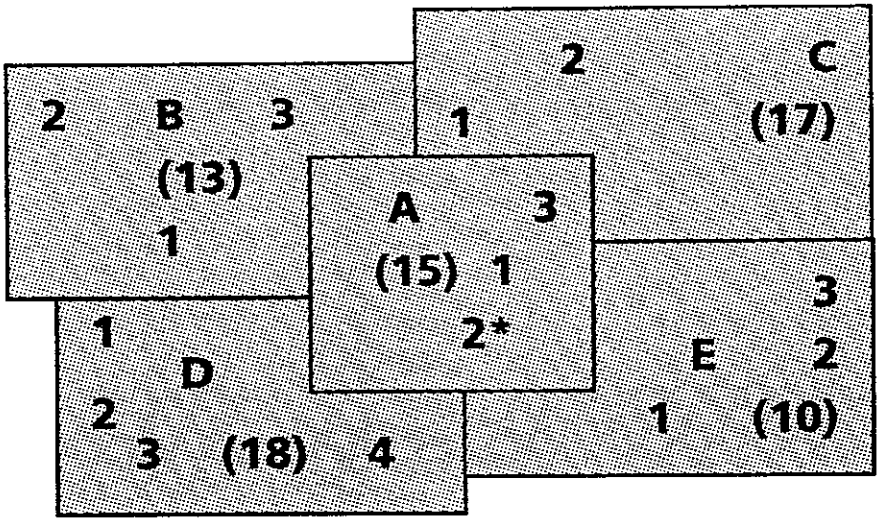
AMBULANCE SUPPORT

&

VICTIM DISTRIBUTION



Ambulance regions with their total number of ambulances

Figures between brackets are numbers of ambulances; other figures are representing hospitals

1	2	3
A	15	8
E	10	13
D	18	22
C	17	30
B	13	36

When a disaster occurs at * a cumulative total of 36 ambulances can be obtained from neighbouring regions

1. region
2. total number of ambulances
3. cumulative total based on a 50 % availability

Ambulance Support

Usually a certain number of ambulances are constrained to a certain region. Each ambulance region is therefore surrounded by other ambulance regions, at least in most cases in those countries with an Emergency Medical System. The number of ambulances in such a region is determined by the daily need for these vehicles and some spare ones.

In case of disaster the need for ambulances increases considerable and support from the surrounding regions is necessary. Therefore each ambulance region should have a so called ambulance support plan where and how many ambulances can be obtained in such a situation. On the other hand, these regions should not be deprived of too many ambulances, since the daily routine requires a certain minimum number for emergency cases in their region. As a general rule not more than half the number of ambulances could become available for a certain period of time.

An Ambulance Support Plan is represented by een simple table, containing the telephonenumbers and the maximum number of available ambulances of the surrounding ambulance regions. The sequence, of course, of alerting the neighbouring regions is also important; the region closest tot the disaster site should be alerted first, followed by the second closest and so on. In this way a cumulative list of available ambulances could be produced in a short period of time.

A summary is presented in the figure and table.

VICTIM DISTRIBUTION PLAN

1	2	3	4	5	6
Region	**Hospital**	**No. of beds**	**HTC**[1]	**Cumulative HTC**	**Distance from disaster site**
A	1	500	15	-[2]	1 km
	2	300	9	9	3 km
	3	200	6	15 (9 + 6)	6 km
E	1	400	12	27 (15 + 12)	6 km
	2	600	18[3]	45 (27 + 18)	9 km
	3	100	3	48 (45 + 3)	10 km
D	etc				
C	etc				
B	etc				

(1) based on 3 per 100 beds per hour for a hospital with basic specialisms (see appropriate chapter)

(2) the nearest hospital should be exempt because of overload by walking victims

(3) neurosurgery and cardiac surgery present

Column 1, 2, 3 and 4 can be filled-in already for each ambulance region; column 5 and 6 should be filled-in when disaster strikes.

Victim distribution

Since it is of paramount importance that victims in a mass casualty situation receive medical treatment adequately and efficiently in the shortest possible time, each ambulance region should possess a victim distribution plan.
Such a plan provides the neighbouring hospitals around the disaster site with an appropriate number of victims, according to their treatment capacity.
In this way these hospitals will not receive more victims than they can handle. The hospital treatment capacity (HTC) is expressed as the number of victims to be hospitalized and treated, according to current medical standards, per hour (see appropriate chapter). Since the nearest hospital will be overloaded by walking victims, this hospital should be exempt as much as possible.

For drafting a victim distribution plan certain data are needed:

- the location of the disaster site;
- the location of the neighbouring hospitals;
- specific diagnostic and therapeutic facilities of these hospitals, like neurosurgery and cardiac surgery;
- and last but certainly not least, the treatment capacity of each hospital.

Some of these data can be collected beforehand already, which makes the final drafting of the plan easier and quicker.
An example of such a drafting is shown in the table.
For the number of ambulances needed to transport a certain number of victims a formula has been developed, which is explained in the subchapter "Medical Transport Capacity" in the chapter on the Chain of Medical Care and its Capacities.
Computerisation of these principles could ease the procedure even more.

A HOSPITAL DISASTER PROCEDURE

Hospital **External** Disaster Procedure	Hospital **Internal** Disaster Procedure

- Both procedurers have 4 phases
- Hospital at the end of the chain of medical care
- Hospital Treatment Capacity: ± 3%
- Disaster Committee

A hospital disaster procedure is in some countries legally obliged, in others only morally obliged, while in most countries it is non-existent.
There are two types of procedures: - a management procedure for the admission and treatment of large numbers of victims, preferably not exceeding the hospital treatment capacity. This is the hospital *external* disaster procedure.
And a management procedure for coping with an internal accident (fire, explosion) or an accident nearby, usually by evacuating (parts of) the hospital. This is the hospital *internal* disaster procedure.
Both procedures have 4 phases: alarm, preparation, execution and evaluation.
The hospital is situated at the end of the chain of medical care, with a certain Hospital Treatment Capacity (HTC), which is determined by personnel, material and methods. This HTC is also determined by the type of injury: mechanical, chemical, nuclear and microbial. As discussed in a previous chapter this HTC is roughly 2-3 % per hour, i.e. 2-3 victims with mechanical injuries per 100 beds per hour could receive adequately and efficiently surgical treatment provided trained personnel, sufficient material and an exercised hospital disaster procedure.
The HTC for chemical, nuclear and microbial patients is unknown so far.

Each hospital should have a disaster committee comprising a board member, two specialists and representatives of nursing, domestic and technical staff and administration. Their task is to draft a disaster procedure, to organize exercises, to function as troubleshooter when real, to coordinate with external parties concerned and to inventory risks.

- Verification of disaster alarm
- Superintendent and/or specialist on duty/call should approve action
- Snowball principle
  1 person alerts 2 others and each of them 2 others again, etc. (operator alerts only a few people!)
- Use of other means of alerting personnel

ALARM

A large general hospital is in a position to enlist a smaller or larger number of staff according to information coming in regarding the nature and magnitude of a disaster. This so-called "balanced response" is difficult to realize in a medium-sized district hospital. In the latter case, restriction of manpower is likely to determine an "all-or-none response".

The disaster alarm, coming from outside the hospital, should be relayed to the duty surgeon. Only he is in a position to decide whether or not the disaster plan should be set in motion. Depending principally on the number of surgeons, operating-room staff and casualty personnel, the disaster plan can be initiated on the receipt of an unexpectedly large number of injured.

If the disaster message comes in by phone, it should be verified in order to avoid unnecessary activities.

The superintendent on call/duty should approve action.

The alerting procedure itself should follow the snowball principle as described in the appropriate chapter.

Having decided that a disaster situation does in fact exist, the duty surgeon initiates the procedure by telephoning others - telephonists, surgeons and casualty staff. They, in turn, alert by telephone other members of the hospital staff. A uniform procedure for every hour of the day should be aimed at; this is by far superior to two separate procedures, one for normal working hours and the other for nights and weekends.

Other means of alerting personnel should also be considered.

- clear command structure/coördination by disaster committee
- adherance to normal hospital routines
- control of routing: victims
ambulances
visitors
- communications guaranteed
- discharge of patients
- clearing of spaces
- keep track of logistics
- simple brief instructions for each department

EXAMPLE OF SUCH AN INSTRUCTION

Hospital Steward's Department

1 Alerted by porter
2 Alert mortuary technician and restaurant personnel
3 Arrange reception of patients requiring only out-patient treatment
4 Reception of persons seeking injured relatives
5 Reception of the press (No information to be given: information to be relayed only by the medical super-intendent).
6 Provision of coffee and rolls for all personnel involved and working overtime

Preparation

When drawing up a disaster plan one should endeavour to adhere as far as possible to normal hospital routine. Hospital personnel should perform duties for which they have been trained and in a location in which they are used to working. The involvement of too many individuals should be avoided.

The flow of T1, T2 and T3 victims should be separated.

The areas for these groups should be cleared.

Those patients who are planned to be discharged the next day, should be discharged immediately.

The routing of ambulances has to be controlled, as well as the elevators on the entrance floor and the main entrance(s).

Communication between hospital personnel, particularly between the members of the disaster committee who are acting as troubleshooters, should be quaranteed. This could be achieved by limiting the use of telephone as much as possible.

Uniform external contacts, preferably through one channel should be established.

Material (supplies) must be used as economic as feasible.

The working instructions for each section should be brief and simple to understand. An example of such an instruction is given in the table.

- every admitted T1 and T2 victim should be accompanied by a nurse
- uniform triage throughout the hospital
- simplification of treatment
- standardization of methodes
- appointment of a medical information carrier for the acquisition, processing and retrieval of medical information from the victims
- this information should be channeled to the outside world (press, police, family) through the superintendent of the hospital

EXECUTION

Having accomplished his or her reporting, each member proceeds to the preparatory duties in order to ensure that a state of readiness for reception of the injured can be achieved within 15-30 minutes. Responsibility for leading the disaster organization should be vested in one individual, preferably the duty surgeon. The latter carries out the triage, which is also described in a previous chapter. Repeated examination of the victims by the surgeons and/or other specialists is important in the recognition of latent or developing lesions.

Responsibility for dealing with medical information should rest in the hands of one doctor. This is a very important aspect of the organization and information regarding deceased or injured relatives should be relayed to the family, police and press through this channel only. The administrative procedure should fulfil certain requirements:

- the personal particulars and the medical notes relating to each patient should be filed together,
- initially, it is convenient to substitute a code or number for the patient's personalia,
- personal particulars are collected and recorded by administrative staff,
- medical notes are recorded by the member of the nursing staff accompanying each T1 and T2 patient,
- having collected and checked the personal and medical data, the medical information officer relays them to the public relations officer (e.g. the medical superintendent),
- the locations where information can be assimilated most readily lie at the beginning and at the end of the casualty routing inside the hospital.

Near the A&E Department a pool of nurses must be created, so that each admitted T1 and T2 victim can be accompanied by a nurse, while being routed through the hospital.

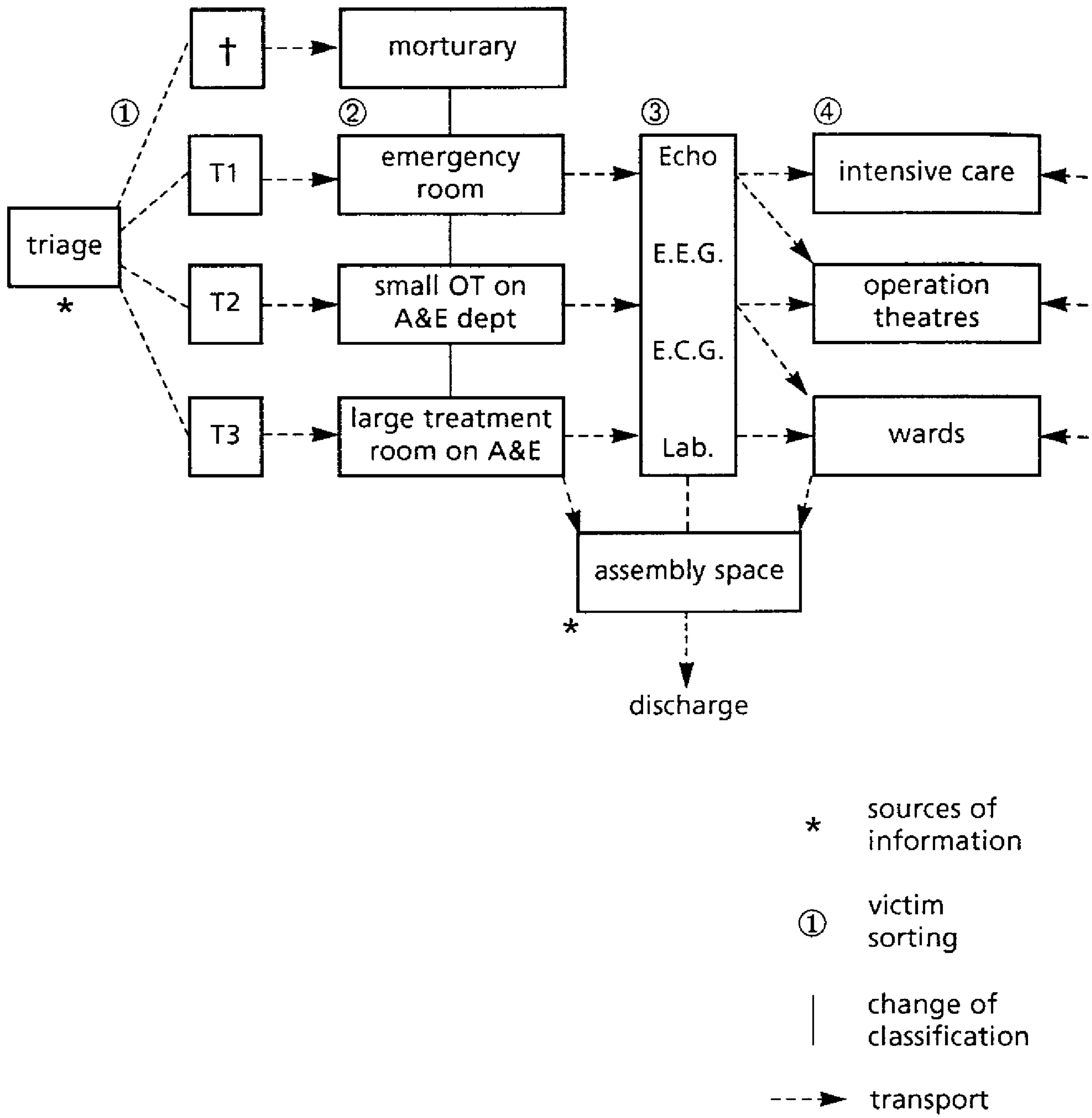
Casualty routing is represented schematically.

Triage results in division of the victims into 3 groups.

Class T1 victims with disturbed vital functions are taken to the emergency room adjoining the A&E Department where facilities exist for cardiac monitoring, defibrillation, ventilation of the lungs, and other resuscitatory measures. Response to treatment results in transfer to the intensive care unit or the operating theatre.

Class T2 patients are brought to the casualty room on the A&E Department where they can be treated prior to admission, whether or not operation is indicated.

Class T3 patients will be walking cases who, after treatment in the large treatment room, may be allowed to proceed home via the assembly space.


†
mortuary
①
②
③
④
T1
emergency room
Echo
intensive care
triage
*
E.E.G.
T2
small OT on A&E dept
operation theatres
E.C.G.
T3
large treatment room on A&E
Lab.
wards
assembly space
*
discharge
*
sources of information
①
victim sorting
change of classification
transport

Initial classification occurs during triage; subsequent appraisal occurs directly thereafter in the A&E Department: in the rooms reserved for class T1, T2 and T3 victims. Further reappraisal occurs in the diagnostic departments and yet again in the intensive care unit, ward, or operating theatre. The patient is thus subjected to continuous reappraisal until the ultimate diagnosis or diagnoses are decided upon.

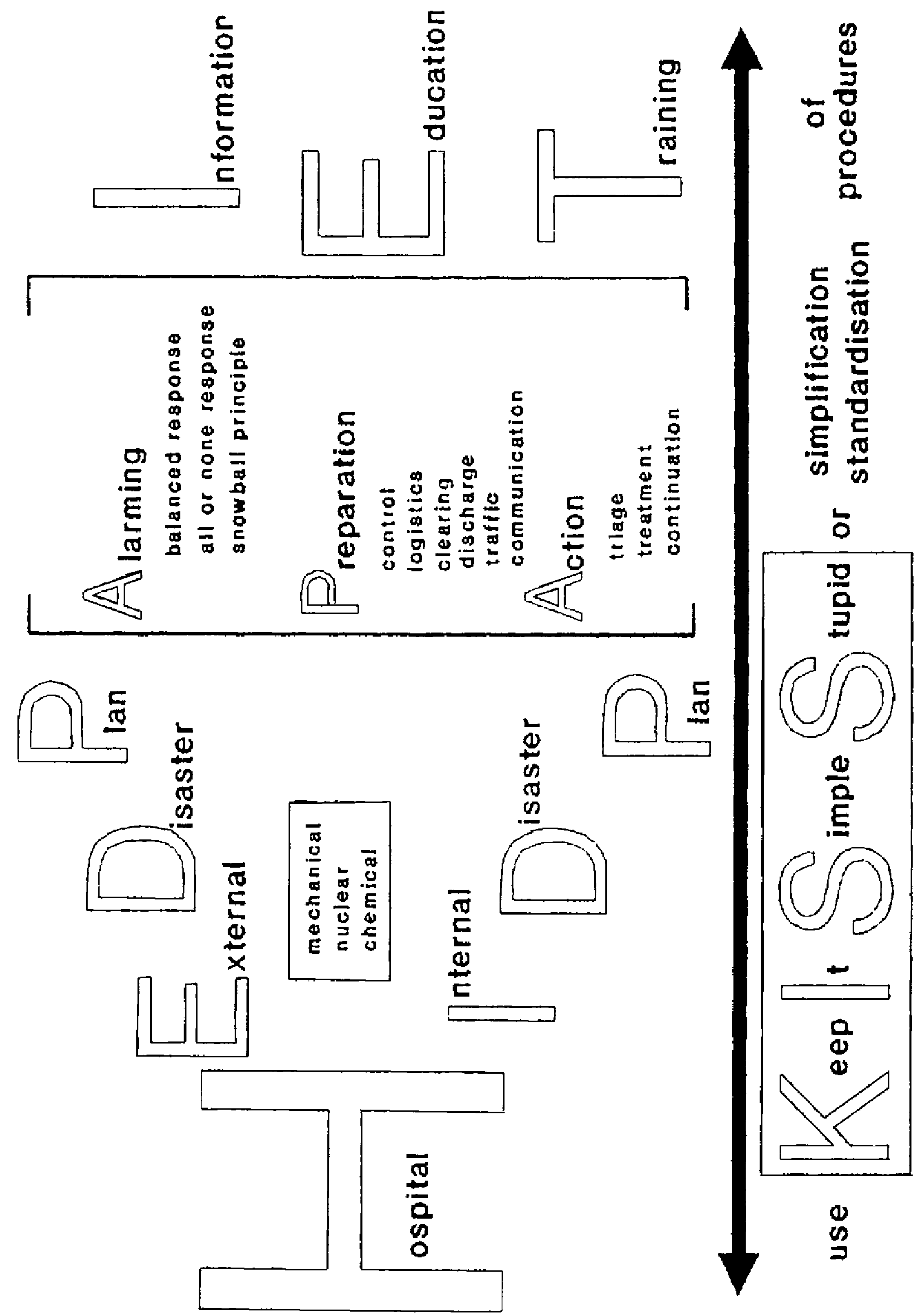
Diagnostic and therapeutic procedures have to be *simplified,* c.q. a simple fracture is reduced and provisionally immobilized, a large wound is desinfected and covered sterile. Some hours later, during a less hectic moment, these should be treated properly.
By *standardisation* is meant that standard procedures are to be utilized for drips, antibiotics, analgesics, anticoagulants and the like.

Specific Situations

- **nuclear disasters**
  - (fixed or mobile installations)
  - selfprotection & decontamination

- **chemical disasters**
  - (fixed or mobile installations)
  - selfprotection & decontamination
  - antidotes
  - respirators

- **microbial disasters**
  - epidemics (cholera, typhoid)
  - acute salmonellosis (planes, ships)
  - selfprotection & sterilisation


Hospital
External
Disaster
Plan
mechanical
nuclear
chemical
Internal
Disaster
Plan
Alarming
balanced response
all or none response
snowball principle
Preparation
control
logistics
clearing
discharge
traffic
communication
Action
triage
treatment
continuation
Information
Education
Training
use
Keep It Simple Stupid
or
simplification
or
standardisation
of
procedures

Evaluation

following a real disaster or following an exercise

- periodic evaluation and up-dating of names, addresses and telephone-numbers of essential hospital personnel;
- periodic exercises of parts of the hospital disaster procedure (e.g. the alarm-procedure, the preparation or the execution phase only);
- once per two years a big exercise involving all services concerned: fire brigade, police, ambulances;

preferably national coordination and standardisation of the exercises.

Hospital internal disaster procedure

- accident in the hospital itself (fire, explosion) or near-by (chemical or nuclear plants)
- same procedures in case of multiple victims and/or
- evacuation of parts or the whole hospital:
  - horizontal evacuation
  - vertical evacuation
- collaboration with the fire brigade

PUBLIC HEALTH MEASURES FOLLOWING A NUCLEAR ACCIDENT*

* ADAPTED FROM AN ARTICLE IN THE JOURNAL OF EMERGENCY MEDICINE (1994)

- Community profile
- Intervention levels
- Action zones

Curative measures		**Preventive measures**
On-site and near-field		Public information
During transportation		Sheltering and other protective measures
In the neighbouring hospitals		Iodine prophylaxis
		Evacuation
	N-teams	
		Decontamination

Public health measures after a nuclear accident or disaster

On the night of 25 April 1986, there was an explosion in one of the four nuclear power reactors in Chernobyl, Ukraine. Twenty-eight people were killed outright; another 3 died within a few days; and approximately 135 were diagnosed as suffering from acute radiation sickness. Only after satellite photos and readings of increased radioactivity, first from Sweden and later elsewhere, had indicated that there may have been a nuclear accident, was the world officially informed of what had happened. The event had a worldwide impact. For thousands of scientists, it meant research opportunities in many different fields: from pure nuclear physics to the study of psychosocial problems, and from genetics to epidemiology. Much of this research has been conducted by the Soviets themselves. However, scientists from outside the Soviet Union often under the auspices of such international agencies as the International Atomic Energy Agency and the World Health Organization, have also conducted research, both in the field-that is, in the region surrounding Chernobyl-and in laboratories. What is more, the scientists have been outnumbered by journalists, who have churned out more half-truths about Chernobyl than accurate information.
Before Chernobyl, the world was busy protecting itself from nuclear weapons. Since the accident, there has been an increasing focus on safety in nuclear power stations, which have rapidly increased in numbers in recent years. Within a 1,000-km radius of the Netherlands, there are about 120 operational nuclear power stations. Dozens of new ones are currently in construction, and dozens more, mainly in Eastern Europe, are now obsolete.

Public health measures following a nuclear accident include medical and preventive measures, together known as "direct measures", which are concerned with meeting medical needs in the direct vicinity of a nuclear accident. This chapter deals with the medical, or curative, measures and the medical and medico-organizational aspects of the preventive measures.

Community profile

=

local environment:
- population density
- age distribution
- roads, railways, waterways
- types of dwellings and other buildings
- relief agencies

Action zones

=

the parameters of the community profile determine the borders of the action zone where public health measures are to be taken.

Intervention levels

=

radiation levels indicating which measures in the action zones should be taken.

DEFINITIONS

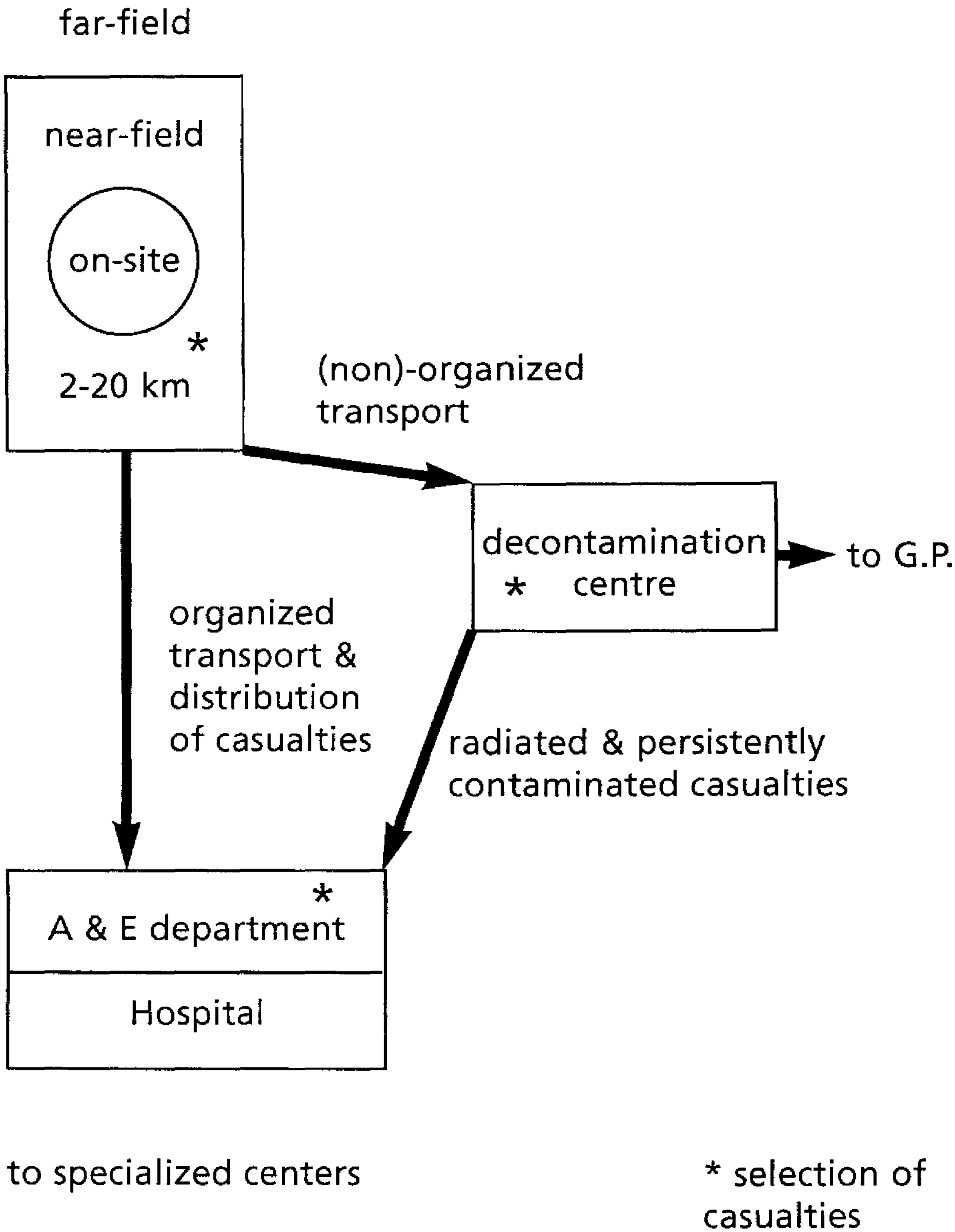
A "nuclear accident" refers to any accident involving equipment used to extract, manufacture, consume, store, or transport nuclear fuel and radioactive substances. All of these processes can result in release of radiation, which in turn can increase risks to human health and the environment. Reducing or eliminating this increased radiation risk requires coordinated effort on the part of agencies or organizations in various disciplines.
The level of administrative coordination-that is, the level at which radioprotective measures are decided and emergency measures managed-depends on the scale, or the possible scale, of the accident. Potential accident locations are divided into two categories ("A and "B") according to the scale of the environmental risk and the potential national and international impact of accidents.

Category A
* nuclear power stations and research reactors;
* nuclear power stations in border areas;
* nuclear-powered spacecraft or parts of spacecraft that have crash-landed;
* nuclear weapons in storage or transit;
* nuclear installations or sources farther away from the borders.

The central government is responsible for administrative coordination in the case of category A locations, since accidents involving these locations are likely to have a nationwide, and possibly international, impact.

Category B
* uranium enrichment plants;
* plants for the production, processing, and storage of radioactive material;
* locations where radioactive material are used;
* the transport of radioactive material and nuclear fuel.

In the case of category B locations, municipal officials are responsible for administrative coordination, since the impact of accidents in these locations is unlikely to extend beyond municipal boundaries.
A nuclear accident's impact on human beings and the environment is determined by the strength of the nuclear power source, the nature of the radiation released, the type of weather, and the "community profile".
"Community profile" refers to the local environment: population density and age distribution, roads, railway, waterways, types of dwellings and other buildings, and the relief agencies locally available. These parameters determine the borders of "action zones" within which measures are to be taken. The parameters are especially important in the case of category A locations.
The fire services are equiped to measure radiation levels, while a medical assistance team is manned with a physics radiation expert. Both groups help to establish the levels of radiation in the environment. Since conditions are bound to vary from accident to accident, individual measures are generally ranges from which the appropiate intervention level can be chosen. The levels determine the measures to be taken in these action zones and can therefore be regarded as aids to decision-making. Intervention levels are determined in light of the advantages and disadvantages that may result from a particular measure: risk reduction is weighed against social disruption and damage to the economy and public health.


far-field
near-field
on-site
*
2-20 km
(non)-organized
transport
decontamination
* centre
to G.P.
organized
transport &
distribution
of casualties
radiated & persistently
contaminated casualties
*
A & E department
Hospital
to specialized centers
* selection of
casualties

The Medical Releif Chain

Serious nuclear accidents, like any other type of disaster, will lead to the establishment of a chain of medical relief. This chain, which starts with coordinated medical treatment and nursing care at the scene of the accident and ends in hospital care, can be divided into three more or less autonomous medico-organizational systems. They are: medical care at the scene of the accident; transportation of victims to various hospitals; and medical care in the hospitals themselves. In the theory, the same medical relief chain and the same three organizational systems apply to all accident, whether in category A or category B locations. However, there is a complicating factor: when an accident occurs, radioactive material is released in clouds made up of water droplets or dust particles, which are invisible and drift according to the weather. This raises the risk of human contamination, both at the scene of the accident ("on-site") and in the immediate surroundings ("near-field"). Victims must be decontaminated at designated decontamination centers.

Two medical relief chains therefore arise: one for the injured, who might also be suffering from radiation exposure and contamination, and one for the apparently uninjured, who might nevertheless be suffering from contamination. The first chain includes the allocation and transport of patients to various hospitals. The second chain involves the transport of the uninjured to decontamination centers. The selection of victims for each of the two chains is therefore important, both on-site and in the nearfield, and later in the decontamination center and in the hospital.

Radiation		Contamination
α-rays β–rays γ–rays		radioactive dust, droplets, aerosols
↓		↓
partial or		external
whole body		clothes, shoes
burns	←	skin, mucous membranes
and		and
		internal
systemic effects	←	inhalation ingestion

Radiated casualties
do not endanger their environment

Contaminated casualties
do endanger their environment

Medical Measures

The nature of the injuries suffered determines the curative measures to be taken. If an accident involves an explosion or fire in either a category A or category B location, the injuries may be mechanical, thermal, nuclear in nature, or combinations of all three. Mechanical and thermal injuries are not discussed further here. However, it should be noted that disorders of the vital functions-repiration and blood circulation-take priority over all other injuries. Whatever nuclear injuries are suffered, these disorders must be treated first.

Combinations of mechanical, thermal, and nuclear injuries resulting from explosions or fires occur only on-site. In the near-field, victims will have been exposed to radioactive contamination but will have no direct mechanical or thermal injuries. The radius of the near-field may vary from 2 to 20 kilometers, depending on the source strength. The geographical area that is affected within the defined radius will depend upon the wind direction and velocity. The near-field constitutes the "action zone" in which the preventive measures discussed below are instituted. Beyond this zone is the far-field, which can be affected both directly, for instance, by increased radioactivity in the atmosphere, or indirectly, by the import of consumer goods that have been contaminated by radioactivity.

Nuclear injuries, which are often not immediately visible, are caused by external exposure to radiation and internal or external contamination with radioactive material. Radiation exposure can affect part of the body or the whole body. Contamination can occur externally via the skin and mucous membranes and internally via inhalation and ingestion. Both external contamination and inhalation may occur either immediately or over the course of a few hours, first on-site and later in the near-field. Ingestion, on the other hand, occurs after radioactive material has entered the food chain and drinking water supplies, which generally takes much longer, both in the near-field and the far-field.

When only partial or whole-body radiation takes place, no first-aid measures are necessary, and health care workers run no risk of exposure or contamination. For evaluation purposes, it is important to discover whether a patient suffers from nausea and vomiting and how soon these symptoms occur. Since these symptoms can have other causes-psychological ones, for example-further evaluation will be necessary, which should usually take place in a hospital. For victims who develop neurological complaints either immediately or in the course of a few hours, the prognosis is poor. First-aid measures should be applied if these patients also have mechanical or thermal injuries. However, it is often not immediately apparent whether or not radiation exposure or contamination has occurred. Their occurence should be assumed barring proof to the contrary. Health care workers should therefore protect themselves appropriately by wearing facemasks, gloves, overshoes, and gowns. The patient should be wrapped in a sheet, not plastic film since it greatly disturbs the regulation of body temperature, and the stretcher

on-site

combined lesions: mechanical
thermal
nuclear: radiated
contaminated

near-field

nuclear lesions, contaminated only

far-field

depending on source strength, windforce and winddirection at most contamination

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NB after days-months contamination possible via water and food

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Disorders of vital functions - respiration and circulation - take priority over all other injuries!
Whatever nuclear injuries are suffered these disorders must be treated first!

Therefore: Basic Life Support & Advanced Life Support first should be wrapped in plastic film, thereby eliminating the necessity to clean it later. On-site triage and first-aid will be provided by staff employed at the accident location, assisted by medical experts specializing in radiation hygiene. A triage methodology, like the one for traumatic lesions, is not available for nuclear lesions proper. Therefore, victims with combined lesions should be selected primarily according to the triage methodology for the traumatic lesion sustained. On-site victims, who will usually be suffering from combinations of injuries, can be transported to neighbouring hospitals by ambulance. The first-aid departments of these hospitals must take extra space available to receive these victims, who may be contaminated. Health care workers should protect themselves appropriately in these situations.

Medical apparatus and any other equipment present in an area reserved for nuclear accident victims must be covered with plastic film. Any spread of contamination, including internal contamination. must be avoided. The clothing and bedclothes of victims and health care workers must be collected and held in safe keeping. Actual injuries must be treated first, by means of debridement, copious irrigation with sterile water, and the removal of foreign bodies. Irrigation fluid and foreign bodies must be kept and examined for radioactivity. Wounds should be closed only once it is established that no radioactivity remains. When wounds have been treated, the patient should be thoroughly washed with regular tap water that can be discharged in the usual way. Then other injuries such as fractures can be treated.

Those few victims suffering exclusively from internal contamination, such as those exclusively exposed to radiation, pose no risk to health care workers. In case of internal contamination, specimens of excreta (urine, feces, sputum, and vomit) should be kept and examined for radioactivity. Further medical examination will yield an estimate of the radiation absorbed, so that priorities for further treatment can be determined in consultation with other hospital departments. The amount of radiation absorbed is an estimate obtained from the actual radiation levels of the environment, clinical signs and symptoms (clinical dosimetry) and clinical measurement (biological dosimitry). Hospitals without access to nuclear accident expertise should call on any national organization dealing with individual radiation cases to provide them with a medical assistance team, or "N (for Nuclear) team". These teams consist of a medical and nursing specialist, a physics radiation expert, and an administrator and provide advice and coordination aimed at ensuring the best possible treatment for all patients. The further evaluation and treatment of victims suffering from internal contamination are of such a specialized nature that they are not considered further here.

In summary, curative measures for on-site victims consist primarily of measures to save life and limb and other first-aid measures, irrespective of nuclear injuries. For those who have been exposed or contaminated in the near-field, curative measures consist of individual case evaluation and management in decontamination centers (see below) and hospitals, possibly involving N-team assistance.

Public information

workers on site
rescuers
public in general

before and during the event

NB the more education and training, the more stressproof the individuals and the less panic and chaos.

Sheltering

exposure		reduction of radiation
max	open air	0
	ground level of brickhouse room without window and door	
0	cellar of a concrete building with a ventilation filter	max

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covering mouth and nose with a wet facemask or cloth

Preventive Measures

Preventive measures include the following: public information, sheltering, iodine prophylaxis, evacuation, and decontamination. These measures are intended for the action zone and should be taken on the basis of the intervention levels discussed above in order to protect the population from unnecessary exposure to ionizing radiation in the event of a nuclear accident.

Public Information

As for information aimed at the general public, government authorities must take the necessary action, especially with respect to population groups living near category A locations. A recent study among people living near a nuclear power station confirmed this view; it is concluded that the better local people were informed about the chances of a nuclear accident and the measures to be taken in such an event, the less anxious they were. This is a conclusion that must be taken seriously in the context of general information on disaster relief.

Sheltering

The extent to which a shelter can protect potential victims from exposure to ionizing radiation depends on its location and type. Sheltering in the cellar of a concrete building with a ventilation filter can eliminate exposure almost entirely. Exposure is at a maximum level in the open air. Between these two extremes, there is a wide range of possibilities.

Exposure is markedly reduced by sheltering in a room without windows or doors, or on the ground level of a brick house in which the doors and windows have been taped and cracks covered with moist rags. If such precautions are taken, exposure will generally be so low to be regarded as harmless. Even in less solid constructions, such as wooden houses, exposure-and especially inhalation-can be reduced by covering the mouth and nose with a wet facemask or cloth. Such measures can significantly reduce exposure to radioactive dust particles and water droplets.

Iodine Prophylaxis

Nuclear accidents, especially those in nuclear power stations, can cause a wide range of radioactive isotopes to be discharged into the atmosphere. Radioactive iodine is often an important component of these. Inhalation and absorption in the bloodstream cause this isotope to be resorbed selectively by the thyroid gland, which then becomes exposed to large concentrations of radioactivity. This greatly increases the risk of thyroid carcinoma developing over a 10- to 30-year

Iodine prophylaxis

- prevents thyroid carcinoma
- administration before or during the discharge of radioactivity
- e.g. Kj tablets of 170 mg. each;
  1 tablet each day for 3 days
- contraindicated: pregnancy < 3 months
  thyroid pathology
  iodine allergy
- children 1/2 dosage
- predistribution in near-field
- normal distribution in far-field, if necessary

evacuation

- public information before and during the event
- arrangement for sick and old people
- medical aspects concern preventive-hygienic measures only

period, leading to a rise in both morbidity and mortality. Anyone who ingests, stable iodine, preferably before or during the discharge, can eliminate or reduce the risk of thyroid carcinoma, since the iodine saturates the thyroid gland and prevents uptake of the radioactive isotopes. The radioactive iodine will be eliminated in the normal way via the kidneys, as will most other inhaled radioactive isotopes. Stable iodine, which can be ingested as either iodide or iodate, protects only the thyroid gland. Caution is advisable in administering iodine to children, pregnant women, persons with an abnormal thyroid gland, and persons with an allergy to iodine. Following Chernobyl, large sections of the populations of some East European countries and the former Soviet Union were given iodine without any noticeable adverse effects. The Dutch government has stored 15 million strips of three 170-mg potassium iodate tablets at reach of 22 different locations around the country for use in case of a nuclear accident within the Netherlands or in a neighbouring country. However, the distribution of tablets (1 tablet for adults and 1/2 tablet for children per day for 3 days) takes time, which is affordable in the far-field where distribution can take place before the radioactive cloud takes effect. But in the near-field, this time is insufficient. For this reason, potassium iodate must be immediately available to the entire population in the near-field, or more specifically in the action zone, and this can only be achieved by means of predistribution.

Evacuation

In view of the absence of public information on nuclear accidents like in the Netherlands, any organized evacuation of the population from an action zone would be impossible at the present time. If an acciedent were to occur, everyone living near the powerstation would pack their bags, jump in their cars, and head east, since the west is bounded by the sea and the prevailing winds blow from the southwest. Given the already crowded state of roads, this would inevitably lead to chaos, possibly resulting in additional death and injuries. The radioactive cloud would likely drift eastward an could cause further casualties from fallout over stalled traffic.

Since nuclear accidents are unpredictable, organized evacuation of the population from an action zone can take place efficiently only if preceded by an advance public information campaign. Experience with evacuations in other countries has shown that chaos can be avoided only through discipline and that discipline is only attainable bij means of effective public information. Medical problems of evacuation include the supervision of the sick and the aged, preventive medical measures in the reception centers, and care for them on their return journey. Additional details on these issues are beyond the scope of this chapter.

Decontamination

- in decontamination centre (by the fire bigrade)
- in the A &E depts of surrounding hospitals
- wounded (except the T1) should be washed
- non-wounded should shower
- wounds should be rinsed until radioactivity has disappeared and then closed
- the water used in this process can safely be discharged into the regular sewage system
- contaminated clothes should be collected separately
- decontaminated non-wounded casualties should be checked by general practioners
- persistent contaminated casualties to hospital
- *protection of health care workers*

Decontamination

Decontamination is a preventive measure for which fire department personnel will be responsible. Firefighters will be assigned to decontaminate people, animals, and material from the action zone who have been contaminated with radioactive material released by a nuclear accident.

If the victims are evacuees, with or without domestic pets, they will first be received in decontamination centers outside the action zone, where they will be examined for internal or external contamination. Individual case evaluation, possibly based on random sampling in certain parts of the action zone-buildings, streets and blocks, for example-can help provide a picture of who is likely to have been contaminated in which part of the action zone. Persons belonging to high-risk groups will be decontaminated by showering and washing thoroughly with soap and water, after which they will be further screened to determine whether they have been sufficiently decontaminated. The water used in this process can safely be discharged into the regular sewage system. Patients suffering from persistently high levels of contamination will be sent to the hospital for further evaluation and examination.

Those with obvious injuries should of course be sent straight to the hospital without initially going through a decontamination center. Actions to save life and limb should always take priority over the treatment of nuclear injuries. The N-team can give logistical and evaluative assistance in the decontamination centers and hospitals. Health care workers in decontamination centers must wear adequate protective clothing. They should also guard against spending too much time on patients with nausea and vomiting who cannot be proven to be suffering from contamination. Vomiting can result from a prevailing fear of radiation as well as from contamination itself. After decontamination, victims can go to reception centers or, more commonly, to friends and relatives.

For the population in the action zone, on-site preventive measures will include sheltering, iodine prophylaxis, evacuation, and decontamination. Iodine prophylaxis will only be of use if predistribution has taken place. Sheltering should be the first measure, since the evacuation of a panicked population will cause chaos. The most logical order for preventive measures in the action zone would seem to be sheltering and predistributed iodine prophylaxis. After the radioactive cloud has blown over-or if there is enough time for a disciplined evacuation-victims may be evacuated via decontamination centers to reception centers, or directly to reception centers. In the far-field, the most appropriate measures would seem to be sheltering and iodine prophylaxis by means of a normal distribution system. However, if these preventive measures are to be implemented properly and in a disciplined manner, a large-scale public information campaign will need to be instituted.