a safety officer
  - Dosimeter monitoring of staff for individual radiation exposure
  - Use of gowns, gloves and N95 masks
  - Procedures to limit spread of radiological contamination
  - Triage at a site outside of the emergency department
  - Radiation survey and decontamination
  - Provision for treatment of life-threatening trauma in the hospital with decontamination limited to clothing removal
  - Collection of key elements of history which will guide identification of exposure level
  - Collection of key laboratory measures which will provide definitive identification of radiation exposure
  - Collection of key laboratory specimens to assess internal contamination
  - Waste handling procedures, including handling of human waste from internally contaminated individuals
  - Notification of state to mobilize treatments for internal contamination, including SNS if indicated by nature of event or number of people affected.

    - Identification of radiological shrapnel in the body with surgical instrument removal and shielded disposal
- *SNS planning including receipt, maintenance and preparation for rapid deployment of DTPA.*

As part of federal SNS preparedness, Calcium and Zinc DTPA useful for the removal of internal contamination due to some transuranic elements are forward placed in states. This supply for North Dakota will be stored in Bismarck and transported by ground (Highway Patrol) for distances less than 100 miles or by air (Civil Air Patrol) for distances greater than 100 miles. Supply will be limited and additional quantities, if needed, will be obtainable through the SNS. SNS planning for all hazards events will ensure rapid arrival in the state of other treatment medications.

- *State cache of PPE and health care materials that can be mobilized*.

The state maintains a cache of health care material including PPE which can be used by health care responders when dealing with a radiological incident. PPE serves as a barrier against some types of radiation and provides a disposable covering for health care workers to help prevent further spread of the contamination. Gowns may also be used as temporary clothing for individuals undergoing decontamination.

- *Identification of sites where population monitoring could occur in each county*

In a radiological event which involves the potential for population contamination with radiological material, sites will be opened outside the hot zone where members of the public can come to be assessed for potential radiation exposure and scanned for evidence of radiation contamination. These sites need showering facilities where external contamination can be removed and patients re-scanned for continuing evidence of contamination.

- *Identification of radiation monitoring equipment availability in the state*

A limited amount of radiation detection equipment will be present at the local level; consequently, the movement of equipment from state stockpiles or from distant local sites where it is not being used will be required.

- *Pre-event development of public information materials*

A radiological event will require a large public information campaign to instruct the public in the following issues:

    - Nature of the different radiological events
    - Sheltering in place and evacuation
    - Signs and symptoms of radiation exposure
    - Radiation contamination
    - Screening sites and medical care during a radiological event
    - Long term surveillance and long term health outcomes

- *Development of health professional education material*

Professional health care providers will need education in all aspects of basic radiation, nature of the radiological event, patient care, safety and self-care, decontamination, contamination control, clean up, and health surveillance.

- *Training and exercising of state and local radiation response*

F: Response.

Public health actions taken in response to a radiological event include:

- *Alerting and response activation*

Recognition of a radiological event may occur when an explosion is assessed by emergency response individuals or by the suspicion of a health care provider that the pattern of injury or signs and symptoms are compatible with radiation injury[1]. Once a radiological event is recognized, NDDoH will use the Health Alert Network to notify key partners including public health and health care (hospitals, EMS) and provide them with additional information about what is known, what to evaluate and appropriate response. Upon notification coming to NDDoH of a local radiological event, NDDoH will immediately activate incident command. If the notification has arrived through public health or health care, alerting will be extended to the Department of Emergency Services.

- *SNS activation*

For any substantial radiological event, NDDoH would request immediate activation of the SNS based on potential for substantial casualties related to the event. Even in the absence of internal contamination requiring drug treatment to decrease total body load of radioactive elements, granulocyte stimulating factor and radiation related equipment may be needed. Once SNS material arrived it would trucked to health care facilities and screening centers impacted by the event. Depending on the nature of the event, CDC may choose to send the push pack or only those specific response elements needed by the state (e.g., monitoring equipment).

- *Coordination of federal public health response with state and local response*

For any substantial radiological event, NDDoH would notify CDC of the event and request technical assistance for all aspects of public health action. CDC would be expected to send a team of people to the state, the incident management of which would need to be coordinated with the Department Operations Center of NDDoH and the State EOC. A separate small team would likely arrive from DHHS who would be collecting information for the administration and Congress[2]. A radiological event associated with blast and thermal injuries or which impaired medical response (e.g., closure of health care facilities in large communities) could generate a request for additional federal resources through the NDMS system including DMAT and DMORT. Placement of these resources would be coordinated with DHHS through the DOC. NDDoH would cooperate with, but not be primarily responsible for, coordination with federal law enforcement officials or FEMA teams.

- *Epidemiological Investigation*

Epidemiological response would be required to assess parameters including:

  - Cause and source of exposure;
  - Extent of population exposure;
  - Severity of population exposure;
  - Risk factors for exposure;
  - Surveillance related to morbidity and mortality; and,
  - Collection of forensic information related to the exposure event.

An associated environmental response would assess:

  - Extent of geographic contamination;
  - Spread of contamination beyond the hot zone;

[1] Depending on the type of event (e.g., radiological source), it may be difficult to confirm that radiological injury is present. In events which cause no contamination (e.g., patient proximity to a radiological source), the patient will not release radiation which would trigger radiation monitors.

- Effectiveness of contamination remediation;
- Management of radioactive waste;
- Need for interventions to control spread of radiological contamination in the environment and approaches to remediation of any contamination.

- *Distribution of prophylaxis*

Prophylaxis following a radiological event is generally limited to provision of potassium iodide (KI) to prevent radioactive iodine from being bound in the thyroid gland. This only occurs when radioactive iodine is present and the potential for internal contamination is present. The potential for radioactive iodine contamination might occur in a release of radiological waste or following a nuclear explosion, but not likely after a dirty bomb and never in a point source exposure. The most likely cause nationally of a major radioiodine exposure event, a nuclear plant accident, would not apply to this state. If radioiodine contamination is present, the KI must be given quickly to be effective. Following the identification of a radiological event, NDDoH will assess the need for prophylaxis of exposed populations and the potential for acquiring KI fast enough to permit prophylaxis.

- *Long term surveillance*

As patients with radiation exposure at all levels are identified, they will be entered into a registry for long term tracking of health outcomes and tracing contamination. Initially cases will be identified through active surveillance, including population screening, for inclusion in an epidemiologic study to assess risk factors. Subsequently, cases would be identified through health system surveillance. Acute radiation poisoning is not specified as a mandated reportable illness (although reporting of any unusual disease cluster is reportable). NDDoH would request providers to report all cases of radiation sickness.

- *Public information*

NDDoH would work with the regional public health PIO from the affected area to develop proposed public messages. These proposed messages would be incorporated into the broader message development out of the joint information center operated by the Department of Emergency Services. Messages would evolve over the course of the first 24 to 48 hours. Initial health messages would focus the incident, general information about radiation exposure, the potential for contamination with this incident and on protection of the population from radiation, (e.g., any actions related to evaluation or sheltering-in-place which populations needed to take). The public would also need messages focused on population risk and health care including who was likely to be at risk, the diversion of patients with concerns about radiological health way from health care facilities to screening centers, the locations of screening centers and who should be evaluated at a screening center. Later messages would focus on treatment, prognosis, identification and removal of contamination from the community, and long term surveillance for adverse health outcomes. In addition to public message distribution, NDDoH will activate a hotline for the public to call in order to receive information related to public health and health care issues arising due to the event.

- *Support of health care delivery system*

The NDDoH role with the health care delivery system would be supportive and include the following components:

- Dissemination of information about the event and the response;

- Provision of professional information (see below);
- Provision of guidelines related to worker protection;
- Provision of guidelines related to preventing the spread of contamination;
- Tracking availability of health care/hospital beds;
- Support for setting up clinical evaluation sites, to be staffed by the health care system (or MRC volunteers), for patients with possible radiation exposure;
- Mobilization of health care transportation resources for patients needing to be transferred to other facilities;
- Provision of needed health care materiel, including PPE and drugs needed to treat radiation syndromes;
- Coordination of federal medical assets with domestic health care providers;
- Management of human remains which have radiological contamination;
- Information and coordination of disposal of radioactive waste from health care facilities.

- *Dissemination of professional information and training*

Initial information would be directed to those hospitals receiving patients to ensure that key actions related to patient care, limiting occupational exposure and limiting the spread of contamination were being followed. Initial contact is likely to be a conversation with emergency room providers in the suspected exposure and referral area by HAN message and DOC to facility contacts. As soon as possible thereafter, NDDoH would hold a video conference with all acute care sites statewide. This would provide a broader range of information related to the incident, potential for contamination, worker protection, decontamination, management of blast and thermal injury, movement of patients to higher levels of care (e.g., tertiary care of complicated trauma or burn care), internal contamination and drug treatment, determination of individual patient radiation exposure, environmental status and management (including safety of food and water supplies), mobilization of state cache, disease surveillance and other issues impact hospital function or personnel. Because of the need to provide clinical information related to a condition rarely encountered, NDDoH would work through CDC and national clinical experts to ensure accurate and complete information was transmitted.

- *Coordinating laboratory specimen movement to labs with radiological testing capacity*

The North Dakota State Public Health Lab does not have capability for the analysis of radiological elements and quantitative radiation measurements. Clinical samples for blood counts and differential could be handled by local hospital laboratories. Specimens for dosimetry would be moved to the nearest capable laboratory for analysis (e.g., Minnesota). Specimens might include both clinical and environmental specimens.

- *Management of patient tracking*

As with any disaster involving an increased number of ill persons, NDDoH would activate the patient tracking system. The system is based on assignment of triage tags to all acute patients who are transferred or discharged to anywhere except home. Each patient's triage tag is scanned on arrival at each destination and information is input regarding location and health condition.

- *Environmental scanning and contamination remediation*

Environmental scanning for radiation would define the boundaries of the initial disaster site as well as detect the spread of contamination from the initial disaster site. Scanning would continue until identifiable traces of radiological material are removed from the environment and properly disposed of.

- *Provision of guidance on worker safety and health*

N95 masks, gowns and gloves are recommended for workers who may be exposed to contamination to prevent contact of radiological material with skin or non-disposable clothing. Contact with contaminated persons does not pose a substantial risk to responders although decontamination should be completed as soon as practicable. Masks, gowns and gloves will not protect against high energy radiation (e.g., gamma rays, beta particles); hence, other shielding is needed by anyone who is near a radioactive source material with the potential to emit this radiation. No PPE is required for responders caring for persons who have been irradiated but are not contaminated with radiological material. Based on information learned about the nature of the radiological event, NDDoH would provide guidance to response workers regarding the type PPE required, and the state cache would make up any shortfall in PPE supplies among health care workers, acquiring additional material through the SNS if required.

- *Provision of guidance and oversight of disposal of radioactive waste*

The Environment Section of NDDoH will provide detailed guidelines on clean up of sites with radiological contamination, protection required for clean-up, and the transportation and safe disposal of contaminated materials. The purpose of the information provided will be to minimize human exposure and provide for permanent storage of contaminated material in a way that does not pose a risk for environmental contamination at a later date. The specific disposal solutions will depend on the scenario, including the specific radioisotopes, the type of material that is contaminated, and the extent of contamination. Some types of contamination would require federal assistance (DOE, EPA, CDC) to safely managed disposal consistent with federal safety regulations. NDDoH will coordinate with DES in making contacts to other agencies which not traditional partners for NDDoH.

- *Identification of water contamination and availability and restoration of clean water sources*

Some radiological scenarios may result in contamination of surface or ground water with radiological material. In some circumstances, this contamination may pose a risk to community and individual potable water sources. NDDoH will provide assistance with the assessment of water for contamination, identification of alternative water sources when needed, and monitoring of water sources for resolution of contamination. (Some radiological contamination of water used for as a potable source occurs naturally, but at a level which is not a human health hazard. Contaminated sources will require monitoring until radiation levels return to non-hazardous levels.)

- *Identification of contaminated food and availability of clean food*

If the initial radiological event resulted in the potential contamination of food, NDDoH will stop the distribution or use of the potentially contaminated food until it can be cleared for use or discarded. Food which was irradiated only (i.e., no radioactive material present) would not be expected to be a risk for human

consumption. In areas where actions have been taken to remove food from distribution or use, the public will be notified and will be provided with information about alternative safe sources of food.

- *Assessment of health threat and recommendations on evacuation and sheltering-in-place*

NDDoH will provide recommendations regarding safe exposure limits for specific areas contaminated with radioactive material and recommendations regarding sheltering in place versus evacuation for management of radiation contaminated areas. For some types of events (e.g., generation of fallout), sheltering-in-place initially followed by evacuation to prevent longer term exposure until radioactive decay or remediation minimize the risk of return. In other events (e.g., dirty bomb), evacuation would likely be the most appropriate immediate response.

- *Mass fatality*

Refer to mass fatality plan.

- *Population needs assessment including mental health*

Displacement of populations and disruption of infrastructure resulting from a radiological event may place parts of the population at risk due to inadequate services including food, water, medication and medical care. NDDoH, with the assistance of local public health, will conduct needs assessments of the affected population to identify unmet need. Needs assessment will need to include an assessment of mental health needs which will be expected to evolve over the course of the response and recovery period. Information regarding mental health needs will be provided to community and state mental health service providers.

- *Support of shelters for persons evacuated*

Medical sheltering of evacuated people will be like other medical sheltering with the exception of needing to monitor persons entering the shelter for radiation exposure and the need to monitor persons in the shelter for any symptoms suggestive of radiation induced illness. General population shelters will be supported by NDDoH in much the same way although NDDoH is not primarily responsible for their operation. See Medical Sheltering Plan.

- *Population monitoring*

The nature of the event and the type of radiation exposure will determine the expected long term outcomes. With internal contamination, the specific isotopes present may differentially irradiate different tissues (e.g., radioactive iodine irradiates thyroid tissue). Many types of exposure may result in bone marrow suppression and an increase in many types of cancer. Registry information regarding the amount and type of exposure each person received as well as the person's age at the time of exposure can be helpful in guiding the monitoring for early detection of treatable illness. Some types of exposure such as external radiation to the skin due to alpha and beta emitters is much less likely to result in long term sequela.

A detailed plan for setting up and managing population screening sites for radiation will appear under separate cover.

- *Mental health monitoring*

Although not well described, long term mental health concerns have been identified after other radiological events.

Appendix 1: Management of DTPA for Transuranic Element Poisoning

Indications for Treatment with DTPA

Given the short treatment delay permitted in order to achieve optimal clinical outcomes, the threshold for shipment of the DTPA from the state stockpile is low. If an acute radiation event which could have resulted in internal contamination of individuals with plutonium, americurium, or curium, shipment will be initiated. The decision whether to administer the DTPA once it arrives on site will be based on more thorough assessment of the event. In the event the material is not used, unopened product will be returned to storage in Bismarck.

If an acute radiation exposure event has occurred, the North Dakota Department of Health will immediately consult with CDC regarding management of individuals who may have been exposed. Following discussions with consultants, NDDoH physicians will consult directly with physicians in the receiving hospitals as well as hospitals in the referral net for the receiving hospitals about treatment advisability and treatment methods. Initially this will be conducted over the phone with local hospital-based physicians, followed by area-wide or even statewide training of physicians using interactive video conferencing over the BTWAN.

North Dakota does not have the capability to test for radioisotopes. In a event with internal patient contamination with radioactive material, but in which it is not known whether the contamination was caused by one of the isotopes which DTPA can effectively remove from the body, the decision to initiate treat will based on knowledge of the event in consultation with federal partners. NDDoH will work with CDC to arrange shipment of diagnostic specimens to a referral laboratory with the capacity to identify radioisotopes, understanding the decision to initiate treatment may not be delayed until diagnostic confirmation is available assuming suspicion of a treatable condition is sufficiently high.

Treatment Protocol and Monitoring of Adverse Events

1. Baseline measures of (CBC with differential, electrolytes, BUN, urinalysis and blood and urine radioassays will be obtained prior to initiating treatment.
2. When internal contamination with plutonium, americurium or curium is known or suspected for a particular patient, treatment will be initiated using Ca-DTPA (unless the patient is pregnant and the expected contamination level is not high, in which treatment will be initiated with Zn-DTPA. The initial dose will be 1g administered intravenously (adult) or for children less than 12, the dose will be 14 mg/kg to a maximum of 1g for a child.
3. Patients will be encouraged to drink lots of fluids and void frequently. Breastfeeding should be terminated.
4. Documentation of treatment initiation will be completed using the patient treatment data form. The completed form for each patient will be forwarded to NDDoH where each for will be copied and data entered into a line listing in the MAVEN surveillance system to aid subsequent patient follow-up. NDDoH make contact back to the provider regarding incomplete fields. A copy of the form will be retained and original will be forwarded to the pharmaceutical company indicated on the form.
5. After the initial dose of CA-DTPA, patients will continue treatment with Zn-DTPA daily. The initial dose will be 1g administered intravenously (adult) or for children less than 12, the dose will be 14 mg/kg to a maximum of 1g for a child. No dosage adjustment will be made for renal failure. Treatment will continue until the excretion enhancement factor approaches 1 (ratio of urine radioactivity before treatment to urine radioactivity after treatment).
6. Radioassays will be monitored in blood, urine and feces once per week. This will require testing at a laboratory outside the state. NDDoH will identify a reference laboratory to which sample material can be directly shipped from the health care institution overseeing the care of the patient (i.e., continued treatment with DTPA). Results of the sample testing will determine the duration of therapy. Follow-up measures of CBC and chemistries will be determined by the provided. Periodic monitoring of trace metals should be performed periodically and supplement if indicated.

Storage and Shipment of DPTA

North Dakota will store the medication in its original containers in a secure, climate-controlled warehouse in Bismarck under the oversight of the SNS director. The material can be released on the request of the NDDoH case manager on call, an NDDoH physician or the incident commander for the Department Operations Center of NDDoH. If NDDoH case manager on call is made aware of a radiation event, the case manager will investigate the incident to determine whether the potential exists for internal contamination of patients with a transuranic element.

If that potential need for treatment is identified, NDDoH will immediately ship both Ca-DTPA and Zn-DTPA up to 100 miles by ground transport (North Dakota Highway Patrol) or by emergency air transport for distances greater than 100 miles (North Dakota National Guard with transport from airbase to hospital by National Guard).

Any local hospitals which have received or are likely to receive patients with an indication for treatment will be sent the medication and contacted by NDDoH physicians. In addition, referral hospitals which may receive patients from a radiation event (including referral from an event in a neighboring state) also will be sent the medication and called by an NDDoH physician.

Since treatment will only be administered by a qualified health care institution, no auxiliary medical supplies will be shipped with the material unless NDDoH receives a request from one of the treating facilities for auxiliary medical supplies.