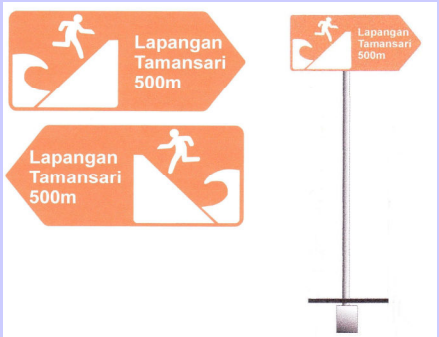

DAPS

Disaster Awareness in Primary School

Tsunami Module

September 2008

Working Document No. 21
Tool

German–Indonesian Cooperation for Tsunami Early Warning System

The Tsunami Module is a joint collaboration of GTZ SEQIP (Science Education Quality Improvement Project) and GTZ IS GITEWS (German Indonesian Tsunami Early Warning System)

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INTRODUCTION

The events of the 26th of December 2004 in Aceh showed again that children are among the most vulnerable to natural disasters. In the past children generally were perceived as "passive victims". Nowadays this perception has changed as it is proven that children can play an active part in disaster risk reduction. Children are the ones who easily pick up new ideas, adopt them and play an important role as multipliers by conveying new ideas and concepts to their families and peer group.

Following this understanding, the GITEWS project “Capacity Building in Local Communities” (GTZ IS) decided to support the integration of tsunami preparedness into school curricula and promote the development of school preparedness plans. The GTZ- Science Education Quality Improvement Project (SEQIP) was quickly identified as an interesting cooperation partner as this project, working on science education in primary schools, already developed preparedness modules for earthquake hazard and is linked directly to the Indonesian Ministry of Education, providing the possibility for integration into formal curricula.

Between October 2005 and December 2008 the project “Disaster Awareness in Primary Schools” (DAPS) financed by the German Federal Ministry of Economic Cooperation and Development was implemented through the team of GTZ-SEQIP taking advantage of the project’s and its consultants’ vast experience and well established structures for teacher training. The project experienced strong support by the Indonesian Ministry of Education at all levels, in particular at the district level as well as from the sector project “Disaster Risk Management in Development Cooperation“ run by GTZ. SEQIP aimed at strengthening risk awareness in Indonesian primary schools and involving the whole school community in order to reduce disaster risk.

The project started with the development of training modules for earthquake hazard. For the project approach it was acknowledged that training modules need to take into account the capabilities of the primary target groups, i.e. teachers, schoolmasters etc, and have to be written in a narrative way. Information should not be jotted down in key points following a given format but must be elaborated by describing all steps in detail. As the focus of the project was on risk management and disaster mitigation, many practical activities have been included, e.g. appropriate behavior during and after an earthquake and a First Aid course. The project applied a “learning by doing” approach in which all participants had to undergo the practical activities themselves. The modules were then used to train teachers, schoolmasters and other actors of the school community. Finally teachers applied the contents in class in order to strengthen the students’ knowledge and awareness concerning natural disasters and preparedness.

In its second phase, the focus of the DAPS project was extended to other natural hazards like landslides, floods and tsunamis. In 2007, the GITEWS project and SEQIP agreed to cooperate in order to assure that technical inputs regarding tsunami hazard and early warning can be included into the newly developed tsunami module. As the implementation process of the Indonesian Tsunami Early Warning System (INA-TEWS) is still ongoing several revisions of the module were necessary in order to keep the document up to date. The version published in this document represents the implementation status of INA-TEWS in December 2008.

Contents of the Module

The tsunami module consists of five chapters. The first chapter provides an overview on natural disasters in general. This chapter has been adopted from the first DAPS module on earthquakes. Chapter two focuses on “Tsunami Hazard and Early Warning” providing general information about tsunami hazard in Indonesia and up to date information on INA-TEWS. Chapter three follows a very different approach. While all other chapters in this module are designed as training modules for trainers and teachers, the chapter on “Tsunami Evacuation Planning” provides a step by step procedure that support school management, teachers and other interested parties in the development of an evacuation plan for their school. The fourth chapter deals with “Tsunami Preparedness” and provides information on what can be done long before a tsunami occurs, how to behave during a tsunami event and what should be considered after a tsunami hit the coast. The last chapter was taken also from the earthquake module and provides basic information on First Aid.

Using the Module

The module serves different purposes. It is designed to be used in Training of Trainers workshops by master trainers from the SEQIP project. In the past SEQIP master trainers provided training courses to staff from the Institute for Education Quality Assurance (LPMP), who then applied it in courses for teachers. Following the above approach, the modules can be used for the training of members of the school community and serve as reference materials for teachers when they prepare classroom lessons in the future.

The DAPS modules are officially recognized by the Indonesian Ministry of Education (DEPDIKNAS).

MODULE 1
CONCEPT OF DISASTER

TRAINING GUIDELINE
CONCEPT OF DISASTER
Duration: 120 minutes
Trainer: DAPS Consultant

Equipment and Materials

- VCD of the tsunami disaster in Aceh and presentation equipment, if available
- Transparencies
- Photos/pictures/newspaper clippings of natural disasters such as tsunamis, earthquakes, floods, landslides (that have already occurred in Indonesia, if possible)
- Learning set

Training Objectives

Participants will be able to:
1. describe in writing the definition of disaster in their own words
2. list 5 disaster types caused by natural phenomenon along with causal factors
3. describe 3 disaster types caused by human behavior
4. identify disaster types based on their causes/sources
5. present this module to students.

Training Steps

1. Present VCD of Aceh tsunami, for approximately 5 minutes or show pictures regarding the impact of natural disasters (taken from shot video for training, video 1)
2. Ask questions regarding the definition of disaster, collect answers from participants, write on the white board without the trainer giving any comments
3. Discuss questions and answers, ask prompting questions until a conclusion is reached
4. Write conclusion on the white board, suggest participants to make notes
5. Review, consolidation

Basically step 2 up to step 5 of the learning cycle are applicable for all concepts.

Competency

Participants will be able to understand the definition of natural disaster, natural disaster types and their causes.

Indicators

1. Participants will be able to describe in writing the definition of natural disaster in their own words
2. Participants will be able to describe 5 disaster types caused by natural phenomena along with their causal factors
3. Participants will be able to describe 3 disaster types caused by human behavior
4. Participants will be able to identify natural disaster types based on their causes.

READING MATERIAL
CONCEPT OF DISASTER

It is mentioned in the draft Law on Disaster Handling that a natural disaster is an event or a series of events caused by nature, humankind and/or both that occurs abruptly or slowly, resulting in loss of life, vast property loss, disruption of infrastructure or facilities, environment, public utilities, loss of lifelines (both social and economical), as well as loss of access to lifelines.

Natural disaster types can be seen on the following table.

Table 1. Natural Disaster Types

Natural Disaster Types	Examples
Geological natural disaster	Earthquake, tsunami, volcanic eruption, landslide, ground subsidence
Climatological natural disaster	Flood, flash flood, tornado/hurricane/tropical storm, drought, forest fire (not caused by humans)
Extra-terrestrial natural disaster	Meteorite fall-out from outer space
Natural disaster caused by human behavior	Forest fire, landslide, water pollution
Natural disaster caused by human behavior and natural phenomena	Forest fire, landslide, flood caused by forest denudation

In line with the heading of this module, the discussion topic will focus on natural disasters caused by natural phenomena, even though disasters may also occur because of human behavior. From the description of disaster definition as mentioned in the draft Law on Disaster Handling, specific natural disasters may occur abruptly or slowly. Natural disasters that occur abruptly include earthquakes, tsunamis, flash floods, windstorms, volcanic eruptions, and landslides. These disasters, due to their sudden occurrence, are very difficult or impossible to forecast.

Different from abrupt natural disasters, as such droughts, famines and environment degradations occur slowly. These disasters naturally have their own causes and characteristics.

A. Tsunami

“Tsunami” originates from the Japanese word of “tsu” which means harbor, and “nami” which means wave. Thus by word, “tsunami” means: harbor wave”. In the fact, a brief description of tsunami is “series of travelling waves most commonly generated by vertical displacement of the sea floor associated with earthquakes below or near the ocean floor that cause a huge amount if sea water to be displaced abruptly”.

Tsunami waves may originate from three sources: earthquakes, volcanic eruptions, landslide all undersea, and meteor falling. The velocity of tsunami waves may reach 800 km/hour in the deep sea, but tends to slow down when approaching coastal areas although they are still quite fast (50km/hour) while the height is increasing as it

reach coastal.

The impact of Tsunami will be much depending on the strength of the wave. Tsunami wave can destroys buildings and carries away people, cars, and other belonging.

B. Volcanic Eruption

A volcano, when erupting, will pour magma through vents in the earth's crust. Magma that overflows the ground surface is called lava, which contains various material called tephra. Except for magma an erupting volcano also ejects hot ash, which consists of hot steam particles. The destruction caused by a volcanic eruption may come from flowing lava, hot steam waves and ash, as well as debris from lava flowing down the mountain top.

C. Landslide

A landslide is the shifting of a large quantity of soil, comprising soil, rocks, and a variety of material moving down the mountainside or steep terrain with loose soil, especially during a heavy rainfall.

The main cause of landslides can be blamed on occurrences such as intense rainfall, geological and topographical conditions, as well as triggered by irresponsible human deeds. In short, a landslide may occur due to heavy rainfall, steep terrain, thick and soft soil with unstable rocks, ground shaking, depleting water supply in a lake or dam, increased burden from buildings, erosion, cliff material deposits, and an old landslide.

D. Flood

In general floods are caused by nature and human behavior. Therefore the solution will not only affect technical aspects but also problems concerning the overall population. Basically, high intensity of rainfall and high tides can increase the frequency and intensity of floods.

With regards to human behavior, very rapid city development and shortfall in drainage facilities, squatter slums alongside canals, littering of canals and rivers, are the main causal factors of floods.

Other than the above, reclamation on marshy land will result in depletion of water supply functions, leading to the slowing down of the water flow and also a higher sedimentation resulting in a water run-off from upstream. This is also the case with excessive use of ground water which may cause soil subsidence and increase the occurrence of floods.

E. Drought

A drought may occur when the water supply is insufficient to meet the requirements. This disaster is caused by a long period of dry season, which may occur throughout the year, for irregular periods beyond prediction. A drought caused by insufficient rainfall is called a meteorological drought, whereas a drought caused by depleting the water supply is called a hydrological drought.

F. Windstorm/Hurricane

Geographically, the coastal areas and small islands in Indonesia are quite susceptible against windstorm disasters. A windstorm can reach a velocity of 200

km/hour with wind speeds of up to 200 kg/m2 which makes it powerful enough to tear down buildings and trees.

Windstorms often occur in Indonesia, for instance *angin bohorok* in North Sumatra, *angin puting beliung* in Bengkulu and South Sulawesi, *angin gending* and *cleret tahun* in East Java, and *angin lesus* in Central Java.

G. Earthquake

An earthquake occurs because of sudden shifts in the earth's crust across a fault. The displacement of a fault and motion of the earth's crust may release energy. Earthquake may occur in land and under the sea. Earthquake that occurs under the sea, may caused tsunami.

Up to now, there are no equipment or method can be used to predict the occurrence of earthquake.

Earthquake occurs frequently in Indonesia, as geographically Indonesia areas lies in the active ring of fire path.

Summary

Natural disaster types and their initial symptoms can be seen in table 2

Table 2. Disaster Types and their Initial Symptoms

Disaster Types	Initial Symptoms
Flood	High intensity of rainfall, for long periods, rise in river water levels as recorded by the observation post
Flash Flood	Barren mountainous area, avalanche prone rocks, high intensity of rainfall, long periods of rainfall, upstream damming up
Landslide/Avalanche	High intensity of rainfall, for long periods, land fissures at upper slopes, water seeping like new springs, slanting electric poles, trees and buildings
Volcanic Eruption	Rise in crater temperature, change in chemical composition of water and steam/gas in crater, lava fallout, slight tremor, forest animals fleeing down mountainsides
Tsunami	Earthquake, depleting sea water level, animals fleeing to higher grounds
Earthquake	Increased frequency and amplitude on seismograph, change in animal behavior (usually quiet)

LEARNING ACTIVITIES
CONCEPT OF DISASTER

Equipment and Materials

- VCD of the tsunami disaster in Aceh and presentation equipment, if available
- Transparencies
- Photos/pictures/newspaper clippings of natural disasters such as tsunamis, earthquakes, floods, landslides (try those already occurring in Indonesia)
- Learning set

Preparation

Prepare VCD presentation of tsunami, or stick photos/pictures regarding certain natural disasters, in line with those available on the white board.

Learning Steps

Activity I: Discussion / Questions Answers on the Definition of "Natural Disaster"

1. a. If the VCD of the tsunami and a VCD Player are available, the teacher makes the necessary preparation for the tsunami VCD presentation, and when ready asks: *"Students, would you please pay attention to what I am going to present with this VCD? Good, are you all ready now? Please pay good attention and don't be noisy."* Then the teacher presents the VCD of the tsunami for approximately 5 minutes.
   b. If the VCD of the tsunami and the VCD Player are unavailable, the teacher shows photos/pictures regarding the impact of tsunamis and other natural disasters to the students. After having finished the VCD presentation or having shown photos/pictures regarding the impact of natural disasters, the teacher says:

2. *"What events have you just seen on VCD or on photos?"* Appoint one of the students whom is raising his/her hand to express his/her opinion. Provide feedback to his/her answer. Ask the other students if they have different opinions. Provide feedback.

3. Teacher: *"Yes, correct, that is the event that not so long ago occurred in Nangroe Aceh Darussalam (NAD). People called it a "tsunami". Do you know the definition of the term "tsunami"?"*. Give students a few seconds to think about the answer. *"Okay, who knows the definition of 'tsunami'? No one? Now listen carefully to my explanation".*

4. Teacher explains the tsunami definition in line with the background information's written descriptions. Thus, definition of "tsunami" is "series of wave caused by vertical displacement under the sea" (written on white board). Tsunami occurence may caused disaster. *Do you know why it called disaster?* Give students time to think about the answer.

5. *"Good, who would like to answer". "Still no one? Okay, now remember what you have observed from the pictures/photos or the VCD presentation". "What are the results of tsunami waves which you have seen on the pictures or in the*

presentation?" Give time to think, then appoint one of the students who is raising his/her hand. If the answer is incomplete appoint another student.

"Your answers are correct, tsunami waves would cause a lot of damage to houses, buildings, vehicles, belongings, and even human life, both injuries and deaths. When the number of damage and injuries reached huge amount, it is called disaster".

6. *"How about rice fields, plantations, and clean water supply as lifelines of the Aceh people?"* Give students time to come up with answers, and also provide feedback.

   Can economic activities such as shops, factories, markets, still function the way they used to? True, indeed, the disruption or consequences caused by a tsunami are utmost severe, as to the environment, people and their belongings, livelihood as well as to lifelines.

   Now then, this sort of severe consequence or disruption is called ***disaster****. Thus how about a definition of disaster? Give students time to discuss among themselves, then appoint one student to bring the discussion result forward and write it on the white board. For the sake of time efficiency, the teacher writes the students' answer on the white board.*

7. *"Who can add more to the disaster definition already written on this white board?"* After there is no more addition received from students, the teacher writes up the description of disaster in line with the formulation provided in the background information. Give students time to make notes.

   Disaster:
   - an occurrence or series of events caused by nature, humankind or both,
   - occurs abruptly or slowly,
   - causes human casualties, loss of belongings, damage of facilities, infrastructure, public utilities, environment,
   - causes loss of lifelines, both social and economic, and loss of access to lifelines.

8. *Good, now let us continue our discussion. What caused tsunami?* Give students time to answer. *Yes, true indeed, earthquake may cause tsunami*. *Meteor falling can also caused tsunami*

9. *Well, now you have understood the definition of the term "disaster".* Ask a student to narrate the disaster definition again without referring to any notes. *Good, are there any more questions regarding the definition of the term "natural disaster"?*

10. Based on the definition of "disaster", give examples of other occurrences that may be classified as natural disasters. Also ask why the students have those opinions. Give other students the opportunity to provide comments against the comments earlier made. Provide feedback.

11. *If there are no more questions regarding the definition of "disaster", let us discuss other matters of no lesser importance than the natural disaster definition.* The teacher proceeds with the next learning activity i.e. "Activity II concerning disaster types and their cause".

Activity II: Disaster Types and their Causes

A. Earthquake

1. *Earthquakes are natural disasters that frequently occur in Indonesia. The word "earthquake" is certainly not unknown to you. What can you feel or see when there is an earthquake?*

2. *Yes, we will feel trembling, shaking, and things that previously were not moving, are now moving. Did those things move on their own? Indeed, like the saying of a proverb "If there is no fire, then there is no smoke". This means that an event is always preceded by a cause*.

3. *During an earthquake, ground that previously did not move will move. If so, what is the cause of the tremor?* Give students time to think and come up with an answer. *Yes, indeed, the source of tremor lays inside the earth. Discuss this description carefully.*

4. The teacher explains how earthquakes may occur and the different types of earthquakes (tectonic, volcanic).

An earthquake occurs at the moment when there is a strong release of energy, after the displacement of a fault was formed due to friction of the earth's crust/plates.

5. Explain that earthquakes do not always cause disaster, for instance an earthquake that occurs in an area where there are no humans. Proceed with an explanation regarding the results of a strong earthquake. Use the Bantul earthquake or another earthquake that occurred elsewhere as an illustration.

6. Conclude this learning activity by summarizing the description of the definition of the term "earthquake" again, its cause, and consequences. Ask students: *"Give some examples of earthquake that already happen in Indonesia?"*

B. Tsunami

1. *We have just finished discussing the definitions of disaster, tsunami, and several examples of other natural events which can be classified as disasters. Now, from the pictures/photos or VCD presentation shown regarding tsunamis, did it occur to you why there is a sudden surge of high tide, which overflows the land with high speed? Or what natural phenomenon may cause a tsunami?* Collect all opinions from the students and do not comment or discuss.

2. *Listen carefully to my question. Are all of you ready now? Good. Sea water that at first looks calm, but suddenly turns into high tide and overflows land at a very high speed, would certainly have a cause. What may the cause be?* Give students some time to think and discuss among themselves. If no one answers, provide the explanation as follows:

3. *If you swim together in a swimming pool, the water level will rise or even overflow. If the seawater suddenly moves and overflows the land at a high speed, there certainly must be an energy stimulation. But where does the energy come from? Or what makes seawater move?* If there is no answer, provide an explanation as follows.

4. *Certainly you still remember the impact of an earthquake. Buildings, houses, trees and other things are trembling as if being shaken. Other than that, an earthquake under the sea may result in displacements and avalanches along the seabed. This occurrence is the main cause of a tsunami, besides an undersea volcanic eruption, under sea landslide, and meteor falling.* Write on the white board, and give students time to make notes.

C. Volcanic Eruption

1. *There is a huge number of volcanoes in our country, therefore the chance of volcano eruption to occur is also quite high. When a volcano erupts what does it eject? Give students time to answer. Yes, radiating liquid material, hot fluid rock pouring through seismic vents called magma. Magma that overflows the ground surface is called lava.*

   Other than magma, what else does an erupting volcano eject? If there is no correct answer, redirect with the question: What do you often see above an active erupting volcano?

   Yes, correct, smoke or clouds that certainly must be very hot, comprising hot steam/gas containing various particles.

2. *What is the consequence caused by the lava flow and moving hot cloud/ash? Give students time to think, answer, and proceed with a discussion to formulate disasters caused by an erupting volcano. Write the summary on the white board, and give students time to make notes.*

3. *Now then, a volcanic eruption can result severe damage and injuries and therefore classifies as a disaster. The symptoms which precede the eruption of a volcano may indeed be forecasted, but when exactly the volcano will erupt is very difficult to determine.*

4. *So far we have discussed these disaster, i.e.... (appoint a student to mention them) Yes, correct, natural disasters of earthquake, tsunami and volcanic eruption. Are there any other disasters?*

   Yes, true, let us now discuss one of them i.e. disasters caused by landslides.

D. Landslide

1. *Whenever there is a landslide flowing down a mountain slope, what do you notice from the soil?*
   Yes, correct, the soil is moving. Does the soil contain other particles? If so, what are they?

2. *Yes, besides a large quantity of soil, other things such as rocks, trees, and other material follow along with the soil. Therefore an "avalanche" is defined as* ***"landslide, comprising soil, rocks, etc".***

3. *Except at mountain slopes, where else do landslides generally occur?*

4. *Yes, correct, along steep river cliffs and other terrain with soft soil. During what season is the highest probability of landslides?*

5. *Yes, certainly, during the rainy season, especially when there are prolonged downpours. The question is, why? Because the soil is soft and easily swept away by water. Rocks and other material too, due to the soft soil, are not planted firmly within the soil. If land moves, other things inside it will also move along.*

6. *Apart from rainfalls, what other factors may cause a landslide? If this is difficult for the students, clarify further; how about human behavior, especially in landslide prone areas, such as a forest edge or a riverbank?*
   Give students time to think.

7. *Yes, human behavior such as forest denudation, cultivation on mountainsides, and rock excavation on mountainsides, sand digs on riverbeds. Buildings or too heavy burdens at certain places can also result in a landslide.*

Landslide: Moving soil, comprising large quantities of soil, rocks, etc. due to heavy rainfall or human behavior

8. *What are the consequences of a landslide? Collect and discuss answers received from students and make a summary. Write the definition of "landslide", its causes, and consequences on the white board. Give students time to make notes.*

E. Flood

1. *Other than landslide, what other disasters may be caused by a relatively long and heavy rainfall? Appoint a student to answer. Yes, floods.*

2. *Except intense and prolonged rainfall, what else may cause floods?* Answers from students may be variable, aim at human behavior.
   Provide another example of human behavior that may result in a flood. Collect opinions from students, discuss, and write a summary on the white board. Give the students a chance to make notes. (See cause of flood written in background information)

3. *Certainly it is not difficult for you to write down the consequences of a flood. Make notes in your notebooks.*

4. *Okay, let us now review a flood disaster.*
   a. *What is the main cause of floods?*
   b. *What kind of human behavior can cause floods?*
   c. *What disasters may occur as the consequence of floods?*

5. *Let us discuss other natural events which occur during the dry season. .*

F. Drought

1. The teacher gives a brief example of what usually happens during a dry season. For the last few years a vast number of certain regions in our country have been experiencing droughts.

2. Droughts are caused by the absence of rainfalls for long periods. Apart from that, another factor that may cause water scarcity is the depletation of the water supply. This relates closely with humankind as the main user of water.

3. A human deed which can lessen water supply for instance is forest denudation so that land becomes barren and unable to preserve water anymore. Thus the water supply will become more scarce. Another cause is the excessive use of ground water.

4. Possible disasters resulting from droughts are for instance insufficient water for humans and other organisms; crop harvests tend to fail leading to food scarcity and even famine, specific illnesses such as hunger oedema.

G. Windstorm/Hurricane

1. The teacher gives brief information regarding windstorms accompanied by heavy rainfall.

2. In certain areas the occurrence is called “whirlwind gale” (*angin lesus*), hurricane, sometimes the following names are also used: *angin puting beliung, angin gending*, etc. Other terms are “typhoon”, “storm”.

3. Teacher explains a windstorm, that the larger the difference in air pressure between two places, the stronger the wind blows.

4. In the tropics, air is hot, humid, and low pressurized. This condition makes it susceptible for hurricanes/typhoons/windstorms to occur.

5. Write disaster risks that may occur as the consequences of a hurricane/typhoon/ windstorm.

H. Summary

Review descriptions of each respective natural disaster as discussed in this module, through questions and answers, including:
1. Definition of each respective disaster type
2. Its causes
3. Its consequences

Make sure that all participants have understood.

Assessment

1. Explain in writing the definition of disaster in your own words!
2. List 5 natural disasters and each respective causal factor!
3. Explain three disasters caused by human behavior!
4. Here are descriptions regarding the cause of natural disasters, write types of natural disasters according to causal description in the boxes below!

Cause	Types of possible disasters
a. Movement of earth's crust/plate	a.
b. Strong earthquake along the seabed	b.
c. Huge difference in air pressure in two places	c.
d. Heavy rainfall, for long periods, instability of land structure, slanting	d.
e. Excessive use of ground water, prolonged dry season	e.

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MODULE 2
TSUNAMI HAZARD AND TSUNAMI EARLY WARNING

TRAINING GUIDELINE
TSUNAMI HAZARD and TSUNAMI EARLY WARNING
Time : 195 min
(15 min Introduction/ 90 min Tsunami Hazard/ 90 min Early Warning)
Trainer : DAPS-Trainer / LPMP-Trainer

Objective

The training module describes the characteristics of the tsunami hazard including tsunami causes and impacts. It explains the importance of a tsunami early warning system for preparedness and how the system works in Indonesia. The module provides the content for training of trainers and training of school community members, i.e. teachers and school committees. It aims to transfer knowledge to the respective training participants and raise awareness about tsunami hazard and tsunami early warning.

An Early Warning System is a system that provides timely and effective information, through identified institutions, which allows communities and individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response (source: ISDR). In order to be able to take this action schools need to be integrated in the early warning system. This integration requires a discussion with the authorities involved in disaster preparedness and early warning at the local level. Schools themselves can help to trigger this discussion. A first step towards this goal can be made at the end of the training, when, in a final discussion some key questions are raised with regards to preparedness and tsunami early warning:

- Is our school in contact with local authorities in charge of tsunami preparedness, early warning and emergency response? **(see also module 3)**
- Is our school connected to the Indonesian Tsunami Early Warning System?
- In case there is a potential for a tsunami, where do we get the warning from?
- Does our school have standard procedures that help us know what to do in the moment when a tsunami warning is received? **(see also module 3)**

In order to find answers to the above questions the school community should pro-actively approach local authorities and find out more about tsunami preparedness in their community and how their school can be linked to the warning system. In the training context, transferring knowledge and raising awareness about tsunami preparedness is not considered an end in itself. The training sessions for school community members provide a very good opportunity to trigger a principal discussion about tsunami preparedness within the respective school and its coastal community. This discussion about preparedness has to be continued throughout the training course (Module 3 and 4) and beyond.

Competence

After the training on module 2 is over, the training participants are:
1. aware of the tsunami hazard and the potential threat to their coastal environment,
2. aware of the importance of preparedness in dealing with tsunami hazard,
3. able to take actions towards school and community preparedness by involving local authorities,
4. able to train other trainers and teachers/ school committees on the content of module 2.

Indicator

After the training is over, the participants should be able:
1. to explain tsunami causes,
2. to explain tsunami characteristics,
3. to explain natural warning signs of a tsunami,
4. to explain tsunami impacts,
5. to show the tsunami prone areas in Indonesia,
6. to explain the definition of early warning,
7. to explain the early warning system in Indonesia,
8. to perform a training course on module 2.

Tools and Materials

1. Module 2: “Tsunami Hazard and Tsunami Early Warning” (as hand out)
2. Video (e.g. Movie “Raging Planet”, until 10’35 or DAPS Video Compilation of Aceh Tsunami) or photos illustrating tsunamis and their impacts
3. Presentation on Tsunami Hazard and the Indonesian Tsunami Early Warning System (as PowerPoint file that can also be printed on transparencies)
4. Laptop/ LCD projector or Over Head Projector (OHP)
5. Plastic transparencies and markers (if no laptop/projector available)
6. Whiteboard and/ or pin board and meta cards
7. Additional materials to be handed out:
    - Tsunami Glossary (UNESCO 2006)
    - Comic Book “Peringatan Tsunami!” (BMG-LIPI-UNESCO-ISDR-GTZ 2007)
    - Tsunami Teacher DVD (UNESCO 2006)
    - Tales of Disasters DVD (IDEP-NoStrings 2007)
    - Poster “Kapanpun tsunami datang, kita siap menghadapinya” (GTZ 2007)
    - Brochure “Kapanpun tsunami datang, kita siap menghadapinya” (GTZ 2007)

Training Steps

INTRODUCTION	**Material**	**Time**
▪ Before the training module starts the trainer explains objectives and expected competences of training module 2	Objectives/ competences in PPT	**15 min**
PART I: Tsunami Hazard (90 minutes)		**Time**
1. The training session begins with **a video or photo presentation** showing impact and loss caused by tsunamis illustrating how terrifying and dangerous this type of natural disaster can be (equipment: dvd player or tv or laptop/ LCD projector).	Video / photos	**15 min**
2. Trainer and participants **discuss** what they have seen in the video/ on the photos. The trainer identifies the important aspects of a tsunami, i.e. causes, characteristics, impact, and documents them on a whiteboard or on meta plan cards (if available). During the discussion, the **trainer uses questions to lead the discussion and probe some general knowledge** regarding definition, causes, characteristics, natural warning signs as well as impact of tsunamis and allows.	White board and/ or pin board and meta cards / PowerPoint presentation	**45 min**
3. The trainer uses the **PowerPoint presentation on Tsunami Hazard** to provide additional visualization and clarification on tsunami characteristics. The focus here is on **tsunamis in Indonesia** (local tsunami) and the **tsunami prone areas** along the Indonesian coastline and provides space for question and answers.	White board and/ or pin board and meta cards / PowerPoint presentation	**30 min**
PART II: Tsunami Early Warning (90 minutes)	**Material**	**Time**
1. Part II starts with the question to the participants **how can coastal communities in Indonesia know that an imminent tsunami threat exists?** Starting the discussion by talking about **natural warning signs** of tsunamis the trainer introduces the concept of the **tsunami early warning system** that provides additional information for communities at risk. The trainer continues by explaining **how the warning system works**, its different components and which data it uses (**earthquake data** from seismographs and **ocean observation** data). The trainer then leads the discussion towards the **roles and responsibilities** within the end-to-end Tsunami Early Warning System.	White board and/ or pin board and meta cards / PowerPoint presentation	**45 min**

2. The trainer provides space for **question and answers** regarding the Indonesian Tsunami Early Warning System.	–	**15 min**
3. The trainer discusses the **key questions** (see objectives above) with the participants ▪ Is the school in contact with **local authorities in charge of tsunami preparedness**, early warning and response? ▪ Is the school **connected** to the Indonesian Tsunami Early Warning System? ▪ **Who are the authorities**/ institutions the school needs to contact to get connected to the early warning system? ▪ In case there is an imminent tsunami threat, **where does the school get the warning from**? ▪ Does the school have **standard procedures** that help to know what to do when a tsunami warning is received? The result of this discussion is documented and put into an **action plan** describing the steps to be taken in order to answer these questions, the person (among the participants) in charge of follow up, and the deadline for action. **NOTE: The results of the discussion will be taken up again during the training sessions for module 3 and 4.**	White board and/ or pin board and meta cards	**30 min**

READING MATERIAL
TSUNAMI HAZARD AND TSUNAMI EARLY WARNING

PART I: TSUNAMI HAZARD: CAUSES, CHARACTERISTICS AND IMPACT

A. What is a Tsunami?

When we look towards the beach or the open sea, there are always rolling waves that crash to the beach. This kind of wave occurs as a result of wind and tidal movement. The height and length of the waves as well as the direction of the waves are influenced by the direction of the blowing wind. When there is a storm, we will see storm waves. When storm waves reach the coast, they can cause damages and loss to those who reside along the beach.

A tsunami is also a kind of sea wave. However, tsunamis are not caused by wind or tidal movement. The word “tsunami” originates from the Japanese terms “nami”, meaning wave and “tsu” denoting harbour– “harbour wave”. A tsunami is a series of travelling waves most commonly generated by vertical displacements of the sea floor associated with earthquakes below or near the ocean floor that cause a huge amount of sea water to be displaced abruptly. Volcanic eruptions, submarine landslides, and coastal rock falls can also generate tsunamis, as can a large meteorite impacting the ocean. Tsunamis have no connection with tides; the popular name “tidal wave” is entirely misleading.

Tsunami waves travel outward from their source in any direction, e.g. the location of an earthquake. They have extremely long length and can travel across entire oceans with little loss of energy. In the deep ocean, tsunami waves can travel at speeds of 500 to 1,000 km per hour – the speed of an airplane. Near the shore, however, tsunami waves slow down to just a few tens of km per hour – yet still faster than a human can run. Only up to just a meter in height in the deep ocean tsunamis can grow to tens of meters on approaching shallow water, inundating low-lying coastal areas and causing great damage and loss of life.

B. What Causes a Tsunami?

A tsunami is generated when a mass of water is abruptly displaced. In Indonesia, as well as worldwide, **submarine earthquakes that trigger a sudden vertical displacement of the sea floor** are the most frequent cause of tsunamis. A brief explanation about the forces that cause earthquakes provides a better understanding about the mechanisms associated with earthquake generated tsunamis.

The underlying force of earthquakes: plate tectonics

Most earthquakes are caused by plate tectonics. Geologists have observed that the continents we live on and the floor of the ocean are not still but in motion. They developed a theory, called the “Theory of Plate Tectonics”, to explain the observed evidence for large scale motions of the Earth's lithosphere (figure 2). This theory describes how the lithosphere is broken up into so called tectonic plates (figure 1).

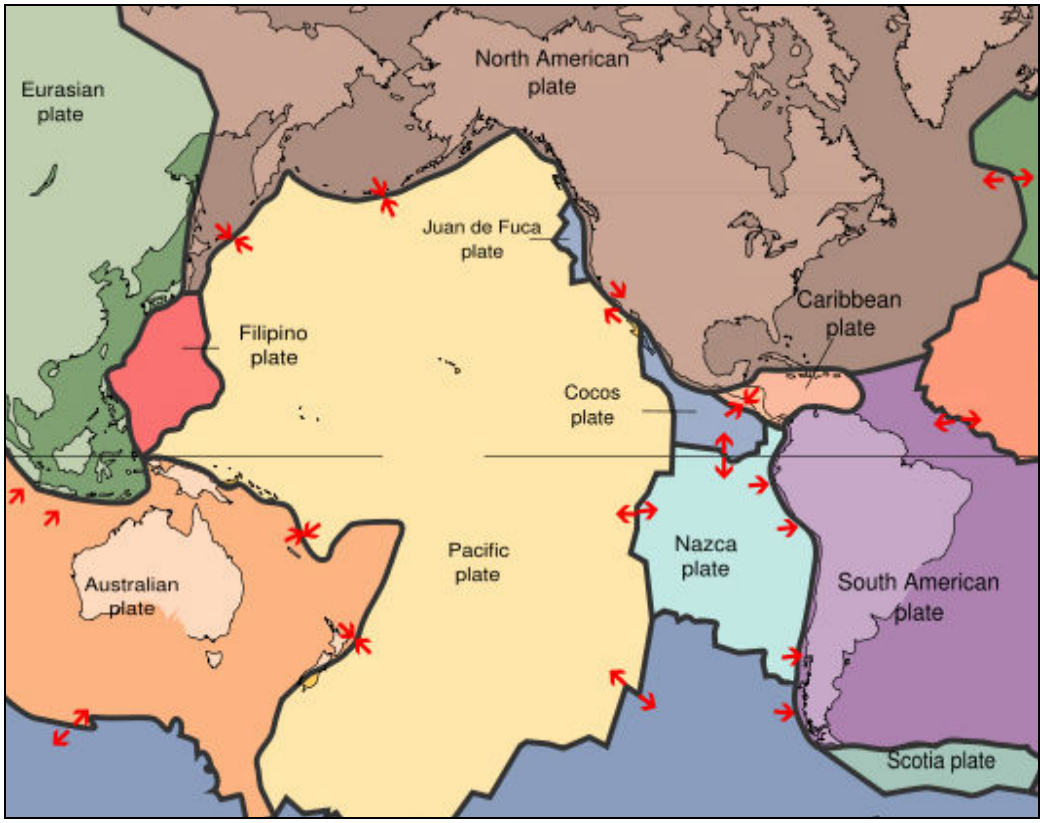


Figure 1: The main tectonic plates worldwide (Wikipedia, 2007)

But how can tectonic plates that have the size of whole continents move? The answer is that the outermost part of the Earth's interior is made up of two layers (figure 2): above is the lithosphere, comprising the crust, and below the lithosphere lies the asthenosphere. Although solid, the asthenosphere can flow like a liquid, moving very slowly over a long period of time. The key principle of plate tectonics is that the lithosphere is broken up into separate and distinct tectonic plates, which ride on the fluid-like asthenosphere. One plate meets another along a plate boundary.

The plates move in relation to one another at one of following three types of plate boundaries (figure 2):

- **convergent** boundaries where two plates collide and one of them is submerged,
- **divergent** boundaries where new ocean floor is created by rising magma, and
- **transform** boundaries where two plates move alongside each other.

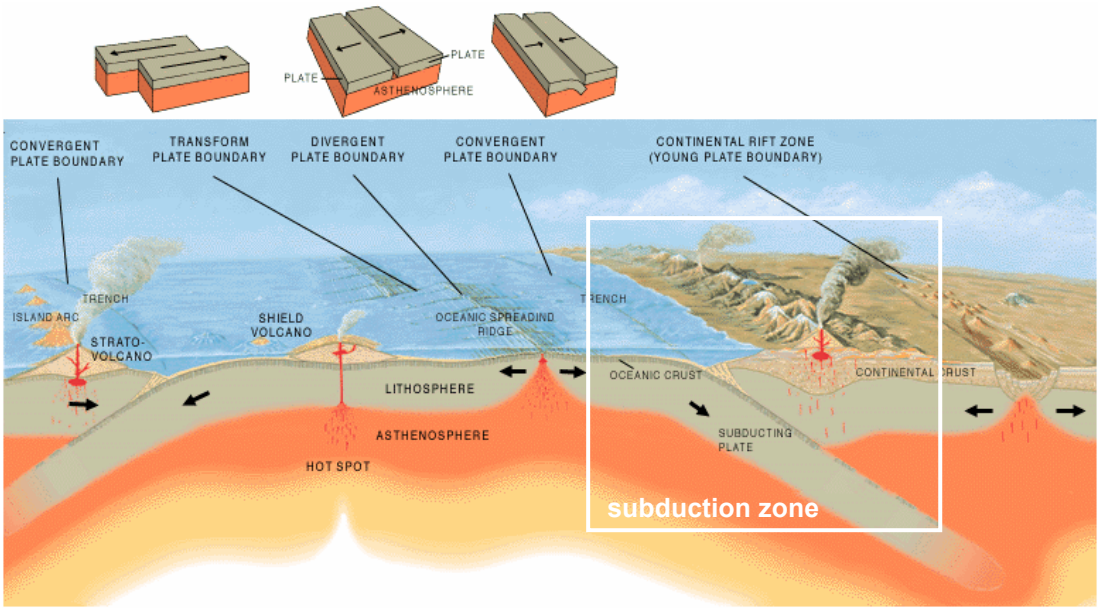


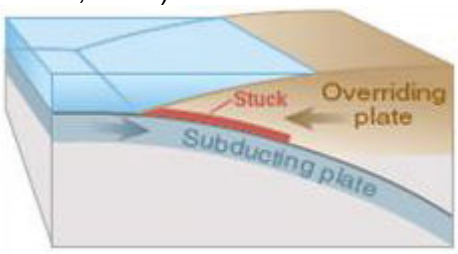
Figure 2: Three types of plate boundaries: convergent, divergent and transform boundaries (Wikipedia, 2007)

Earthquakes, volcanic activity, mountain-building, and oceanic trench formation occur along all plate boundaries. The lateral movement of the plates is typically at speeds of 0.65 to 8.50 cm per year depending on the respective tectonic plate.

Submarine earthquakes at subduction zones – the main cause of tsunamis

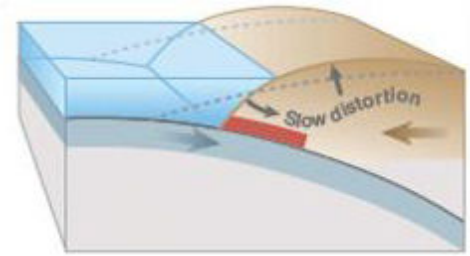
The plate boundary that is responsible for the generation of tsunamis is the **convergent plate boundary**. Here, one plate submerges under another. The zone where this happens is called **subduction zone** (see figure 2). The mechanism that leads to earthquakes at subduction zones is explained in the following figure 3:

Figure 3: Vertical alice through a subduction zone explains tsunami generation (USGS, 2005)



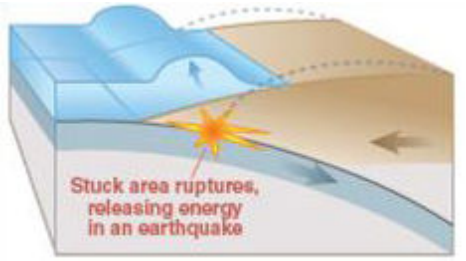
One of the many tectonic plates that make up Earth's outer shell descends, or "subducts," under an adjacent plate at a convergent plate boundary. This zone is called a "subduction zone". When the plates move suddenly in an area where they are usually stuck, an earthquake happens.

a. Before the earthquake



Stuck to the subducting plate, the overriding plate gets squeezed. Its leading edge is dragged down, while an area behind bulges upward. This movement goes on for decades or centuries, slowly building up stress.

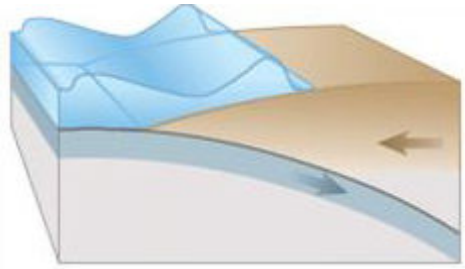
b. During the earthquake



Tsunami starts during earthquake

An earthquake along a subduction zone happens when the leading edge of the overriding plate breaks free and springs seaward, raising the sea floor and the water above it. This uplift starts a tsunami.

c. Minutes after the earthquake



Tsunami waves spread

Part of the tsunami races toward nearby land, growing taller as it comes in to shore. Depending on the tsunami's energy, another part heads across the ocean toward distant shores.

Not all submarine earthquakes at subduction zones cause tsunamis. In order to cause a tsunami, an earthquake needs to fulfill the following criteria:

- The earthquake is located **under the sea** (submarine earthquake).
- The **depth** of the centre of the submarine earthquake is **less than 70 km**.
- The submarine earthquake has a **magnitude of > 6.5** on Richter Scale.
- The **movement** of the tectonic plates occurs **vertically** which makes the sea floor rise and lift up the body of water above it.

Example: The tsunami in Aceh on December 26, 2004 was caused by a submarine earthquake with the magnitude of 9.3 on Richter Scale. The earthquake lifted up the sea floor by about 20 m on average which caused the tsunami waves. The tsunami killed more than 125.000 people in Indonesia, and in total more than 250.000 people around the Indian Ocean.

This earthquake occurred at the subduction zone off the west coast of Sumatra. However, this subduction zone is not the only potential earthquake and tsunami source for Indonesia. In fact Indonesia is situated in an area with many subduction zones and therefore highly tsunami prone, as the following section C will explain. Before that, let us have a look at other tsunami causes.

Other Tsunami Causes

Submarine volcanic eruption

Although relatively infrequent, violent volcanic eruptions can also displace a great volume of water and create extremely destructive tsunami waves. There are different processes associated with (sub) marine volcanic eruptions that can cause tsunami waves:

- Waves can be generated by the sudden displacement of water caused by volcanic slope failure (similar to a landslide) or gigantic flows of hot gas, ashes, and rock directly entering the sea at a very high speed displacing a huge amount of water.
- Another cause can be a massive explosion that occurs when rising magma in a volcano gets in contact with water. The extreme temperature of the magma (anywhere from 600 ºC to 1,170 ºC) causes the water to become steam immediately resulting in a huge explosion that displaces a massive amount of water.
- In the aftermath of a volcanic explosion the volcano's emptied magma chamber may collapse. A massive amount of water abruptly enters these chambers. This sudden displacement of water can cause tsunami waves. Or, to put it in a different way: during eruption the volcano spewed its innards in a huge amount. Then water is sucked into the empty chamber of the volcano to replace the material spewed.

One of the largest and most destructive tsunamis ever recorded happened on 26 August 1883 after the explosion and collapse of the Krakatau volcano in Indonesia. The explosion and collapse generated waves reaching 42 meters high, destroying the coastal towns and villages along the Sunda Straits on the islands of Java and Sumatra killing more than 36,000 people.

Submarine landslides and coastal rockfalls

Tsunami waves can also be generated by displacements of water resulting from rock falls or landslides from the coast as well as sudden submarine landslides caused by the failure of submarine slopes. This kind of tsunami occurred in 1815 when Tambora Volcano on Sumbawa Island erupted. The landslides occurred due to the volcanic eruption and fell into the sea causing an enormous violent tsunami. Submarine landslides are often triggered by earthquakes.

Meteor impact into the sea

What happens if we drop a stone into the sea? From the place where the stone falls a circular wave will radiate into all directions. Imagine if a huge meteor falls down into the sea. A devastating tsunami will occur. There is a small chance that a tsunami will occur due to meteor because most of meteors are already burnt down and destroyed when they enter the earth's atmosphere. However, if the meteor is big enough, it can pass the earth's atmosphere without being completely destroyed and eventually impact into the sea. A tsunami caused by a meteor might have occurred 35 million years ago in the Gulf of Chesapeake (according to the geological profile researched by USGS, United States Geological Survey).

C. Tsunami Prone Areas In Indonesia

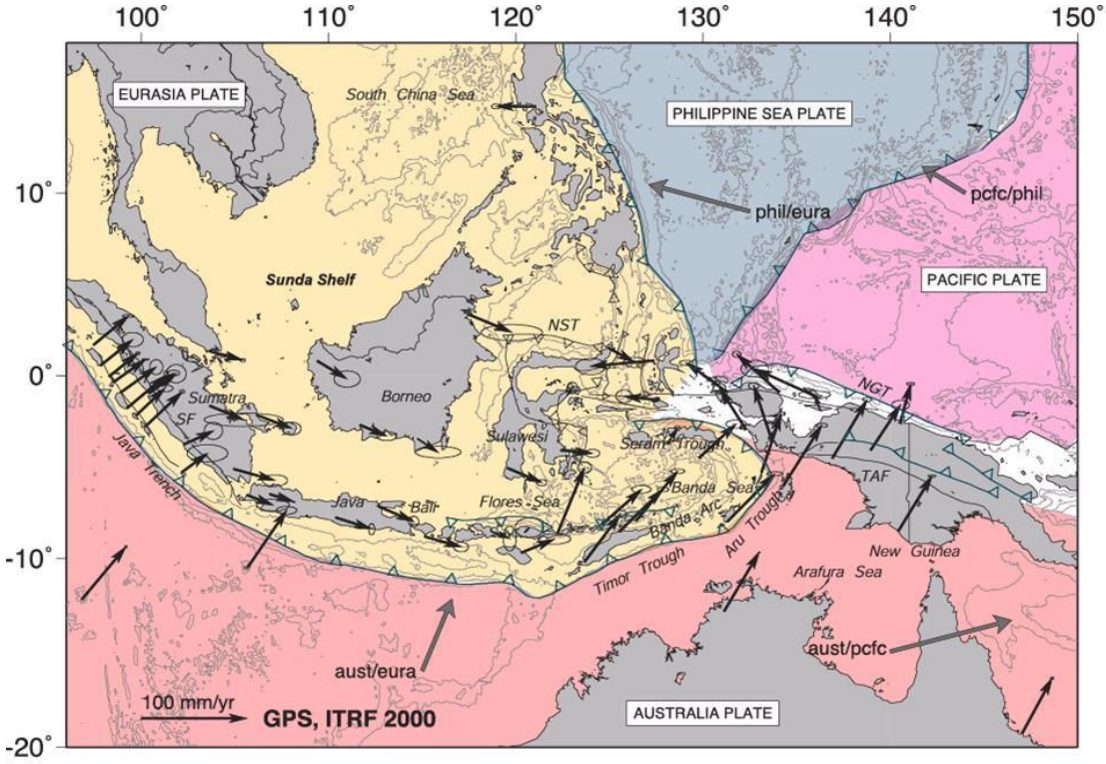


Figure 4: Tectonic plates of Indonesia and their motion (Bock et al, 2004)

Where are the tsunami prone areas in Indonesia? Unfortunately, the answer to this question is: **many of the Indonesian coastlines are prone to tsunamis!** It is important to know whether one lives in a tsunami prone area or not. A tectonic map of Indonesia (figure 4) illustrates the fact that the archipelago is surrounded by many convergent tectonic plate boundaries. These subduction zones that can generate submarine earthquakes with vertical displacement of the sea floor are all potential source areas for tsunamis.

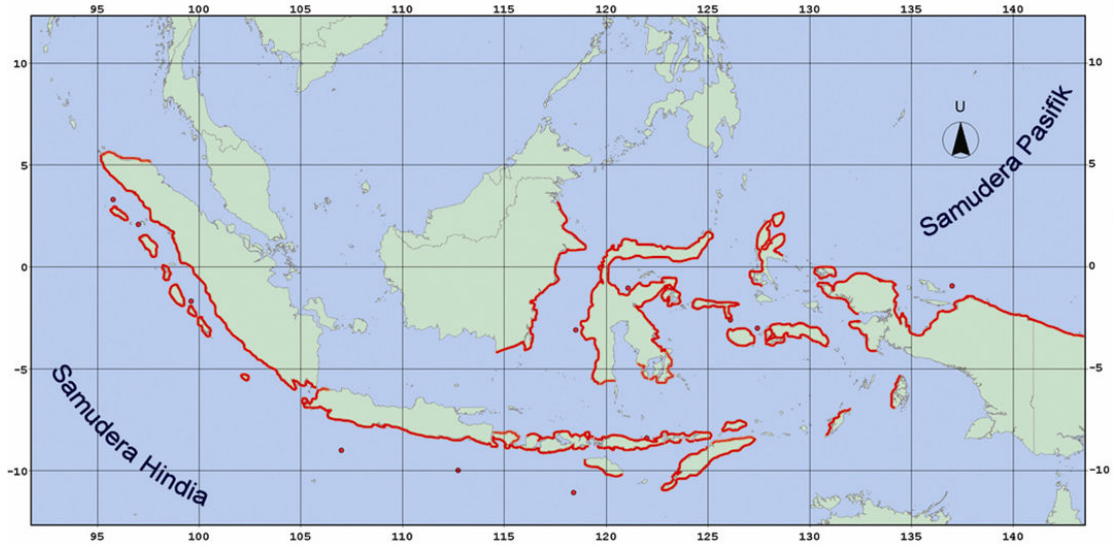


Figure 5: Tsunami prone areas in Indonesia (BMG, 2007)

The position of Indonesia located in the close vicinity of these subduction zones means that Indonesia has one of the most tsunami prone coast lines in the world – as indicated by the red line in figure 5.

The most prominent subduction zone in Indonesia is the **Sunda Trench** (also in parts called **Java Trench**, see figure 4). It runs all along the western and southern coast of the archipelago. This subduction zone lies in close vicinity under the sea off the coasts of the Islands of Sumatra, Java, Bali, and the Nusa Tenggara Islands. It marks the tectonic plate boundary where the Australian plate submerges under the Eurasian plate.

In general, there are three major plate boundaries around Indonesia involving four major plates (see figure 4):

- the **(Indo-)Australia Plate** meets the **Eurasian Plate**,
- the **(Indo-)Australian Plate** meets the **Pacific Plate**,
- and the **Pacific Plate** meets the **Philippines Plate**.

The word "tsunami" became famous in Indonesia – in the most saddening way – after the Indian Ocean Tsunami in 2004. Tsunamis, however, have struck and brought damage and loss of life to Indonesian coast lines long before and repeatedly throughout the archipelago's history. Table 01 gives examples of tsunamis that have hit Indonesian coasts over the last 15 years:

Table 01: Examples of tsunamis in Indonesia over the last 15 years

Date/Year	Magnitude (RS)	Depth of Earthquake	Run up (max)	Inundation (max)	Number of Victims	Impact area
17-06 **2006**	7.7	6 km	4.6 m	500 m	668	Southern coast of Java
26-12 **2004**	9.3	30 km	35 m	5000 m	250,000	Aceh/ Indonesia (and other Indian Ocean countries)
03-06 **1994**	7.7	33 km	13 m	500 m	220	Southern coast of Java
17-02 **1996**	8.2	32 km	13 m	No data	107	Biak / Papua
12-12 **1992**	7.8	36 km	26 m	No data	196	P.Babi / Flores

Note: for the definition of run up and inundation see section E

Tsunamis in Indonesia are a common natural phenomenon. As can be seen from the table above, each tsunami has individual characteristics and impact. The following sections will help us to understand more about tsunami these characteristics (section D) and tsunami impact (section E).

D. Tsunami Characteristics

Tsunamis can come from near and far: local and distant tsunamis

Tsunamis travel across the sea before they reach a shore. The distance they travel can differ considerably. Different types of tsunamis can be distinguished in

accordance to their energy and the distance they travel before reaching a coast:
The destructive impacts of ***local tsunamis*** are confined to coasts that are close to the epicentre of the earthquake. Local tsunamis have very short travel times and arrive within minutes at the shore. They are produced by a local earthquake (or submarine landslide) affecting a very limited area. However, they can still be destructive. A recent example of such a local tsunami in Indonesia that only affected a limited area in close vicinity to the epicentre is the local tsunami that was triggered by an earthquake south of Java Island on 17 July 2006. Known as the Pangandaran Tsunami, it struck several districts in West and Central Java, destroyed infrastructure and killed almost 700 people (figure 6).

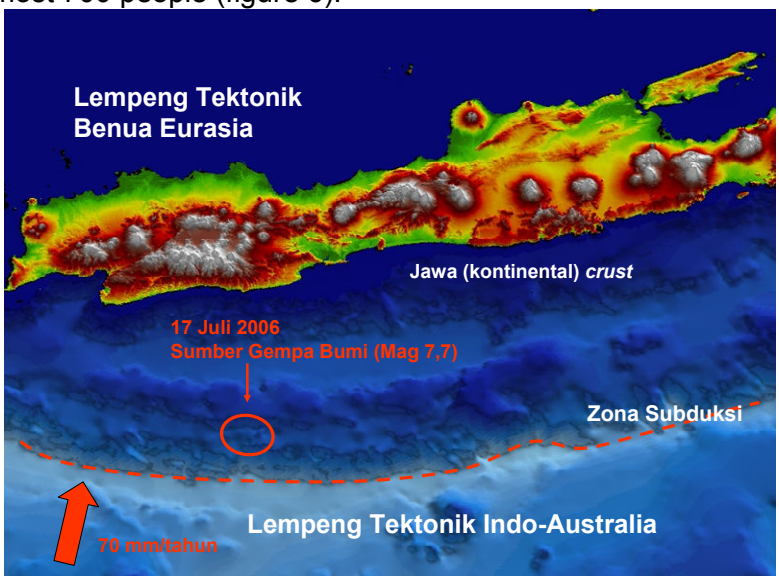


Figure 6: Earthquake epicentre of Pangandaran (Java) Tsunami in 2006

A ***distant*** (or ocean-wide) ***tsunami*** may arrive at a coast several hours after it was generated in a far away location. Ocean-wide tsunamis have impacts across an entire ocean and are generated by major earthquakes. The tsunami in Aceh was a distant tsunami that traversed the Indian Ocean and caused destruction not only in Indonesia but also in Thailand, Malaysia, Sri Lanka, India and at the eastern coasts of Africa (figure 6).

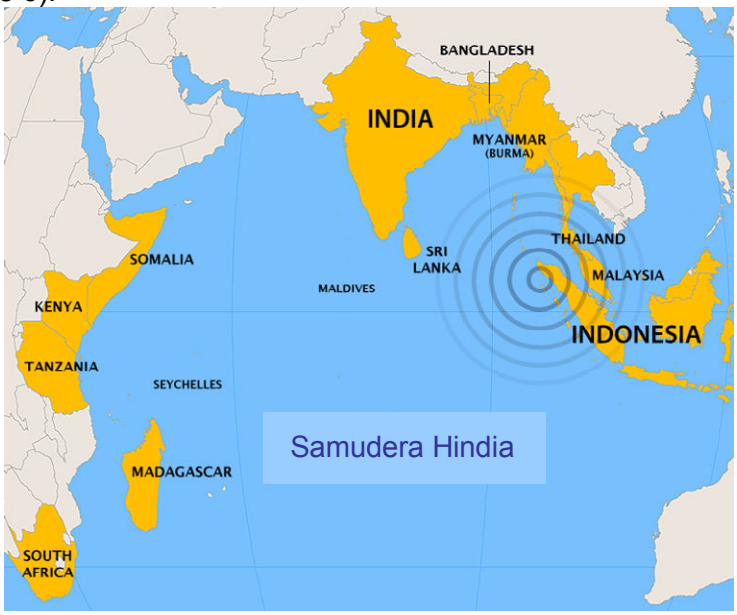


Figure 7: Earthquake epicentre off the shore of North Sumatra and countries (in yellow) impacted by the Indian Ocean Tsunami of 26 December 2004

As we discussed above, Indonesia is located in close vicinity to (convergent) tectonic plate boundaries (subduction zones) with frequent earthquakes that bear the potential for tsunami generation. The small distance between many of the Indonesian islands and these potential earthquake sources makes the **local tsunami** threat the **major tsunami threat** for the coast lines of Indonesia.

A Tsunami is a series of waves that can reach the speed of an airplane

A tsunami travels outward from its source region as a series of waves. Its **speed** depends upon the depth of the water. If the water is deep, like far from the coast, the tusnami waves travel fast. If the water becomes shallower, like closer to the coast, tsunami waves slow down. In the deep ocean, tsunami waves can travel at speeds of 500 to 1,000 km per hour, as fast as an airplane. Near the shore, however, a tsunami slows down to just a few tens of kilometers per hour (figure 8) – however, the speed of the water approaching and flooding the coast is still faster than a human can run.

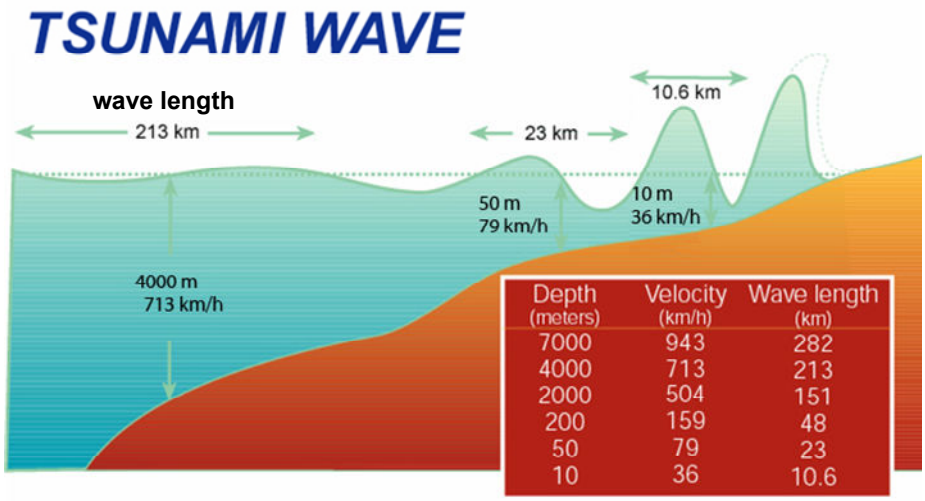


Figure 8: A comparison of speed and wave height of tsunami waves in various sea depths (UNESCO Tsunami Glossary)

The **height of a tsunami wave** also depends upon the water depth. A tsunami wave that is just a meter or less in height in the deep ocean can grow to tens of meters at the shoreline. Unlike wind-driven ocean waves that are only a disturbance of the sea surface, the tsunami waves' energy extends from the surface all the way down to the ocean bottom. This is the case because they were triggered by earthquakes at the sea floor that moved the whole sea water body above. Near the shore, this energy is concentrated in vertical direction by the reduction in water depth, and in the horizontal direction by a shortening of the wave length due to the wave slowing down The result is that the waves rise tremendously when reaching shallow water (figure 8). The **length of tsunami waves** is greater than the length of normal sea waves. Wave length can also be described as wave period indicating the time for a single wave cycle or, in other words, the time it takes from the arrival of one wave peak to the arrival of the peak of the next wave. Since tsunami's wave length is very long, tsunami periods may range from just a few minutes to as much as an hour or more.

Another thing that is very important to remember is that a **tsunami is not only one wave but a series of waves**. And: when a tsunami reaches the coast, usually the first incoming wave is in many cases not the biggest among the chain of waves still to come. The following waves often are even bigger and more destructive.

If we look again at the two aspects of tsunamis: great wave length (or period) and tsunamis being not only one wave but a chain of several waves, a very crucial characteristic of tsunamis becomes apparent: **tsunami events can take several hours from the arrival of the first wave until the last wave has arrived at a coast and the event is over.**

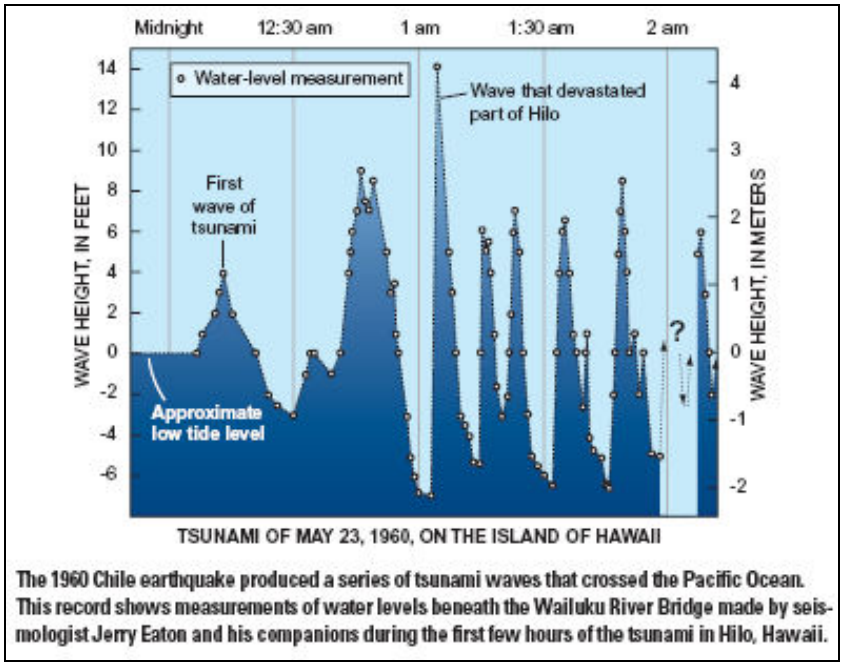


Figure 9: Wave arrival times and wave height at Hilo, Hawaii during the Chile Tsunami in 1960 (UNESCO Tsunami Glossary)

Figure 9 above shows the example of a distant tsunami that was generated by an earthquake near the coast of Chile (South America) in 1960. This distant tsunami was generated by a major earthquake which gave the tsunami enough energy to travel across the whole Pacific Ocean. The first tsunami wave travelled 15 hours until it reached the Island of Hawaii in the middle of the Pacific Ocean and 20 hours to Japan in the far north-western part of the ocean. The above diagram (figure 9) illustrates what happened after the first wave had arrived shortly after midnight. The first wave was just the beginning of the tsunami disaster that caused great damage the harbour town of Hilo, Hawaii. It took about 2 hours until the last of the approximate eight tsunami waves had arrived and the tsunami event generated thousands of km away had ended.

All tsunami events consist of more than one wave. Examples for this can also be found in Indonesia. The 1992 tsunami in Flores came with five waves and it took two hours until all waves had arrived and the direct tsunami danger had ended. Knowing that a tsunami is not over after the first wave is very important since going back to the coast after the first wave although the danger is not over yet can cost people's life when they get caught in a subsequent wave.

When a **tusnami reaches the shore**, it can have a wide variety of expressions depending on the size and period of the waves, the near-shore bathymetry (the depth and shape of the sea floor close to the coast), the shape of the coastline, the state of the tide, and other factors. These factors influence the tsunami's impact on land before it hits the coast. In some cases a tsunami may only induce a relatively benign flooding of lowlying coastal areas, coming onshore similar to a rapidly rising tide. In other cases it can come onshore as a bore – a vertical wall of turbulent water that

can be very destructive.

As we have learned especially from the Indian Ocean Tsunami that hit Aceh, nature provides us with some **natural warning signs of a tsunami event**:

- Most tsunamis disasters are triggered by submarine earthquakes. For Indonesia most tsunamis are local tsunamis. Local tsunamis originate from an epicentre not far from the coast. If this is the case the **ground shaking** caused by the earthquake can be felt in coastal area. However, if the tsunami is caused by an earthquake that happens far away the earthquake may not be felt.
- After the earthquake occurred and just minutes before the arrival of the first tsunami wave, the **seawater** might all of a sudden **withdraw** (as if it is being sucked into the ground) and expose the seafloor close to the beach. If that happens, it is a definite indicator that a tsunami wave is on the way to the particular coast. However, there are some tsunami incidents where the seawater does not withdraw at all – as it was the case during the Indian Ocean Tsunami in Sri Lanka.
- **Animals run away from the coast**.
- Some unusually **strong smells** waft from the beach. Witnesses report the smell of salt or fish just before a tsunami struck.
- **Strong winds blow from the sea** to the coast.
- A **roaring sound** can be heard that resembles the sound of an airplane or train.

2. The Impact of Tsunamis

What is the impact of a tsunami when it hits land?

We all remember the horrible pictures from Aceh after the tsunami hit on 26 December 2004. The tsunami killed thousands of people, made coastal population homeless, destroyed people's assets, erased entire parts of the coast and changes landscape patterns. The satellite images below remind us of the extent of devastation caused by the tsunami waves in Northern Sumatra.

Figure 10: Satellite images showing a part of Banda Aceh (top) and the Village of Lampuuk in the District of Aceh Besar at the west coast (bottom) before and after 26 December 2004

Although a tsunami event like the one in Aceh that affected the whole Indian Ocean is infrequent, tsunamis are among the most terrifying and complex natural phenomena and have been responsible for great loss of life and extensive destruction to property. Depending on its energy and the characteristics of the coast, damage and destruction from tsunamis are the direct result of three forces:

- Direct wave impact on structures,
- Inundation, and
- Erosion.

The following categories of zones help to distinguish tsunami impact on land:

- **Erosion** Zone or **Impact Zone**: close to the shoreline where structures are exposed to erosion, scour, wave action and flooding
- **Wave Zone**: subject to wave action and flooding
- **Flood Zone**: subject to flooding

During a tsunami event, deaths occur by drowning and physical impact or other trauma when people are caught in the turbulent tsunami waves. Strong tsunami-induced currents can lead to the erosion of foundations and the collapse of bridges and seawalls. Floatation and drag forces have moved houses and overturned railroad cars. Tsunami associated wave forces have demolished frame buildings and other structures. Considerable damage also is caused by floating debris, including boats, cars, and trees that become dangerous projectiles that may crash into buildings, piers, and other vehicles. Ships and port facilities have been damaged by surge action caused by even weak tsunamis. Agricultural land can be damaged or destroyed by erosion of the soil and/or infiltration of salt water. Fires resulting from oil spills or combustion from damaged ships in port, or from ruptured coastal oil storage and refinery facilities, can cause damage greater than that inflicted directly by the tsunami. Other secondary damage can result from sewage and chemical pollution following the destruction.

What terms do scientists use to describe a tsunami's characteristic on land?

If we want to describe the impact of tsunamis on land we can use different terms that scientists defined to talk about the effect a tsunami has on the coast (figure 11):

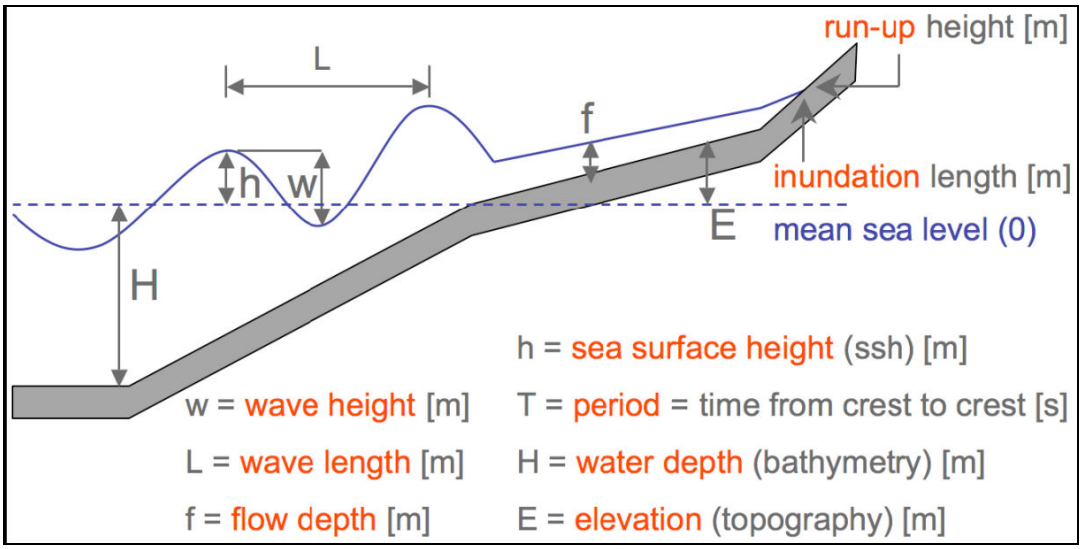


Figure 11: Main terms to describe tsunami characteristics on land (UNESCO Tsunami Glossary, 2006)

There are four terms that help us to understand the characteristics of tsunamis when they reach land: **wave height at coast, flow depth, inundation** and **run up**.

We have learned that tsunami waves are not very high in the open and deep sea. When they reach shallow water near the shore the waves raise up. The **tsunami wave height** describes how high a tsunami wave is at the coast measured from the trough to the crest of the wave (see figure 11). The different tsunami waves of one tsunami event usually have different wave heights.

When a tsunami reaches the coast it floods the coastal areas. As figure 11 shows, the maximum horizontal distance inland that a tsunami penetrates, generally measured perpendicularly to the shoreline, is called ***inundation length***.

The depth of the water that floods the coastal land is called **flow depth**. The flow depth becomes smaller as the water moves further inland.

While inundation refers to the horizontal distance the wave penetrates inland, ***run up*** is the elevation on land reached by seawater during a tsunami event, This elevation is measured relative to some stated datum such as mean sea level (see figure 11). Ideally run up is measured at a point that represents the inundation length, i.e. the maximum horizontal distance the water penetrates inland.

Below are more photos of tsunami impact caused by different tsunamis during the last 15 to 20 years in Indonesia:

Damage to infrastructure (Biak, 1996)

Destruction of plantations (Biak, 1996)

Damage to settlements (Pancer, 1994)

Damage to settlements (Maumere, 1992)

Debris and destruction (Pangandaran, 2006)

Devastation to settlements (Aceh, 2004)

A boat floated into the City (Aceh, 2004)

Loss in livestock (Aceh, 2004)

What factors influence the impact of a tsunami on land?

The impact of a tsunami on land is determined by different factors, these factors include:

- Orientation and configuration of coast line,
- Offshore bathymetry (structure of the sea floor close to the coast),
- Coral reefs or islands that influence the orientation of the tsunami waves,
- Onshore slope,
- Onshore features like mangroves, sand walls, vegetation and buildings,
- Wetlands, river and river flood plains.
-

Inundation and run up of a tsunami vary in accordance to its energy and the above factors. Inundation and run up of the tsunami in Aceh are among the highest ever recorded in Indonesia. In flat areas the water reached up to 5 km inland while 35 m was the highest run up recorded.

E. Probability of Tsunamis

Tsunamis are among the most dangerous and complex natural phenomena, being responsible for great losses of life and extensive destruction of property in many coastal areas of the world's oceans. They are a typical example of "low probability – high consequence" disasters. This means tsunamis do not occur very often but if they occur, they are very dangerous and can cause great damage. On average, 2-3 damaging tsunamis occur in the world's oceans annually, but at each particular coastal location the recurrence interval between destructive tsunamis can vary from 30-50 to 200-300 years.

Most tsunamis are caused by submarine earthquakes. Science is not able to predict earthquakes and therefore can also not predict tsunami events. In tsunami prone areas like in Indonesia, tsunamis can always happen, at any time, during the day or at night, in the morning or in the afternoon.

F. What factors can help to reduce the risk associated with tsunamis?

Since nobody can predict earthquakes, as the major cause of tsunamis, the occurrence of a tsunami is also not predictable. However, people can be better prepared for tsunami disasters. The following factors that determine the preparedness of tsunami prone regions and their communities are crucial:

- **Knowledge about the hazard:** people in coastal communities are aware that

their community is located in a tsunami prone area, are familiar with the characteristics of the tsunami hazard, and know how to react in case a tsunami is on the way to their coast.

- **Early Warning**: a tsunami early warning system is in place and functions. The communication system between a tsunami warning centre and the communities in tsunami prone areas allows the people at risk in coastal areas to receive a tsunami warning as early as possible before a tsunami strikes.
- **Plans for reaction**: communities know how to react to the warning.

The following part II of module 2 describes how a tsunami early warning system works and how it can help to reduce people's risk and save lives.

PART II: The Indonesian Tsunami Early Warning System – INA-TEWS

Most of the Indonesian communities in tsunami prone areas are at risk of local tsunamis. Locally generated tsunami waves may reach the coast in very short time. For that reason coastal communities have to react quickly to the warnings that they can get before a tsunami strikes.

What are the warnings that people in coastal communities can get before a tsunami strikes? As we have already learned, there are **natural warning signs** that can be observed before a tsunami strikes. The first warning communities may receive is **ground shaking** from a strong earthquake. Unfortunately, ground shaking is not a very reliable tsunami indicator as feeling of "strong ground shaking" may be highly subjective. Additionally there is a possibility that the location of the epicentre was on land and consequently no tsunami danger exists; and: there are also reports of local tsunamis where people did not notice a prior earthquake, for example the earthquake that led to the local tsunami which struck Pangandaran on the Island of Java (in 2006) and killed more than 650 people.

Sudden withdrawal of the sea may be observed as a second natural warning sign. In the case this sign is being observed, the tsunami is already on the verge of striking. There are only a few minutes left to move away from the coast line and rivers and to higher ground. The first wave arrives no longer after the withdrawal of the sea and is much faster than a person can run. Leaving the coast only upon observation of seawater withdrawal might already be too late. If people are close to the coast and feel an earthquake it is vital that they immediately leave the coastal strip and river banks. If no earthquake was felt, however, and the sudden withdrawal of the sea is observed people should waste not a second and leave the beach and rivers immediately!

Other than being aware of the natural warning signs and reacting on them without delay, what else can coastal communities do in order to increase their capacity to cope with the tsunami threat and react before the disaster strikes? They can link themselves to a Tsunami Early Warning System.

By definition "an **Early Warning System** is a system that provides timely and effective information, through identified institutions, which allows communities and individuals exposed to a hazard to take action to avoid or reduce risk and prepare for effective response" (UN/ISDR). Early warning systems can be established for many different natural hazards, e.g. floods or volcanic eruptions. The objective is always the same: provide information to the people at risk as soon as possible before a disaster strikes so that they can take actions to avoid serious consequences.

The devastating tsunami in Aceh on 26 December 2004 took coastal communities

and many tourists by surprise and killed thousands of people. After this experience Indonesia decided to establish an **Indonesian Tsunami Early Warning System (INA-TEWS)** in order to be better prepared for future tsunami events – which will definitely come – and warn communities in coastal areas before a tsunami hits. Already today, tsunami warnings can be received in Indonesia. However, the Indonesian Tsunami Early Warning System (INA-TEWS) will only be fully operational in 2009.

How does the Indonesian Tsunami Early Warning System work? INA-TEWS, as any complete and effective early warning system, has four elements (see figure 12) as well as clear roles and responsibilities. It requires the involvement, attention and commitment of institutions at different levels as well as the general public and coastal communities who are the communities at risk. The following sections will discuss the four elements step by step.

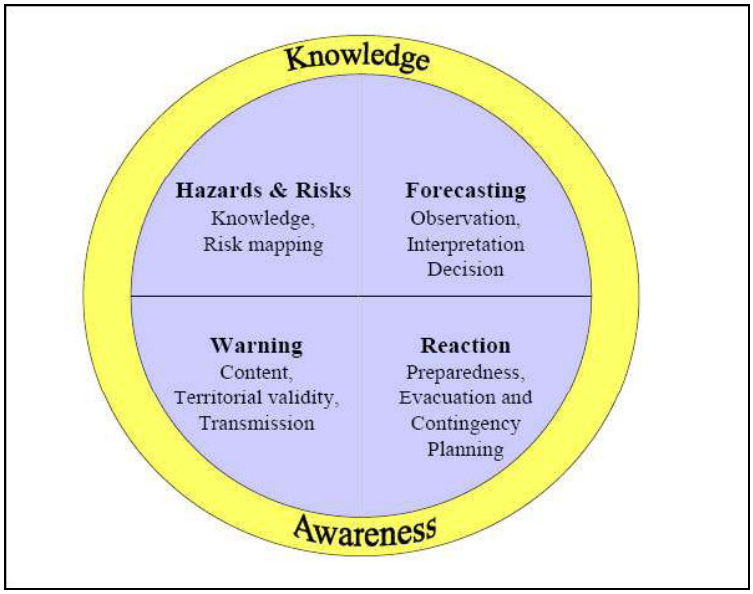


Figure 12: Elements of an Early Warning System

A. Understanding Hazards and Risks

In many regions of the world natural disasters threaten communities in many different ways. Indonesia too is a country with many natural hazards, e.g. floods, volcanic eruptions, earthquakes, and tsunamis. Depending on where people live in Indonesia, they might be exposed to one or more of these hazards, but they are able to prevent them from having grave consequences for their lives. Knowledge and understanding about a natural disaster, how it is caused, its characteristics and how it can harm humans and their assets is the first important step to protect oneself. For example, knowing about ground shaking at the coast as the first natural warning sign of a local tsunami helps to respond, i.e. move away from the beach and not get hit by the tsunami. People who don't have this knowledge are less capable of protecting themselves sufficiently against the impacts of a tsunami. Scientists say that these people are more vulnerable to the tsunami threat than those who know what to do. Understanding how a tsunami is generated and what it can do when it reaches the coast is therefore very important and can help to save lives.

If we talk about tsunami **risk** we have to consider the two components: the **hazard,** meaning the natural threat and its potential physical impact, and **vulnerability**, in simple terms, the level of inability of communities and individuals to protect

themselves from the impact. The simple equation for risk looks as follows:

Hazard x Vulnerability = Risk

The assessment of tsunami risk requires systematic collection and analysis of data. The first step for local communities is to identify whether they are located in a tsunami prone area. If this is the case communities have to understand the tsunami **hazard** along their coastline and the **vulnerability** of their community to this hazard. As a result of an assessment tsunami risk maps can be produced. These maps can help to motivate communities to link themselves to the tsunami early warning system and get prepared. Also, these maps are the basis for evacuation planning and evacuation mapping. In case risk maps are not available, hazard maps can be used to plan evacuation during a tsunami event since hazard maps are the basis for the identification of hazard zones and safe zones.

Local authorities will have to define whom to involve in risk assessments. Since hazard assessment requires a lot of expertise, local communities should seek advice from experienced institutions; for Indonesia amongst others: LIPI (*Lembaga Ilmu Pengetahuan Indonesia*) and DKP (*Dinas Kelautan dan Perikanan*). Special attention in risk assessments has to be given to participatory approaches involving the local population, especially for vulnerability assessments.

B. Forecasting: Data Monitoring and Warning Service

The Indonesian Tsunami Early Warning System relies on earthquake monitoring and ocean observation. It is the responsibility of the National Meteorological and Geophysical Agency (*Badan Meteorologi dan Geofisika*, BMG) to monitor and analyze seismic and oceanic data as well as to disseminate earthquake information and tsunami warnings to the general public, local authorities and institutions. BMG monitoring and warning services operate 24 hours a day since earthquakes and tsunamis can happen at any time of the day or night.

After an earthquake the National Warning Centre of BMG in Jakarta compares incoming seismic data (from seismographs all over the country and also from other countries) with a tsunami simulation data base in order to assess the possibility of a tsunami, the expected wave height and potentially affected areas. Based on this information **BMG** decides whether a potential tsunami threat exists, and if yes, a first **warning** is generated by BMG and disseminated. BMG uses three levels of advisory and/ or warning:

- "Advisory" (Waspada) → expected wave height of tsunami < 0.5 m
- "Warning" (Peringatan) → expected wave height of tsunami 0.5-3 m
- "Major Warning" (Awas) → expected wave height of tsunami > 3 m

In addition to the warning levels BMG will provide information on the area along the coast that will potentially be affected.

Besides seismographs, INA-TEWS installs ocean observation technology: GPS units on land and buoys on the ocean's surface to detect vertical movement and tsunami waves. Additionally, tide gauges, instruments that can measure changes in sea level, are installed at the coast. These instruments allow INA-TEWS to observe whether a tsunami has been triggered by the earthquake. In case these instruments in the ocean detect a tsunami BMG issues another warning message confirming an imminent tsunami threat: this means a tsunami is definitely on the way. If no tsunami

is detected, BMG sends out a message that cancels the previous tsunami warning of a potential tsunami. In case a tsunami has hit the coast, BMG will send out an All Clear message after all waves have arrived, the tsunami event ended and the danger is over. Figure 13 below provides an overview of INA-TEWS:

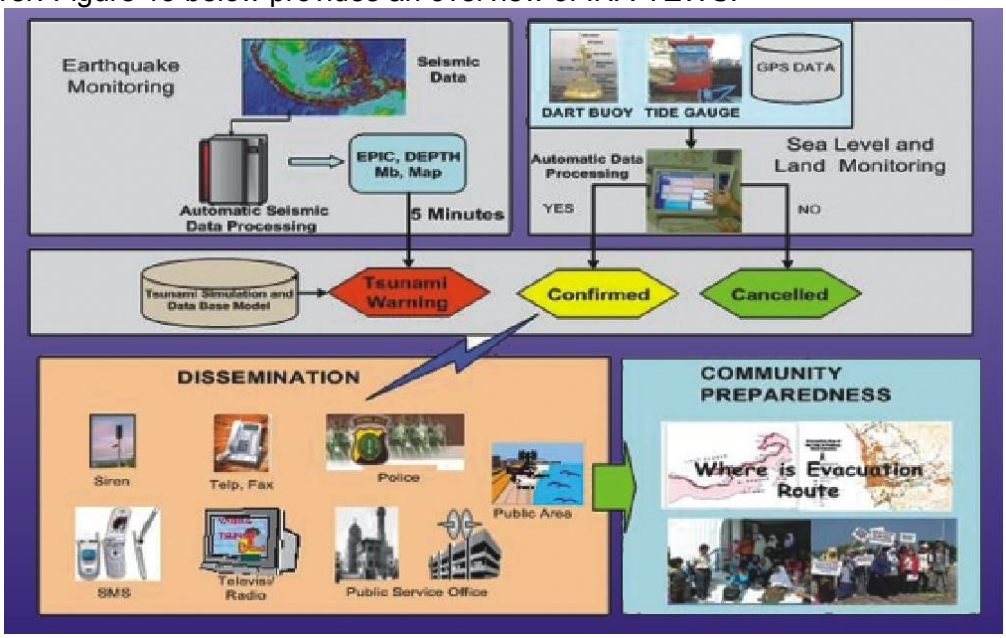


Figure 13: Design of the Indonesian Tsunami Early Warning System (INA-TEWS)

C. Warning Dissemination: From BMG to People at Risk

The major objective of an early warning system is to bring the warning to people at risk as quickly and direct as possible. For this purpose BMG sends out tsunami warnings to the general public, local authorities and institutions. The general public can receive tsunami and earthquake messages from national media, such as TV and radio. BMG sends the warning to the media stations (TV and radio) and they screen the information during their programs. The BMG Warning Centre in Jakarta also uses SMS, RANET (a satellite based dissemination tool) and FM RDS (a radio based dissemination tool) to send out information and warnings to local authorities. The use of multiple communication channels is necessary to make sure that the information reaches as many people as possible. In case one channel fails other channels can still convey the warning.

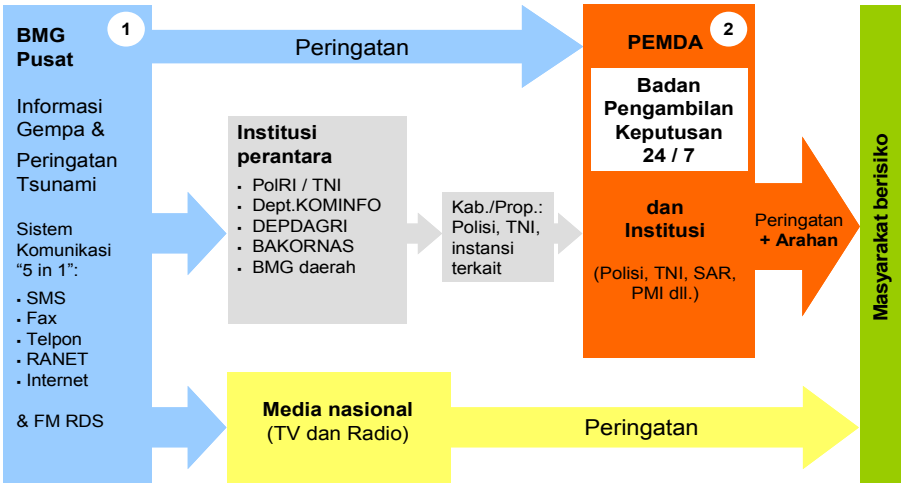


Figure 14: Roles and responsibilities in INA-TEWS

BMG is the institution that monitors and analysis earthquake and ocean data. Therefore it is the only institution that can send out tsunami warnings in Indonesia. However, as figure 14 shows, BMG is not only the only institution involved in the warning system. Local governments play a very important role.

It is the role and responsibility of local authorities to receive information and warnings from BMG Jakarta and to give guidance to the communities in their area on how to react to the warning. This means that local authorities have to decide whether coastal communities should evacuate or not. If a decision for evacuation has been taken local authorities have to disseminate evacuation guidance to their communities in order to make sure that people at risk respond appropriately to the tsunami threat. The guidance from local authorities must be simple, clear and easy to understand so that communities can respond to it appropriately and save their lives. Also, the communities at risk need to know long before a tsunami what messages they can expect and what these messages mean.

BMG only provides the warning while local government authorities provide guidance to the people on how to react to the warning, i.e. whether to evacuate or not. Evacuation means here, moving out of the hazard area – away from the beach and to higher ground – BEFORE the tsunami strikes. In order to allow people to move to a safer place and save their lives they have to receive the warning and evacuation guidance as quick as possible. A local tsunami does not give us a lot of time because it can reach the coast within less than half an hour after the earthquake – sometimes only 20 minutes afterwards. It is essential that we react as quickly as possible on the information that we can get before it strikes.

The Problem of Uncertainty when dealing with Tsunamis

As we have learned, earthquakes cannot be predicted. Since earthquakes are the main cause of tsunamis, consequently tsunamis can also not be predicted. And to make it even more difficult, an earthquake that

1. is submarine, i.e. located under the sea,
2. has a magnitude of more than 6.5 SR, and
3. a depth of less than 70 km,

might not actually cause the devastating tsunami waves. A fourth criteria has to be fulfilled which is that the earthquake caused vertical displacement of the sea floor. So far, however, scientists are not able to tell immediately after an earthquake – and just by looking at the earthquake data – whether it caused a vertical or horizontal movement of the sea floor.

This means that when dealing with tsunamis we deal with a high level of uncertainty whether a tsunami has actually been triggered or not by an earthquake. And secondly, it means that the first (very quick) tsunami warning (from BMG) that is based entirely on earthquake data can only warn of the possibility that there will be a tsunami or, in other words the potential for a tsunami. In the moment this first warning is sent it is not yet clear whether a tsunami will actually come.

Having said that, it is most important to understand that the moment of ground shaking gives us the first important opportunity to react, i.e. to move away from the beach and to higher ground. Though the first warning from BMG does not provide 100% certainty whether a tsunami will come or not it is probably the last chance to react in case a tsunami becomes reality and hits the coast. Waiting for a confirmation message means not using precious time for reaction and might cost many lives – including your own. Waiting for the sea to withdraw and watching the fish jump around on dry ground almost certainly has serious consequences for you and the people around you.

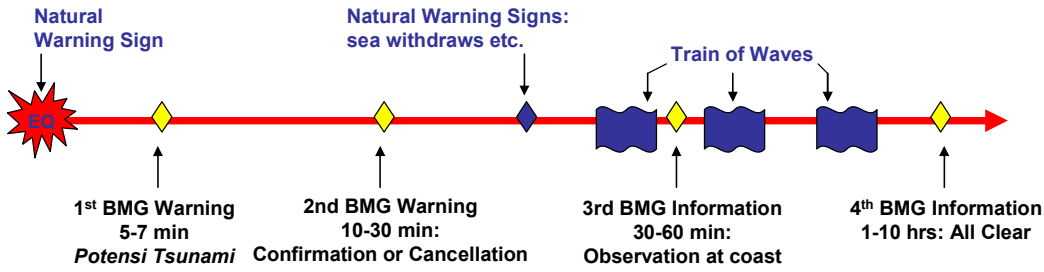


Figure 15: Approximate time line of a tsunami event and incoming information from ground shaking until all clear message displaying available information from nature and INA-TEWS before, during and after the event (GTZ IS-GITEWS); note: the time in minutes is just an estimation based on other tsunami events, actual time can vary largely.

D. Reacting to Warning

An early warning system can only help to save people's lives if the people in a disaster prone area understand the hazard and the warning system. It is essential that the local population knows and respects the warning messages and knows how to react. Upon reception of warning and guidance they need to take appropriate and timely action. This requires a clear understanding of the natural warning signs as well as the content of warning and guidance messages which they will receive in case there is a potential for a tsunami.

Education and preparedness programs play a key role. It is also essential that disaster preparedness, management and especially evacuation plans are in place. These plans have to be in place long before a tsunami strikes and they should be well practiced and tested. Disaster Preparedness Plans describe activities and measures taken in advance – before the disaster strikes – to ensure an effective response in the moment a tsunami threat exists and the waves are on the way. This includes timely and effective early warning and evacuation. The communities should be well informed on standards for safe behavior, available escape routes and safe areas.

All the above tasks are the responsibility of local authorities. Schools can be found in every community. They play an important role in helping communities to raise awareness and get prepared for the tsunami threat.

Actors of the Indonesian Tsunami Early Warning System

There are many national institutions involved in INA-TEWS. The Ministry for Research and Technology (RISTEK) is appointed as coordinator and focal point for human resource development. Eight other institutions that act as focal points for INA-TEWS are:

- BMG is the focal point for earthquake monitoring and warning dissemination
- BPPT is in charge of oceanographic monitoring
- Bakosurtanal is appointed to deal with coastal deformation and geospatial data
- LIPI is mainly responsible for preparedness and awareness in local communities
- The Ministry of Home Affairs serves as the focal point for public education
- The Ministry of Communication and Information is in charge of developing and handling Communication Technology and Information

ANNEX: SUMMARY

- Tsunamis are sea waves caused by submarine earthquakes, volcanic eruptions, submarine landslide or the fall of a meteor into the sea. Submarine earthquakes are the major cause of tsunamis. As experts have learned from experience, a submarine earthquake can cause a tsunami if the earthquake has a magnitude of more than 6.5 SR, the location of the earthquake is less than 70 km deep, and the movement of the plates is vertical. When they reach the coast, tsunamis are very dangerous and can destroy cities and villages and kill many people.

- A tsunami is not only one wave but it consists of a series of waves. This means that a tsunami disaster can last for several hours until all the waves have arrived and the situation returns safe. On the open ocean a tsunami is invisible and as fast as an airplane. Only when it reaches the shallow coast it slows down and builds up to a very big wave that hits the coast at a speed that is still much faster than a person can run.

- Many coastlines in Indonesia are prone to tsunami disasters. The type of tsunami that threatens Indonesian coasts is mainly the local tsunami. Local tsunamis are tsunamis that hit the coast shortly after they have been triggered. The time between earthquake occurrence and tsunami arrival at the coast is often less than 30 minutes.

- The first natural warning sign of a local tsunami (if felt) is strong ground shaking caused by an earthquake. The next natural warning sign is a sudden withdrawal of the sea water that exposes the sea floor close to the coast. Other common signs are a strong unusual smell of salt or fish and a strong wind from the sea.

- Indonesia has a tsunami early warning system – internationally known as Indonesian Tsunami Early Warning System or INA-TEWS. An early warning system is a system that provides timely and effective information, through identified institutions, which allows communities and individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response. This means that people can get a warning of a tsunami and move away from the dangerous area close to the sea and to higher ground BEFORE the tsunami comes.

  - ➲ **Local Tsunamis reach the coast very quickly–sometimes within less than 30 minutes. It is essential to react directly and immediately to any sign or warning of an approaching tsunami, even if you cannot be 100% certain that it will actually arrive!**

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The main resource for tsunami information on Indonesia is the Jakarta Tsunami Information Centre to be visited at www.jtic.org

MODULE 3
EVACUATION PLANNING PROCESS FOR SCHOOL

TRAINING GUIDELINE
EVACUATION PLANNING PROCESS FOR SCHOOL
Time: 120 minutes
Trainer: DAPS Consultant

Introduction

Different to the other previous series of tsunami modules, namely module 1 and 2, this module 3 is only intended for the teachers and the school management as basic knowledge of evacuation planning process. This module contains an explanation on what to do an who is responsible for each step in the evacuation planning process at school. This module consists of 5 planning steps necessarily to be known by the school community. The steps in the evacuation planning process are sequentially related to one another, where the first step will result in an output that will be used as an input for the second step, and the second step will result in an output which will be used in the next step, and so on.

Competency

To understand an evacuation planning process for tsunami at school and to make a school evacuation plan.

Indicator

Upon the completion of the training, participants are expected to be able to:

- identify inputs needed in the evacuation planning process
- identify / obtain access to any supporting documents for evacuation planning issued by the local Government
- identify important factors in the tsunami evacuation planning
- identify safe environment from the potential tsunami hazard
- identify vulnerability groups within the school environment
- identify critical infrastructure in the vicinity of the school
- identify evacuation routes from the school to the safe areas
- determine a field coordinator in the evacuation process
- develop an evacuation procedure at the school level
- identify supporting tools for evacuation
- explain the importance of socialization plan
- explain the importance of evacuation drill
- develop school evacuation plan

Tools and Materials

- A local tsunami hazard map or, if not available, an example from other areas
- A local tsunami evacuation map or, if not available, an example from other areas
- Module 3, evacuation planning process
- LCD projector
- Markers, flip chart , push pin and other writing materials
- ZOPP cards
- Video Player, of Laptop with Infocus
- Video of Indonesia tsunami drills or Srilanka

Steps of Training

1. When available and possible, the meeting is started with playing a video about tsunami evacuation simulation which shows actions taken by a community to save life from tsunami (use Indonesia Tsunami drill or Srilanka).

2. The Trainer and the Participants discuss about what they have just observed from the film, and identify important factors from the tsunami evacuation simulation. The results from the identification exercise will be used as a start to enter into the main activity of learning about evacuation planning process.

3. Ask participants, what came up their mind when they hear 'evacuation planning process'. Collect and write keywords in zopp paper.

4. Present Figure 1 to participant. Introduce them to the evacuation planning process using the steps presented. Mark the keyword from them which match with the stages.

5. Discuss each step detailed and thoroughly each steps and have participant fill out with their context.

6. Consolidate the understanding of the Participants by reviewing all of the steps and any important considerations in the tsunami evacuation planning process. It is necessary to inform the Participants that the success of the evacuation process will be determined by different factors. The working team at school needs to coordinate with the district implementing unit for disaster management (Satlak) or the regional disaster management body (*Badan Penanggulangan Bencana Daerah*/BPBD) to ensure the success of the evacuation plan.

7. Ask the group to develop working team and working plan to make school evacuation plan.

READING MATERIAL
EVACUATION PLANNING PROCESS

Information Background

Conducting an activity of evacuation drill to anticipate potential tsunami hazard has an objective to increase community preparedness in anticipating the hazard which potentially to become disaster. Evacuation from tsunami requires proper planning. Proper planning will hopefully allow a smooth and effective evacuation. This module will discuss tsunami evacuation planning process. There are 5 steps to prepare in the tsunami evacuation planning process. The first step should produce outputs which can be used as the basic inputs to continue to the second step, and so forth. The steps to be prepared in the evacuation planning process are explained sequentially in this module. Steps to be taken on evacuation planning process is presented in sequence throughout the module. For a comprehensive overview, please find below diagram shows steps to be taken on evacuation planning process.

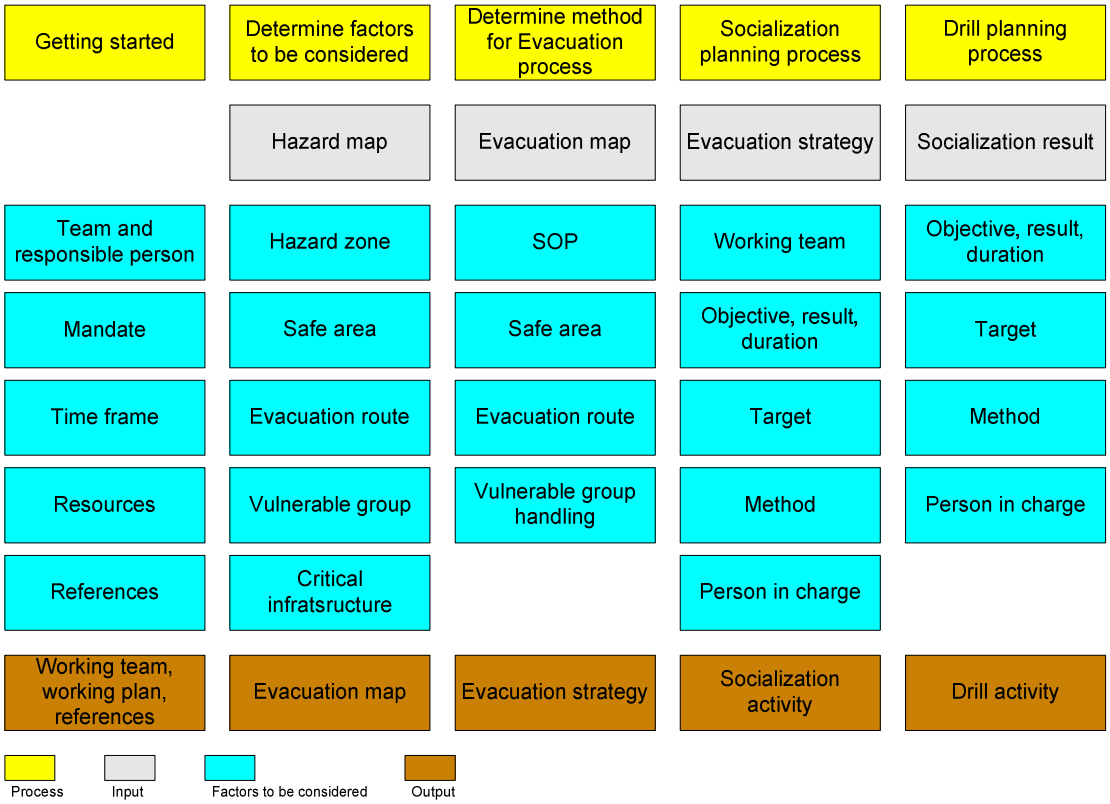

Figure 1. Steps to be taken on evacuation planning process

The yellow boxes consist of steps to be taken, while the blue boxes are factors to be considered in each of the steps. As it shows from the figure, there are 5 steps to be taken. An in depth description can be obtained throughout this module.

There are several inputs needed to prepare a work plan: who is responsible for the production of an evacuation plan, authority (mandate) given to the school, how long (time frame) needed to prepare an evacuation plan, resources, and references required for evacuation planning. The inputs needed will be explained in details in the following sections:

- **Who is Responsible**
  In the evacuation planning, the responsible person for preparing work plan should be clear. School as institution, is responsible on the safety of their community, and includes students, teachers, and staffs. On school level, the Headmaster is responsible to develop school evacuation plan. The headmaster can form a team, working hand in hand to develop school evacuation plan. The team can consist of teachers, parents, and staffs. Each of the team members has its own responsibility. The planning process includes responsibility sharing for each member. School team need to coordinate with the local government to make sure that school plan is in line with the local plan.

- **Authority (mandate).**
  BPBD held the mandate to make evacuation plan in district level. School needs to have a specific evacuation plan to be used by school community. The school plan needs to refer to local plan. Representative from BPBD can be invited to be one of the resource people in the planning process, if necessary. The school also needs to coordinate with other institution related in the local evacuation plan. Integration of the school plan with the local plan is mandatory.

- **Schedule (time frame).**
  The initial preparation needed is to make a schedule for the work plan. It is very important to ensure the effectiveness of the work plan. The school needs to make a schedule for the work plan which indicates when the work will be commenced and when they will be completed? Develop a work plan with a realistic time frame for the completion. It is expected that a detailed work plan will enable the targeted work to be achieved and completed in accordance with the planned time frame. In case of BPBD has activity related to evacuation plan, school can adjust their schedule to make sure that their plan is update.

- **Resources.**
  An important input to develop a work plan is to know the resources needed in the area. The district and/or the school which will develop a work plan for tsunami evacuation planning process needs to identify the resources available and needed, who will be involved, what qualifications required, the amount of fund needed, and which institutions should be involved to assist the process of developing the work plan and to ensure the implementation of the next steps. The resources consist of man power, fund, documentation, and time.

- **References.**
  References of supporting documents are needed to develop an evacuation plan. They may be in the form of risk maps, master plan, and legal framework. Such documents are needed as basic inputs to develop an evacuation plan.

    - Evacuation map for tsunami
      Local tsunami evacuation map is the basis for evacuation planning process. The map shows safe areas, risk areas, evacuation points, and evacuation route. Tsunami prone area should have a tsunami evacuation map. Nevertheless, not all area already have evacuation map. It is possible that only hazard map or vulnerability map is available in a particular area. If this is the case, the planning process should not stop. There is a principle called “rule of thumb” can be applied. “Rule of thumb” is a common sense used to save lives. On tsunami, the rule of thumb for evacuation is stay away from beach and river, and move to higher land (30 m above sea level or higher).
    - Tsunami early warning system

Tsunami early warning system is defined as provision of information timely and effectively, through identified institutions, to the community so that the individuals in the tsunami risk areas are able to take actions, to avoid or to reduce the risks and to prepare for an effective response. Tsunami early warning system is a series which consists of equipment and people who analyse natural signs and process the information to be disseminated to the decision makers. Early warning plays an important role to minimise potential loss. Early warning may appear in the form of natural signs or official warning issued by the Government. It is recommended to learn again the natural signs of tsunami and the Indonesian tsunami early warning system (INA-TEWS) in Module 2. Make sure that the school has the access to the tsunami early warning system implemented by the Government.

- Legal basis
  On national level, Law Number 24 Year 2007 on Disaster Management is legal the base on disaster management. There is also the Presindential Decree Number 8 Year 2008 on National Disaster Management Body and other legal basis. In provincial level, some has issued the Provincial Law related to disaster management. School needs to have a a copy on this legal basis as a reference.

A. Step 1: Start Planning

What needs to be done by the school?

1. To understand the evacuation plan in the district if it is already available.
2. To collect references or documents as previously mentioned above.
   School needs to have copies of the above documents. An institution or a body which has the mandate to issue such documents already exists. The institution is called Satlak or the regional body for disaster management (BPBD) at the provincial or district levels. At the national level, it is called national body for disaster management (*Badan Nasional Penanggulangan Bencana*/BNPB). To obtain the documents, one may contact the local BPBD.
3. To form a work team
   Besides what has been mentioned above, the school also needs to form a work team. The main tasks of the work team are:
   a. To study the documents
   b. To develop a work plan or a strategy for the evacuation planning process at the school level

   To optimize the work team at school, the following is recommended:
   a. After the documents needed are obtained, allocate time to study and understand the documents and the explanation inside. Make sure to know whether the school is located in the risk area or not. If there is anything unclear, contact Satlak or the local BPBD to provide a clearer explanation regarding the contents of the documents.
   b. If the district has not developed or does not have complete data required, it should not prevent the school from developing a planning, but the school can begin an evacuation planning process for the safety of all the school community. In case of emergency and there is no evacuation map, use basic evacuation procedure – move away from the coast and rivers, and find higher ground.

As stated earlier, one of the reference of evacuation planning process is a local evacuation map. What the school needs to do if the district does not have an evacuation map? Evacuation map is compulsory and preconditioned for developing

an evacuation plan. If the district does not have an evacuation map, the school should encourage and emphasize the importance for the district to have an evacuation map. On the other hand, the school should develop an evacuation map for the school environment at least to give guidance to a safe area. The plan will need to be endorsed by school management.

A tsunami evacuation map must be endeavored by the district which is located in a tsunami prone area. The map shows a region with locations for evacuation identified by the local Government. Selection of evacuation locations is based on the estimation of potential tsunami effect in the area. Using the map, we can determine safe areas to head for, and estimation of distance and time travel to the safe areas. In the evacuation plan, mark the locations where the school and agreed safe areas are.

B. Step 2: Determining Factors Needed For Consideration

The second step in the evacuation planning is to determine important factors in the evacuation planning, which is usually shown in the evacuation map. On the evacuation, it is very important to identify hazard area, safe area, and evacuation route. Basic information of the map, such as: location of the sea, river, bridge, and critical infrastructure should also shown. All component of the team needs to work together on identifying these factors. If evacuation map is available, these factors can be seen and reviewed using the map. If not, then school need to have their own.

- **Hazard Zone**

Hazard Zone is the areas identified as being at risk towards tsunami threats. Hazard zone must be abandoned when receiving tsunami early warning. In the tsunami hazard map, the high hazard zone is usually marked in red and the medium hazard zone is marked in orange. This hazard zone is at risk to experience significant damages in time of tsunami. Hazard zone is usually around the beaches with a certain distance or around the river sides. If your school or your homes is located within the hazard zone, you should have a good evacuation strategy. Check whether your school is located in the hazard zone.

- **Safe Area**

Safe areas are the locations which are referred to as the destinations for evacuation, either it is for horizontal evacuation or vertical evacuation (Evacuation Shelter Building). Such safe areas are identified as the areas which are not at risk towards tsunami threat. During the development of evacuation plan, safe zone must be identified clearly. Safe areas are not the same in each district. The features of safe areas depend on the conditions of the district: far from the beach or on a certain elevation. In general, an example of safe areas from tsunami is:

- An area with a certain distance from the beach (depending on the gradient of the beach) or >4 km from the beach.
- High ground – If the location of a high ground is too far to reach, consider to use story building with robust structure for temporary evacuation (temporary shelters)
- Reachable. It is very important to identify safe areas that can be reach within 10-20 minutes by foot.
- Wide-space area, as it is expected that plenty of people will be heading.

There are 2 type of safe area of evacuation point, namely horizontal evacuation and vertical evacuation.

- **Horizontal Evacuation**
  One of the evacuation methods is horizontal evacuation, which is to move people to safer areas horizontally or to a higher ground in order that they are prevented from tsunami inundation. Horizontal evacuation is generally carried out by moving away from beaches.

- **Vertical Evacuation**
  If the location of the school is within the coastal vicinity among dense population and buildings that unable to conduct horizontal evacuation due to limited facility and time, vertical evacuation can be opted as an alternative to save life. Special buildings to be used for vertical evacuation are evacuation shelter buildings (ESB). If shelters are not available in the area, robust story buildings can be used as an alternative for evacuation. The existence of vertical evacuation places need to be considered when developing evacuation plan.

Check whether your school is appointed to be one of the evacuation point. If school is the evacuation point, the plan should also be based on that condition.

- **Evacuation Routes**

Besides knowing safe areas from tsunami, it is important to also know evacuation route leading to safe areas when developing evacuation planning. Safe routes are the shortest paths with the lowest risk to reach to the safe areas. Study the evacuation map. If your area already has a tsunami evacuation map, it is important to know well where the safe areas are and which routes to be followed to arrive in the safe place. Take the agreed safe routes for evacuation, and follow the route as far as you can. Watch for possible panic behavior of the people or the traffic of the people when the warning is issued. Consider the travel time needed to reach the safe place. Time travel during normal condition is very different from the time of disaster event. Not all of the tsunami prone areas in Indonesia have tsunami evacuation maps. Socialize the evacuation route from school to safe areas, to school community, especially to teacher appointed to be the coordinator of mass movement during evacuation. Keep update on the information about the condition of the evacuation route to anticipate any obstacles that may occur.

- **Vulnerable Groups**

Vulnerable groups are people who need special attention and assistance during evacuation. These groups must be identified clearly in the evacuation planning. Vulnerable groups in school may consist of elderly teacher/staff, disabled student, or pregnant teacher/staff, etc. Most of student, under 12 years old, goes into vulnerable group, and therefore also need special treatment during evacuation. The group need to be informed so they can prepare and attach themself on the vulnerable group in case evacuation is conducted. Normal evacuation procedure cannot be established for these groups. Before disaster event, make sure that the school has data of the number of people belong to these groups. Discuss at school about how to assist these vulnerable groups in time of evacuation, or contact Satlak or the local BPBD at the district or province to obtain information about how to handle vulnerable groups. The school evacuation plan should consider treatment of vulnerable groups.

- **Critical Infrastructure**

Other important factors to be considered are critical infrastructure. Critical infrastructure constitutes physical building which are vital for the school and community. In school, critical infrastructure may consist of: laboratory with chemical ingredients, school electricity central, school database filing. Anticipation is needed to secure these critical infrastructure. Damage on the infrastructure will not only affect

teaching activity post disaster, but can also affect surrounding environment. Before disaster stirkes, identify the location of critical infrastructure and take secondary hazard risk for surrounding environment.

C. Step 3: Determining Strategy For Evacuation (Developing An Evacuation Plan)

The next step in the evacuation planning process is to determine evacuation strategy. Evacuation strategy is a structured plan which includes actions to be taken, what needs to be prepared when receiving tsunami early warning (TEW), where the safe areas to head for, how to get to the locations, how long it will take to reach to the safe area during evacuation, which routes to follow, and who is assigned to give command to the school community when an evacuation is decided, who will guide the movement of the school community. Using the risk, hazard and evacuation maps and/or information from the district as previously explained in Step 1 and Step 2, the school can develop an evacuation strategy. As most (but not all) tsunami was preceded by earthquake, the evacuation strategy should also include earthquake evacuation strategy.
The school can develop an evacuation strategy using the risk, hazard and evacuation maps and any available information. What the school needs to do to develop an evacuation strategy?

1. Understanding early warning and decision making
Tsunami early warning may occur in 2 type, namely natural warning and early warning from BMG or local government. Refer to module 2 to have deeper understanding on tsunami early warning. Another important factor after receiving early warning is decision making. Headmaster as the responsible person in evacuation planning process, is also the decision maker. Before disaster strikes, a decision making flowchart is needed. A back up plan is also needed, in case of headmaster is not in place.

2. To Determine Safe Locations to Head For
Based on the risk map, decide the safe locations to head for during evacuation. In accordance with the location condition of the school community, the direction to the safe areas may be horizontal or vertical. It means that they can do horizontal or vertical evacuation. Horizontal evacuation is to evacuate to safe areas away from the beach, and is carried out by referring to the agreed evacuation routes. While vertical evacuation is to save life by going up to higher and strong buildings or constructions (buildings with two or more stories/floors). Vertical evacuation is opted if the school is located away from the safe areas or the safe areas cannot be reached within an estimated time. Make sure before conducting an actual vertical evacuation that the buildings are strong enough and have the capacity to accommodate an estimated number of people. Safe areas should also fulfill main criteria: reachable and wide-space. Calculate the time requires reaching the area and how many people can fit in the place.

Decide and mark, for example in green, the safe locations in the evacuation map. In the actual locations on the ground, safe areas can be marked with the signs of safe areas for evacuation.

3. To Decide on Evacuation Routes
One part in the evacuation strategy that needs to be prepared is to decide safe routes for evacuation. Decide and mark the safe routes in the evacuation map. For example, mark with green line, follow the safe routes that have been agreed upon or

recommended for evacuation by the local Government. The evacuation routes should be planned and decided in advance. In the field or in the actual locations, the evacuation routes usually are equipped with evacuation signs, in order to facilitate the movement of the people to the safe areas. It is recommended to use wide road as it should be able to accommodate hundreds (or thousands) people. Evacuation route should also take into account location of bridges that may fall apart due to major earthquake. Evacuation sign need to be placed in intersection to avoid confusion.

4. To Deal with Vulnerable Groups

If vulnerable groups are identified at the school, make an action plan to provide assistance to the vulnerable groups before evacuation is carried out. Identify what facility / vehicles to be used, who will deal with these groups. All of these should be planned and made in written as a document for implementation. This document certainly can be made opened for future revision in accordance with the development of the condition at the school.

5. To Develop Procedures (SOP)

Develop a complete evacuation strategy in written. All evacuation plan details at school should be made in written so that it becomes a procedure (Standard Operating Procedure - SOP) and it can be revised any time in accordance with the latest situation development. Thus, it becomes a life document for saving the life of the school community. Procedure of tsunami evacuation constitutes a crucial element and integrated in the tsunami evacuation planning process.
The contents of SOP are:

a. Division of Tasks

Division of roles or tasks is a part of the evacuation strategy during evacuation. Determine the tasks for each of the members of the school community for evacuation. Long before disaster occurs, the names and the tasks division should be made in complete and clear. Make sure that each of the assigned persons understands their tasks.

Some of the important tasks are:

- Receiving information of tsunami early warning,
- Giving command for evacuation,
- Guiding the movement of the school community, and
- Coordination in the safe areas.

b. Details of steps to be carried out during evacuation

All of the steps to do should be planned well and carefully before a disaster happens.

- What needs to be done by a person who receives tsunami early warning,
- How the evacuation command will be issued,
- What needs to be done by a person who guides the movement of the community and what needs to be considered,
- What needs to be done in terms of coordination once the group has arrive in safe area, and what needs to be done on safe area.

D. Step 4: Making Socialization Planning For Evacuation Plan

After all the strategy or the evacuation plan is documented as a procedure, the procedure is meant to be a living document for the school community. The next step is to conduct socialization of the completed evacuation plan. The socialization activities should be planned in advance. The same as the evacuation plan,

socialization needs a strategy. How to plan socialization?

The following is the steps to plan socialization:

1. To Decide on the Work Team

Decide a work team at school to organize the socialization of the evacuation plan. The work team can be formed by involving teachers and the school management. If possible, the members of the school committee are to be involved as the members of the work team for socialization. Decide the tasks for each of the members in the team.

2. To decide on the Objectives, the Expected Results and the Time frame for the Socialization

After the work team is formed, decide the objectives of the socialization, the expected results, and the time frame for the socialization activities. The objectives of the socialization to be carried out by the local BPBD and the school is basically the same, the difference is only on the target groups for the socialization. In general the objective of the socialization at the school is to improve the preparedness of the school community towards potential tsunami hazard. The results expected from the socialization activities are that:

- The information about the school evacuation plan can commonly be understood by the school community,
- All of the evacuation components: safe zone, hazard zone, evacuation routes, evacuation signs, safe areas, actions to be taken and who leads the evacuation must be understood by the school community,
- As a preparedness measure, the school community is ready to anticipate tsunami,
- Feedbacks to the completed evacuation plan can be obtained so that improvement to the evacuation plan document can be made possible.

Decide how long the socialization activity will be implemented, and consider the achievement of the objectives and the availability of the resources.

3. To Decide on the Target group for the Socialization

Decide the target groups for the socialization of the tsunami evacuation plan in accordance with the coverage areas. The target groups of the socialization by the local BPBD are clearly different from the target groups aimed by the school. The target groups for socialization at the school are the entire school community, including the teachers, the school management, the school guards, parents and the students. It will be better if the socialization also consider involving the school committee and the community within the vicinity of the school. Parents need to be convinced not to come to the school in case tsunami happen. School will conduct their evacuation plan and bring all students to safe areas.

4. To Decide on the Method of Socialization

The socialization activities can be carried out by the school in different ways. For example, to provide information directly to the school community on a regular basis by conducting regular discussions for the teachers and the school management about evacuation plan, displaying posters showing how to evacuate from tsunami, and distributing brochures or leaflets showing how to evacuate from tsunami. Socialization at the school can use combined selected methods by considering the affectivity, the capability of the school and the availability of the resources.

5. To Decide on the Officers for Socialization

The appointed person along with the team is responsible to prepare and conduct socialization. The team may consist of teachers, school staff, or school committee.

E. Step 5: Developing Planning for Evacuation Drill

Socialization alone is not enough for the school community to take appropriate actions during evacuation process. Socialization activity still needs to be followed up with conducting evacuation drill for the school community; the drill should correspond to the strategy of the evacuation plan developed. Evacuation drill is important to be conducted for the school community in order to avoid confusion about what to do when tsunami occurs.

By conducting tsunami drill it is expected that the school community are trained to automatically take appropriate actions when tsunami strikes. Evacuation drill for the school community can be conducted together with the drill for the surrounding community, and in coordination with Satlak or the local BPBD at the district or province. The same as the Step 4, this evacuation drill should also be planned in advance, and the strategy is prepared. How to plan an evacuation drill?

The steps to prepare an evacuation drill are as follows:

1. To Decide on the Work Team
   Decide the work team who will organize the evacuation drill at school. The work team in the school should coordinate with the work team from the local BPBD to plan an evacuation drill. The work team can be formed from the teachers and the school management. When possible, the work team includes members of the school committee as the members of the work team for tsunami evacuation drill. Decide the tasks for each of the members of the work team in the evacuation drill.

2. To Decide on the Objectives, the Expected Results and the Type of the Evacuation Drill
   Decide the objectives of the evacuation drill to be conducted. In general, the objective of the drill at school is to train for an appropriate response by the school community to anticipate tsunami. Decide also the results to be achieved in the evacuation drill.

3. To Decide on the Target Participants of the Evacuation Drill
   The targets of the evacuation drill at school are all the school community, including the teachers, the school management, the school guards and the students. It will be better if the evacuation drill also considers to involve the school committee and the community around the school. Coordinate with the local BPBD.

4. To Decide on the Method for Evacuation Drill
   Coordinate with Satlak or the local BPBD. The method for evacuation drill should be carried out on the ground and directly to the safe areas. The drill should be started with an explanation, what will be done if the warning sign is heard, how to get to the safe areas, where is the safe areas to be headed for and so on; all is in accordance with the completed evacuation plan.

5. To Decide on the Officers for Evacuation Drill
   The work team at school needs to select for the Officers who will organize the evacuation drill. Coordinate with the personnel at the Satlak or the local BPBD at the district or the province at all time. Personnel for socialization at school can involve sport teachers, BP (guidance and counseling), the school management and the school committee.

Tsunami evacuation plan will not run well if it is not supported by a good preparation of the Government, the community, and the school community in the tsunami risk area. A tsunami evacuation planning process needs to be organized carefully. There are five important steps to be prepared in the evacuation planning process, where the five steps are sequentially correlated and cannot be separated.

It is important to remember that the school should always coordinate and synergies with Satlak or the local BPBD during the evacuation planning process and during the planning of evacuation drill, so that all parties are in good coordination.

Concerning with the responsibility of the evacuation planning, students should not be burdened what so ever and are not responsible for the evacuation planning process. The evacuation planning process at school becomes the responsibility of the school management and the teachers.

No need to wait. Regardless the availability of local evacuation plan, school needs a school evacuation plan. Next important step to make this whole learning process useful is by developing a working and start develop school evacuation plan. Safety of all school community relies on the school evacuation plan.

LEARNING ACTIVITIES
EVACUATION PLANNING PROCESS

Media and Materials

- Local tsunami hazard map or, if not available locally, an example of the same map from the other region
- Local tsunami evacuation map or, if not available locally, an example of the same map from the other region
- Module 3, evacuation planning process
- LCD projector
- Markers, flip charts, push pin and other writing materials
- ZOPP cards
- Video of tsunami evacuation simulation
- VCD player/Laptop

Preparation

Before starting the training, make sure that all of the maps needed are prepared for the learning / training process.

The Steps of Learning

Initial Activity

The meeting is started by playing a video of tsunami evacuation simulation which shows activities of a community saving their life by going to safe areas.
The Trainer and the Participants conduct a discussion about what they have just observed, identify any important factors necessary for consideration during the tsunami evacuation simulation process. The results of the identification are noted on the boards, without being commented either right or wrong. Then it is informed that the training session will be focused on the evacuation planning process. The Trainer inform about the competency to be achieved and the indicators.

The main Activity

- By connecting it with the previous video show, the Trainer inform about the importance of the evacuation planning process and prompt the Participants to suggest the steps to be taken in the evacuation planning process and also the sequence of the steps.
- Participants are asked to write what came up in their mind when they hear ‘evacuation plan’. Write the keyword in the paper. Present figure 1 to the participant and match some keyword appears earlier with words in the figure.
- Give participant information on what is evacuation plan and what the importance of the plan.

❖ **Step 1. To Start Planning**

- Together, identify who needs to be part of the team to develop evacuation plan, and develop timeframe of the activity and resources needed.
- Identify references and who/how to access to the documents

❖ **Step 2. To Decide on the Factors for Consideration**

- Explain what is the meaning of each factors. And afterward, mark hazard areas, safe areas, and evacuation point in the map.
- Identify vulnerable groups and the number of the groups in the school.

- Identify critical infrastructure and its location in the map

❖ **Step 3. To Decide on a method for Evacuation (to develop evacuation plan)**
- Discuss within the group on how to conduct the evacuation. Visualize the plan into the SOP.
- Decide which safe area to head for, considering time to reach, and what route needs to be taken.
- Discuss how to handle vulnerable group. Identify support/help available and how to access.
- Write the result on a paper

❖ **Step 4. To Develop a Socialization Planning for Evacuation Plan**
- Develop the plan to conduct socialization. Emphasize the need to socialize the plan within the school community.
- Form the team to prepare socialization. Appoint person in charge.

❖ **Step 5. To Develop a Planning for Evacuation Drill**
- Discuss how the plan should be tested to know whether it is working or not. Lead the discussion on the importance of having drill to test the plan.
- Prepare the drill by defining the method and the target.
- Develop the team and appoint person in charge (use the same team for socialization is an option)
- Write the whole plan and have all participant sign the document as agreement.

Together with the Participants, the Trainer concludes all the important points resulted from the series of discussions conducted and remind the Participants that the responsibility for the development of the planning process lies with the teachers and the school management. Students are not burdened at all with the planning process.

Consolidation Activity

In order to consolidate the understanding of the Participants, at the end of the training conduct a review to all steps and important considerations in the tsunami evacuation planning process. Raise some questions by referring to the indicators to consolidate the understanding of the Participants. It is necessary to remind the Participants that the school should always coordinate and synergies with Satlak or the local BPBD in the evacuation planning process and the evacuation drill planning, so that each party are in good coordination.
Right after the learning session ended, trainer helps the participant to form a working team and create a working plan to develop a school evacuation plan.

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MODULE 4
HOW TO SURVIVE DURING A TSUNAMI

TRAINING GUIDELINE
HOW TO SURVIVE DURING A TSUNAMI
Duration: 120 Minutes
Trainer: DAPS Consultant

Competence

Upon the completion of the training, trainers are expected to be able to:
1. understand what actions to take long before tsunami strikes
2. understand what actions right before tsunami strikes
3. what actions to take when tsunami strikes
4. what actions to take after tsunami strikes

Indicator

Upon the completion of the training, trainers are expected to be able to:
1. identify the necessary actions during the preparedness stages
2. identify the necessary knowledge and behavior to have before the tsunami
3. identify responses to tsunami warning
4. identify the right actions upon arrival at safe areas
5. identify the right actions after the disaster

Tools and Materials

- Video on tsunami
- Simulation video
- Plastic transparencies and modules
- Over head projector
- Government early warning scheme
- Evacuation map

Steps of training

1. The trainer begins with a video on simulation (use the CD on documentation of national drills from Ristek)
2. The trainer discusses the content of the video and the relationship between a tsunami occurrence with the simulation by placing the emphasis on the importance of self evacuation
3. The trainer opens up the discussion on what preparedness measures to take to reduce damages and losses resulted by tsunami
4. The trainer presents the early warning system developed by the government
5. Participants discuss about dissemination of early warning to community and how to react to warning
6. Carry out simulation of self evacuation
7. Discuss what actions to take upon arrival at the safe areas
8. Discuss what actions to take after the disaster

READING MATERIAL
HOW TO SURVIVE DURING A TSUNAMI

The tsunami that hit Aceh in 2004 has opened our eyes that Indonesia is very prone to disaster. Most Indonesian coastal areas are prone to tsunami. Community and school community should have the knowledge on preparedness and responses as well as the necessary actions to take.

Figure 1. Link between Preparedness and Response

The following presents five significant issues related to preparedness capacity.

1. Knowledge about risk
   To have the knowledge whether one lives in a tsunami prone area is a good start. This information can be obtained from the local disaster management body (BPBD). When one comes to a new area, it is a good to be well informed about the area and read or seek further information related to tsunami.

2. Establishing safe behavior.
   Safe behavior aims at saving lives. When disaster strikes, lives are the most important. “Saving lives” become the most fundamental principle. Safe behaviour in the context of tsunami can refer to how people respond to tsunami waves, rivers, roads, and how people respond when they are trapped in a tsunami.

3. Learning, understanding, and respect warning (natural warning, and official warning services).
   Community can respond timely and effectively to disaster if they understand and respect warning services. Respect to warning is obtained by understanding tsunami risk. People’s perception of tsunami risk and warning services need to be explored. Therefore, the local government needs to show their respect towards warning services and guidance, including by appointing a reliable and authorized institution to develop and disseminate warning and guidance, eliminating misleading warnings, communicating the progress of early warning

systems, and providing information on the difference between warning and evacuation order.

4. Knowledge on how to respond to tsunami
   Knowledge on how to respond to tsunami is very significant. The following section of this module will further elaborate on how to respond appropriately.

5. Education or socialization to the general public.
   Preparedness is a group effort. Information about risk, warning, and respond will need to be implemented in a wider scale of community. Therefore an education or socialization is needed. Information should flow smoothly especially among people in risk areas. Continuous sozialization ensure people remembers information necessary to be used to save themselves. Socialization can also be used as forum to share and exchange knowledge.

Unlike earthquake which totally unpredictable, tsunami bears some signs that we can use to trigger evacuation effort. The signs has been widely known as natural sign and official warning services. These signs is the key factor on saving lives. A long term effort preparedness are aimed to prepare community on understanding the signs and doing proper reaction.

To prevent death casualties or injuries in school environment when tsunami strikes, teachers should have the knowledge on appropriate responses within the school environment. Appropriate knowledge on tsunami responses can protect schools from tsunami that can happen any time. In addition, such knowledge can be useful for students when saving for their lives around their house or when they visit the coastal areas.

A. Preparing Yourself for Tsunami

These actions that should taken before, during and after tsunami are aimed at assisting participants to understand how to be prepared for tsunami and how to respond rapidly, appropriately and safely during the tsunami as well as how to take actions after tsunami is over.

By definition, disaster preparedness is a series of activities aimed at preventing or minimizing death casualties or losses resulted from extreme natural phenomenon which allow institutions and communities to take timely and appropriate actions. Based on the actor, preparedness activity can be classified in 2 type: (1) activities taken by the government or institution, and (2) activities taken by individual.

The following steps should be taken by the government or institution in disaster preparedness measures:

1. Develop **legal framework** and specify government assistance for disaster preparedness
2. Develop the mechanisms for **appointment and coordination of government officials**, which clearly defined roles and responsibilities as well as job allocation and communication structures.
3. Establish or **build disaster preparedness capacity at the local and national level** and the rescue team (especially human, financial, logistic and communication resources)
4. Develop a participatory **evacuation and emergency plan**
5. **Infrastructure and logistic measures**: ensuring appropriate accommodation in emergency condition, securing communication lines, stockpiling food and

medical supplies, and developing evacuation routes.

6. **Training and capacity building**: training on evacuation, recovery, rescue, emergency medical treatment, emergency accommodation arrangement.
7. **Enhance capacity or rapid assessment** of basic need for assistance and data on loss and damages to ensure rapid and systematic relief delivery.
8. **Develop appropriate early warning system for local communities:** ensuring that communities in disaster prone areas receive, understand and react to warnings.

The above steps cannot be implemented in isolation by one institution only. Every institution has their own responsibilities in line with their mandates in disaster preparedness. School community can carry out step 3 and 4. The other steps can be carried out in integrated manner with other authorized institutions. Tsunami module 3 discusses about evacuation and emergency plan. Module 4 focuses on tsunami preparedness and response.

Learning from the painfull experience of tsunami, preparedness is a necessity. As tsunami and earthquake are linked in most of the case, earthquake preparedness need to be develop inline with tsunami preparedness. Some efforts can be done in terms of individual preparedness are as follows:

- Collect relevant documents from BPBD on self-evacuation during tsunami. See module 3 to identify necessary documents.
- Hold family meeting and discuss why tsunami preparedness is necessary. Discuss about earthquake and tsunami. Learn the procedures for self-evacuation during earthquake. Carry out *drop cover and hold* procedure by protecting the body from possibility of the collapse of buildings and other items around us by ducking under a table or other safe areas within the house. Discuss about evacuation routes available in your area.
- Always have a "*Tas Siaga"* (Emergency Bag or "preparedness bag") ready containing personal needs for three days, radio (with replaceable batteries), water, first aid items, torch light, canned/dry food, medicines, important documents, sufficient money and clothing, gloves, bath kit, and other tools necessary in case of an evacuation (such as scissors, knife, can opener). Check the bag on regular basis. Replace the supplies when necessary. Put the bag in an easily accessed place.

Figure 2. Emergency Bag (Tsunami Poster GTZ IS)

- Organize training and update your evacuation plan every six months. Also check the emergency bag, replace any supplies when necessary such as food and medicine which have passed their expiry dates.
- Learn about early warning system and ensure you have access to the early warning issued by the government
- Participate in preparedness training activities and self-evacuation simulation organized by the government
- When in new area, explore the environment. Is it close to the shore? Is it nearby a river? Are there any tsunami warning signs? Are there any evacuation signs? Are there any early warning equipment installed?

The National Meteorological and Geophysical Agency (*Badan Meteorologi dan Geofisika* /BMG) plays a key role in tsunami early warning system. The information from BMG will be sent out to the Decision Maker Body 24/7 (operational 24 hours a day, seven days a week), interface institutions at national and local level and the national media. Community will obtain warning information from the local government and national media. See Module 2 for detailed explanation about INA- TEWS.

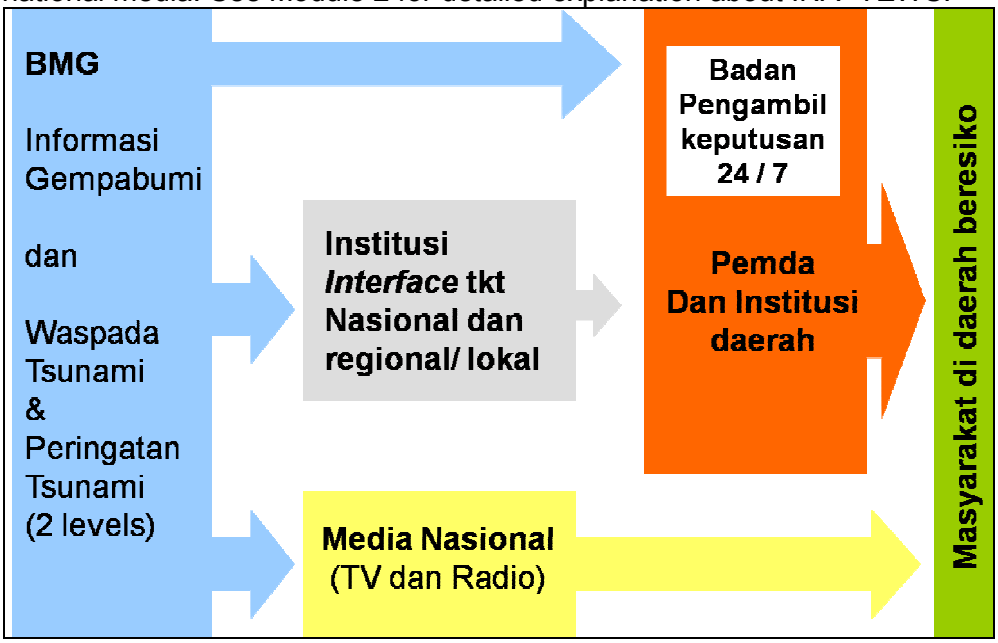

Figure 3. Tsunami Early Warning Information Dissemination Mechanism

Local capacity is key for saving lives. Preparedness at this stage aims at strengthening the capacity of the community to respond to tsunami through better education about tsunami risk, community's involvement, and disaster preparedness.

B. Understand and React to Early Warning

Communities can receive tsunami warnings from 2 sources. First they can get them from natural warning signs that can be observed before a tsunami strikes. The second source of tsunami warnings is the government. The government issues tsunami warnings through a number of communication means. People have to ensure that they have access to the early warning system developed by the government.

1. Natural warning signs

Ground shaking or earthquake is one warning sign of a tsunami. In addition, there are other natural warning signs that can be observe (see module 2 and the module

on earthquake). However, it is important to note that tsunami event may not necessarily be preceded by ground shaking. Earthquake occurrence cannot become the only reliable indicator of a tsunami.

2. Warning from the government

As Indonesia is prone mainly to local tsunami, it needs a tsunami early warning system that can reach community in a short time. At the national level, BMG has developed an early warning scheme that can disseminate information on earthquake and tsunami within 5-10 minutes after the occurrence. Five minutes after an earthquake, BMG will disseminate data and information on the earthquake and whether a potential tsunami threat exists. The information will be issued to the provincial and district government. It is the responsibility of the district government to issue the information on whether community should evacuate or not. After the information on the earthquake occurrence is disseminated, subsequent information will be sent out containing the result of observation of whether a tsunami has been generated or not. An "All Clear" message will be issued within 1-10 hours. The following shows the early warning scheme that is currently in place in Indonesia. The blue box shows the scheme currently operational, while red box shows future scheme of early warning.

Figure 4. Early Warning Scheme

The government sends tsunami warnings through sirens, loudspeakers, text messages, telephone, radio or television broadcast. These warnings should be adhered to.

When receiving or observing tsunami warning, one should inform people around them. If an earthquake is felt, they need to save their lives first from the earthquake. After the shaking subsides, they should move away to higher ground or stay as farthest away as possible from the beach when higher ground around the beach cannot be found. An evacuation should follow afterwards because tsunami can happen in a very short time that there is only limited time for evacuation. Never approach the beach to watch the tsunami. Tsunami waves can travel at 30 km/hour

on land, which is much faster than a trained athlete can run.

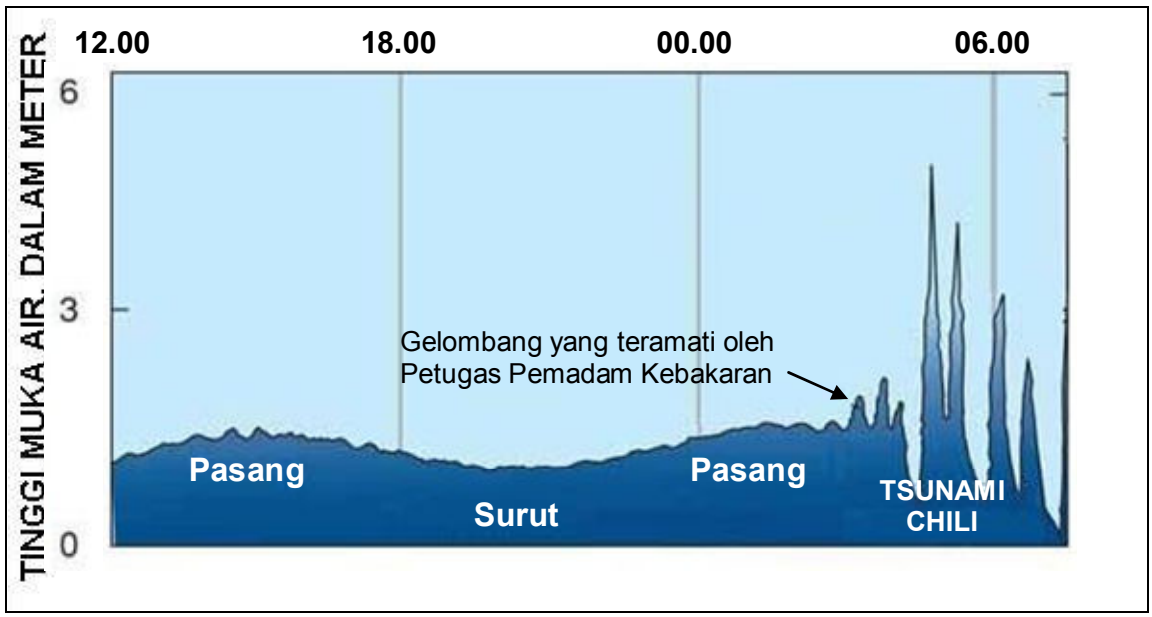

Figure 5. Tsunami height at Onagawa Port (Atwater, *et al*, 1999)

Another thing that is very important to remember is that a **tsunami is not A single wave**. Tsunami wave can occurs in series of wave. In most cases, the first wave is not the highest one. Therefore it is necessary to stay in the safe aras until there is official information that tsunami has over. Figure 5 and 6 show the height of the tsunami wave generated by the earthquake in Chile in 1960 that struck Japan and Hawaii.

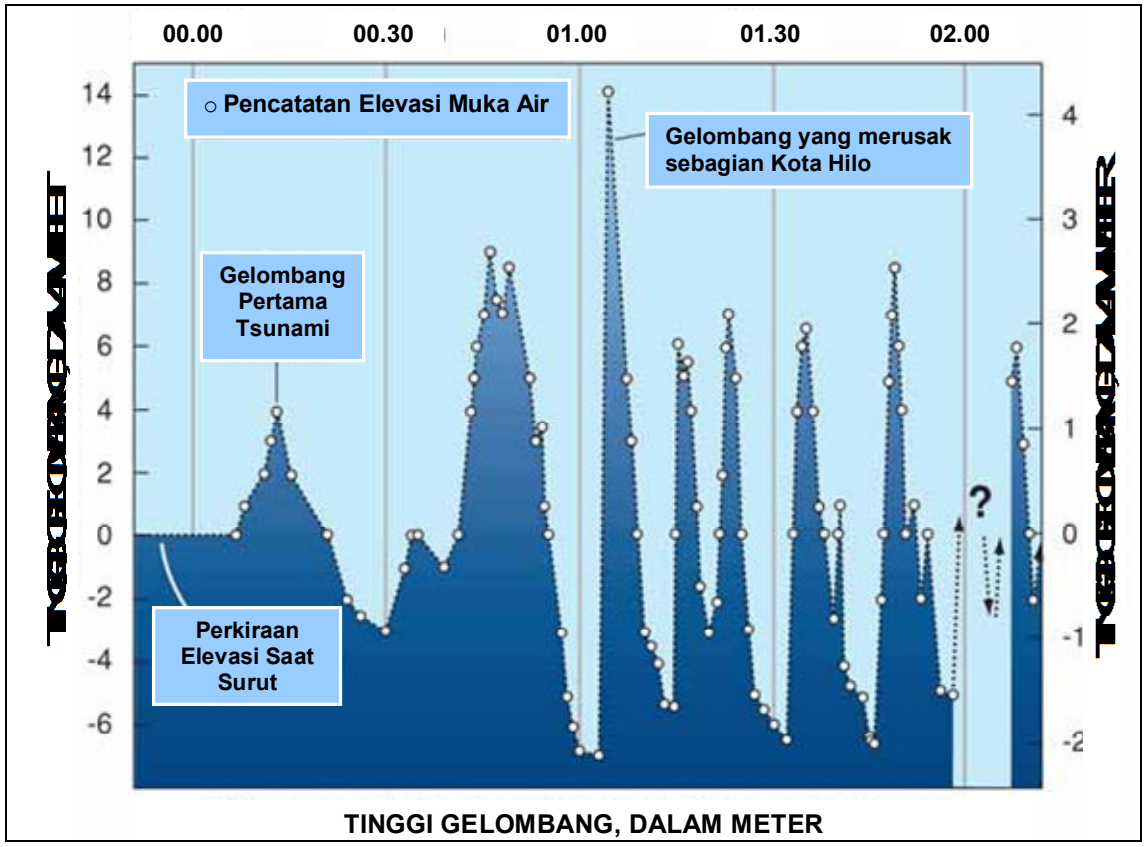

Figure 6. Wave height in Hawaii (Atwater, *et. Al*., 1999)

If earthquake occurs, duck cover hold is the first attemp. After the tremor stop, goes out from the building/house/school. If natural tsunami warning occurs or official warning has been issued, take only basic belonging and do the following, depending on the location:

1. At school
   Gathered in the meeting point in school and follow the direction from the appointed school member. Go to the designated evacuation area in the group.

2. Outside of the school
   a. At home
      Take only very important document and belonging, and headed to designated evacuation area. Lock the house before leaving. If any member of family is in the school, no need to attemp to go to school to collect them. School will conduct their evacuation plan. Family member should go right away to evacuation place.

   b. At the beach
      When an earthquake is felt at the beach (especially followed by the sudden withdrawal of the sea), move away from the beach to higher ground immediately. DO NOT wait for warning or announcement of the coming tsunami. Stay away from the river, lake, delta, drainage or river that runs directly to the sea. Do not panic, but stay alert. When possible, do not use motor vehicles. Experiences in Japan and Hawaii as well as Jogja, show that evacuation using motor vehicles can lead to traffic congestion and incidence.

      Wait for information from the media or radio before going back to the beach. Wait until the authority (e.g. BMG) issues the information that it is now save to go to the lower grounds.

      As most of the coastal areas are located near the ring of fire, local tsunami is a possibility. Therefore, it is very necessary to immediately move away from beaches or rivers in case a strong earthquake is felt. Check evacuation sign or board if any, to decide which route to be taken. Or find multi story building for vertical evacuation.

   c. At sea/on the boat
      When tsunami warning is issued when someone is at sea or aboard a boat, they should stay at sea and not take their boat to the coast. It is safer to stay at the sea. Ensure that the tsunami is over and it is safe before going back to the beach/port.

   d. In a multi-storey building
      The roof top of a multi-storey building can be used as an evacuation point when it is not possible to move to higher ground to respond to tsunami warning. However, people should stay alert and find floating items to hold on if the building cannot resist the tsunami waves.

A tsunami evacuation plan should be developed by referring to the evacuation plan developed by the local government and school. It is important, therefore, to understand the content of an evacuation plan.

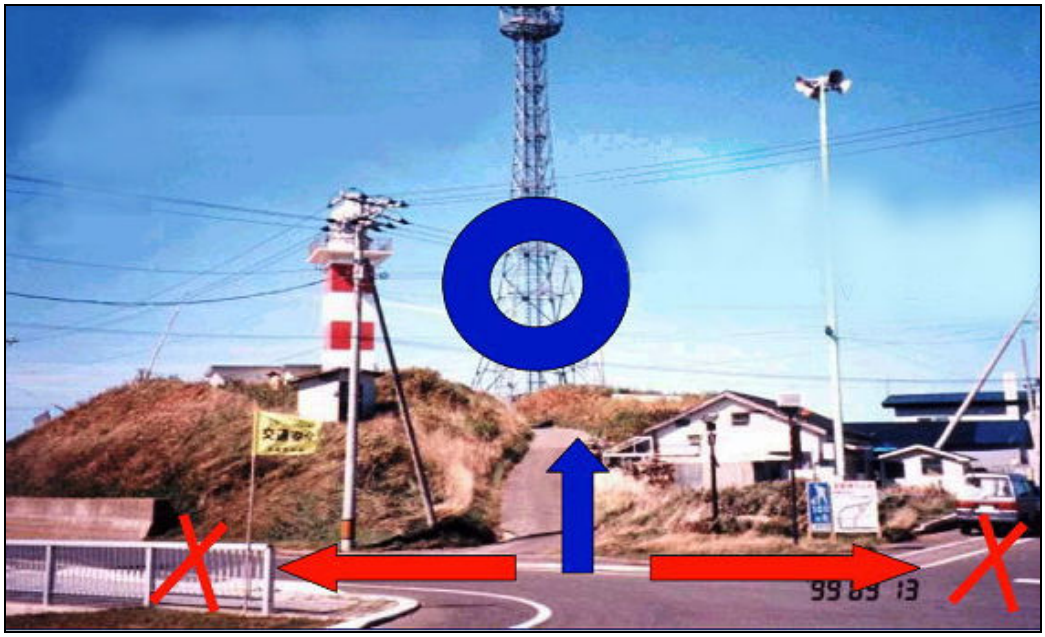

Figure 7. Evacuation routes (o right, x wrong) (Diposaptono, 2005)

During evacuation, prioritize the weak and those who need assistance such as children under five, the elderly, the sick or disabled because they have limited mobility. Always pays attention to the evacuation sign or map available in the area. Figure 8 give example of evacuation map of an area.

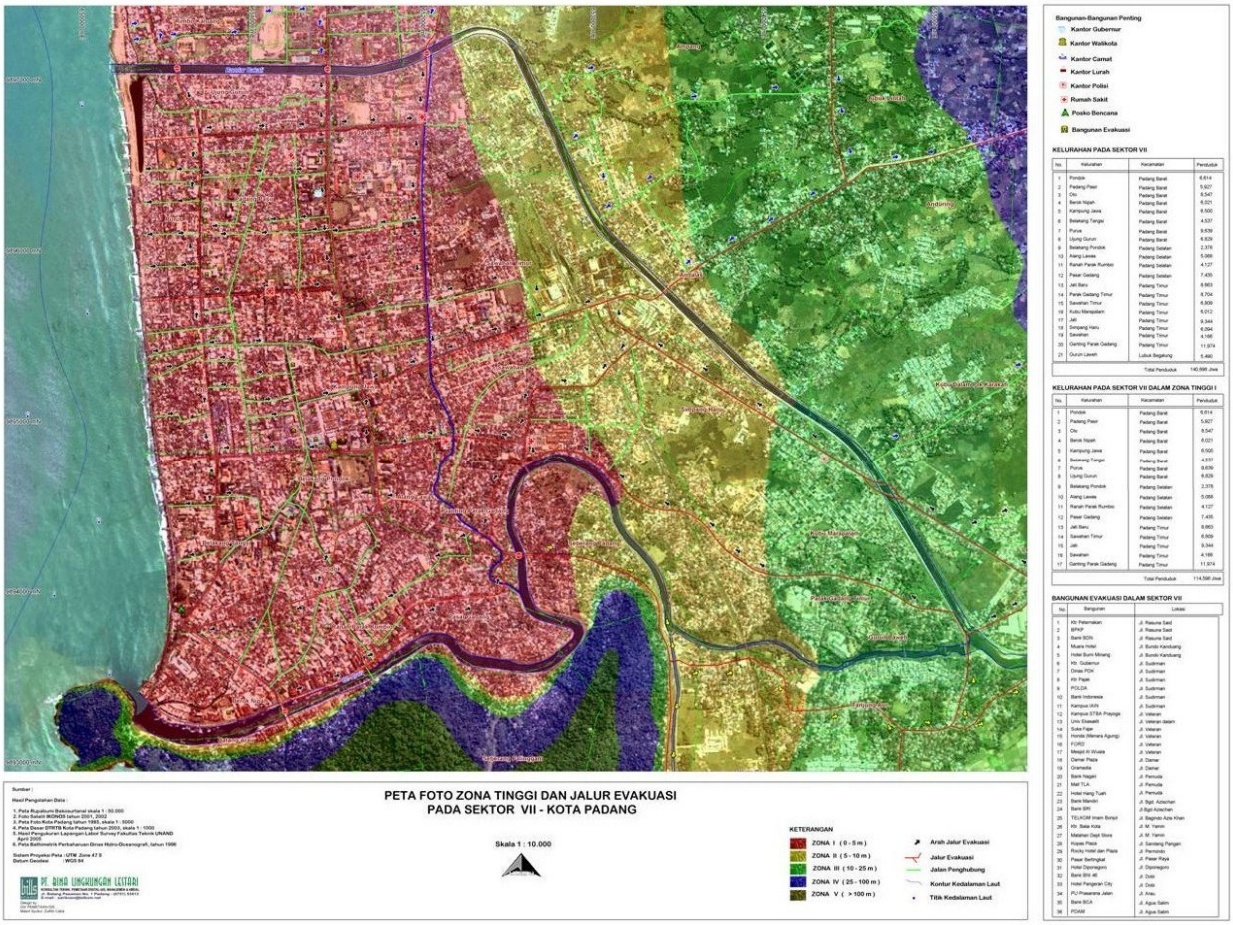

Figure 8. Example of map of tsunami risk map for Kota Padang Sector VII (Kogami/UNESCO, 2005)

Follow the guidance for evacuation available from local government, if any. Be alert of the tsunami prone areas. The following figure gives an example of evacuation sign.

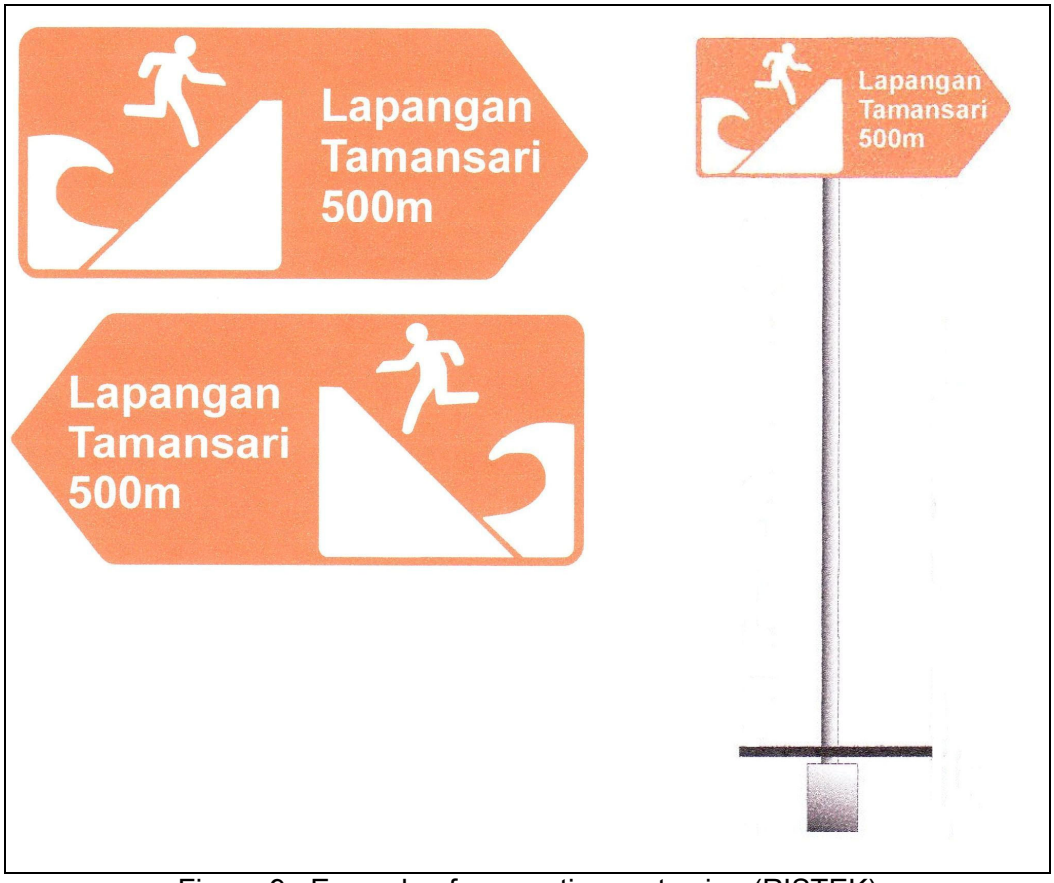

Figure 9. Example of evacuation route sign (RISTEK)

Example of evacuation buildings is given in Figure 11. These buildings are actually school buildings, museums or other public buildings which will be used as the shelter or evacuation places during tsunami.

Figure 10. Tsunami Disaster Management and Research Center Building, Syiah Kuala University, NAD (TDRMC Unsyiah, 2008)

The buildings consist of two stories with cavities underneath to allow water to pass.

The stairs to the second level are wide enough to give spaces for evacuees to reach the top of the building. If the local government does not have such buildings to be assigned for evacuation, existing buildings (offices, hotels) can be used for evacuation.

If you are trapped in a tsunami, find and climb a tall and strong tree. If the wave drifts you, find anything that you can use as a raft

C. Actions to Take in Safe Areas

Find a first aid attendant right away if you find anyone needing treatment. If you have first aid skill, enlist yourself to be a volunteer to help the affected people.

- if you are not injured, join with the rescue team and follow their instruction on the rescue effort
- Use telephone when in emergency only. The use of telephone lines may increase in times of disaster so it should be used for emergency only.
- Listen to the radio or further announcement. Wait until there is announcement by the authority that it is now safe to go to the lower ground. Tsunami can damage roads, bridges or other places, making them unsafe.
- Give your data to registration official. The data will make it easier to find evacuees. When separated from the family, report to the official in charge.

D. Actions To Take After The Tsunami

- Keep away from a building if there is water around. Leftover water from a tsunami can erode the strength of a building foundation and make it collapse, break the floors or make the wall collapse.
- Use cautions when entering an empty building. Water intruding the building during a tsunami can damage the building in unexpected places. Watch every step.
- Use a proper covering for the foot or a good pair of boots. Scratch wounds often occur in the aftermath a disaster.
- Beware of wild animals, such as snake. Use a stick to check for inundation. Water carried by the tsunami waves push them out of their lairs.
- Use flashlight to check a building. It is safer and easier to use because it does not cause fire.
- Check the buildings, walls, floors, doors, stairs, and windows to make sure if a building is not damaged or is about to collapse. A crack or damage in the base means that the building is no longer safe to live in.
- Be alert of fires resulted from broken gas pipes, oil spill, electricity wires or electronic devices. Flammable materials may be carried by water during a tsunami. Fires frequently happen after a tsunami.
- Check for a leak in gas pipes. If you smell gas or hear a hissing voice, open the windows wide and leave the building immediately. Turn off gas valves or switches.
- Check for damaged electrical wires. If you see a spark or open/damaged wires, or smell burnings, shut off the main panels. Call for a knowledgeable person when you have to pass an inundation of water to shut off the panels. Electronic devices should be dried and checked before in use again.
- Check for water taps and water sewage. If you see any damages, avoid using the toilets.
- Be alert of the ceilings, walls, or decorations that may fall.

LEARNING ACTIVITY
HOW TO SURVIVE DURING A TSUNAMI

Tools and Materials

- Video on tsunami event
- Video on simulation
- Laptop
- In focus/ Projector
- Government early warning scheme
- Evacuation plan
- Example of an emergency bag

Preparation

Prepare a video on tsunami event and simulation. The video will become the reference in the main activity. An early warning scheme is presented when discussing early warning system.

Steps of Learning

Initial activity

The learning starts with presentation of video on tsunami event and simulation, followed by a brief discussion of 5 minutes on what the participants have observed of the video presentations. The discussion is led to the different responses people show to tsunami in the video on tsunami (lack of preparedness) and in the simulation video (preparedness). The trainer explains briefly that simulation is a practice of community preparedness that ultimately aims at minimizing death casualties when tsunami strikes.

Main Activity

Activity 1: **Tsunami Preparedness**

- Discuss result of evacuation plan in module 3
- Mention 5 significant issues related to response capacity, namely (1) understanding of risk, (2) establishing save behavior, (3) respect and learning of warning services, (4) knowledge on how to respond, and (5) enhanced public awareness and education. Trainer gives space for questions. Add more information if discussion goes into more details in the next section.
  Repeat briefly the characteristics of tsunami in Indonesia, which is commonly preceded by an earthquake. Use brainstorm method to repeat what response to be taken in case of an earthquake.
- Brainstorm to give more ideas on what actions to take to establish tsunami preparedness. Ask participants to ask questions on efforts in enhancing preparedness. Give opportunity to other participants to give comments or to ask other participants before the trainer gives feedback to participant's input or ideas and give any ideas that have not been mentioned by the participants.
- Show an example of an emergency bag and open question and answer session on why the items in the bag are necessary
- Discuss about the content of emergency bag for students

Activity 2 : Actions to Take upon Receiving Tsunami Early Warning

- Ask questions to the participants on what are the natural warning signs of tsunami

(available in module 2). Give opportunity to other participants to respond. Trainer does not give any comments whether the answers are right or wrong.
- Continue by explaining that there are two types of tsunami early warnings. The one previously discussed refers to natural warning signs. Continue with early warning from the government
- Explain that tsunami is not necessarily preceded by an earthquake. A tsunami can also be caused by an earthquake that is not felt
- Display the timeline of government early warning system
- Open a question and answer session on responses to tsunami early warning signs. Complement the answers with relevant supporting illustration, such as Figure 1 and 2.
- Group the answers into 2 big categories, at school and outside of the school

Activity 3 : Tsunami Self Evacuation
- Display figure on self-evacuation routes, evacuation routes, example of tsunami prone area map to open the discussion
- Mention the main principle of evacuation, namely to stay away from the beach and river and move to higher ground
- Elaborate further on tsunami self evacuation
- Write down participants' answers on meta cards and post the correct ones on the board

Activity 4 : Actions to Take Upon Arriving at Safe Areas
- Start the discussions by introducing that the focused action upon arriving at safe areas is to give first aid and seek information
- Emphasize that first aid for the injured can only be carried out by the assigned attendants.
- Elaborate the actions to take in safe areas

Activity 5 : Actions to Take after the Tsunami
- Ask if there is anyone among the participants who have experienced tsunami. Give opportunity to those who have experience to tell other participants what happened after a tsunami
- Complete the list of actions to take after the tsunami by introducing the first 3 actions. Give opportunity to the participants to add. Give remarks to every action listed.

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Komunitas Siaga Tsunami, http://kogami.multiply.com

MODULE 5
FIRST AID PROCEDURES AND EQUIPMENT

TRAINING GUIDELINE
MODULE 5
FIRST AID PROCEDURES AND EQUIPMENT
Duration: 4 hours
Trainer: DAPS Consultant

Competencies

On completion of this training, participants are expected to:
1. understand/realise the importance of first aid procedures, be familiar with injuries and conditions that could be fatal and with evacuation procedures, and know what equipment to prepare in advance and how to administer first aid to casualties.
2. be able to put into practice first aid and evacuation procedures.
3. be able to present this module to students.

Indicators

On completion of this training, participants are able to:
1. explain the principles of first aid
2. describe potentially fatal conditions
3. describe first aid procedures
4. describe evacuation procedures
5. know what equipment to prepare in advance
6. simulate first aid techniques
7. present this module to training participants.

Equipment and Materials

- First aid kit
- Handout

Procedure

The training involves following the steps contained in this module with the participants taking the role of the pupils and the tutor the role of teacher. These steps are as follows:
1. explain the aim of this module
2. explain the theory of first aid procedures, including the aims, components, criteria and equipment.
3. explain the theory of potentially fatal conditions, including types of conditions, their causes, signs, first aid principles and first aid techniques.
4. model, with the help of the participants, first aid techniques for common scenarios in times of natural disasters
5. ask the participants to practice in pairs or groups
6. explain the theory of evacuation procedures, including definition, aim, criteria and equipment
7. model, with the help of the participants, evacuation procedures
8. ask the participants to practice in pairs or groups
9. model, with the help of the participants, techniques for treating casualties
10. ask participants to practice the techniques for treating casualties
11. divide the participants into groups to identify essential first aid equipment.

READING MATERIAL
FIRST AID PROCEDURES AND EQUIPMENT

Competencies

On completion of this training, the participants are expected to:
1. understand/realize the importance of first aid procedures, be familiar with potentially fatal injuries and conditions, evacuation procedures, and essential equipment in the first aid kit, and know how to administer first aid to casualties.
2. be able to put into practice first aid and evacuation procedures.
3. be able to present this module to students.

Indicators

On completion of this training, participants are able to:
1. explain the principles of first aid
2. describe potentially fatal conditions
3. describe first aid procedures
4. describe evacuation procedures
5. know what equipment to prepare in advance
6. simulate first aid techniques
7. present this module to training participants.

A. introduction

When a disaster occurs, there will always be casualties, because an event cannot be called a disaster unless there are casualties, be they people, property, the social order, infrastructure, or the environment. In some cases, many are casualties not of the disaster itself, but of misguided first aid. So, we need to know more about the principles, procedures and skills for treating causalities of disasters.

In the immediate aftermath of a disaster, when everything is still panic and chaos, you need to stay calm and keep a cool head, especially in the event of an unexpected disaster. If you are in the midst of an ongoing disaster and have survived, you should lend a hand to help any casualties, and inform others of the situation so that assistance and coordination can be requested.

Given that there are casualties who need help, we need to look at the principles and procedures of first aid in more detail. The first aid you administer to casualties will have an enormous effect on their subsequent condition. Appropriate and immediate first aid will go a long way to ensuring that victims survive.

B. The Principles Of First Aid

1. The aims of first aid

The aims of first aid are to:

- **Prevent the casualty's condition from deteriorating**

In many cases, fatalities result from casualties not receiving help quickly enough or because there is no one available who is able to administer first aid. Example: If a casualty has a wound that is bleeding, even just a little, the bleeding should be stopped properly as quickly as possible to prevent the person losing too much blood, for example by using sterile gauze. Using cloth that is not sterile will lead to infection that will exacerbate the person's condition.

- **Minimize the number of casualties**

In a disaster situation, the number of casualties is huge. First aid helps to minimize the number of casualties and prevent their condition from deteriorating. It is also important to ensure that in administering first aid, the helper does not become a casualty him or herself simply for want of recognizing his own capacity and skills. Example: To help a person who is drowning in a river, the helper must be able to swim and understand the situation in the river in order to prevent the helper from drowning too, which would only add to the number of casualties.

- **Facilitate further treatment**

First aid is a temporary measure and further treatment will need to be given by a competent professional or institution, such as a midwife, health worker, doctor, health centre, or hospital. Therefore, first aid must be administered in a way that will not interfere with further treatment. Example: A casualty with burns is given first aid that consists of rubbing soy sauce or toothpaste on the burn. Upon arrival at the hospital, before the wound can be treated, the health worker will have to clean the soy sauce or toothpaste from the wound, which, of course, takes time.

- **Minimize the casualty's distress**

The aim is that administering first aid will minimize the casualty's physical pain and psychological distress, such as panic.
Examples:
~ Treating casualties kindly by, for example, reassuring them that help is on the way, and that their injuries are not serious.
~ Covering burns with new, unfurled banana leaves.

2. The components of first aid

The components of first aid are:

- **The casualty**
  The key component in first aid is the casualty, or the person who is hurt, injured or wounded and needs help.
- **The helper**
  The helper is a person who is in a better condition than the casualty, and who is willing and able to administer first aid.
- **The injury/wound**
  The injury/wound is the condition that is causing the casualty physical or psychological distress. You need to be familiar with types of injury/wound, principles for treating them, and how to administer first aid..
- **First aid equipment**
  First aid equipment is the equipment that can be use to help administer first aid. First aid equipment may include standard equipment and alternative items available close to hand that can be used instead. First aid equipment is used to cover, bind, restrain, pull, lift, and move when administering first aid.

3. Criteria for helpers

A helper who is going to administer first aid must meet these criteria:

- Be willing to help
- Be sincere and impartial
- Have knowledge of first aid principles and procedures, and the skills to treat casualties.
- Be dexterous
- Be familiar with the local conditions
- Know how and when to ask for help

- Be able to provide and use first aid equipment

4. Priority casualties

Under the emergency conditions following a disaster, there are usually far more casualties than there are helpers, so helper will need to decide which casualties to treat first. These are some guidelines for setting a priority scale:

- Pick out casualties who are most able to be helped given the environmental condition and the casualty's condition, and who the helper is most able to assist.
- Priorities causalities needing minor treatment, so they can then assist the helpers.
- Pay particular attention to casualties who are very frightened or panicking, so they don't get in the way of helpers.
- If people are buried or covered by something and have to be searched for, help those found first.
- If you encounter a dead body, try to put it from your mind for the time being; use your time to look for survivors.
- If a casualty is still mobile, involve him or her as much as possible, for example by sending him or her to get help.
- If a casualty has more than one type of wound/injury, treat them in this order:
    1). Breathing difficulties,
    2). Bleeding,
    3). Loss of consciousness,
    4). Broken bones

C. Identifying Potentially Fatal Conditions

All wounds are potentially fatal and must be treated as soon as possible. But the four most potentially fatal are:

- Arterial bleeding
- Breathing difficulties
- Heart attack
- Shock

Before discussing arterial bleeding, we need to look first at wounds in general.

General information about bleeding

a. Bleeding wounds

Bleeding wounds can be sustained during a flood as a result of being gouged by building materials or other objects, struck by falling buildings, cut by sharp objects and so on. Remember that bleeding wounds are very serious and must treated as quickly as possible, for these reasons:

- A 20% loss of blood can cause unconsciousness and if help is not administered, may cause death. To calculate how the maximum tolerable volume of blood loss, assume a normal volume of 70-100 ml per kilogram body weight. For example, Amir weighs 20kg, so his minimum volume of blood is 70 ml x 20 = 1,400 ml, or 1.4 litres. So, Amir could lose consciousness (go into shock) if he loses 20% x 1.4 litres, or 280 ml or 0.28 litres of blood.

- Where blood flowing out from a wound, the wound becomes a window for viruses or bacteria (germs) to enter the body, so the wound must be covered up to prevent infection.

There are two kinds of bleeding :

1). Internal bleeding

Internal bleeding occurs when there is a wound inside the body, but the blood cannot flow out of the body. The parts of the body most commonly affected by internal bleeding are the chest, abdomen, and brain.

Keep the patient calm, ask him to rest or lie down, elevate the legs, cover the patient with a blanket to prevent excessive heat loss, don't give food/drinks, get the patient to a health centre or hospital as quickly as possible, because treatment can only be given by a competent professional.

Signs of internal bleeding

a). Signs of internal bleeding in the abdomen are discomfort, tightness in the stomach wall, stiffness in the muscles of the stomach wall, swelling of the abdomen.

b). Signs of internal bleeding in the chest are difficulty breathing, coughing up blood/foaming red at the mouth, bloody faces or urine.

c). Signs of internal bleeding in the brain are loss of consciousness, perhaps resulting in paralysis or death.

d). Other signs - other associated signs are paleness/headache, tiredness, nausea, cold sweaty skin, an erratic, weak pulse, and rapid, shallow breathing.

2). External bleeding

External bleeding occurs when the patient's skin is cut or scratched and blood exits the body through this cut or graze.

Signs of external bleeding:

a). The skin is scratched or cut.
b). Blood is flowing out from a cut in the skin.
c). Pain and discomfort.
d). If too much blood is lost, the patient may feel dizzy.

b. Principles of first aid for bleeding wounds

Although the body has the ability to stop the flow of blood itself, first aid must nevertheless be administered to bleeding wounds. The first principle is to stop the bleeding, which can be done by:

a. applying pressure to the wound
b. bandaging the wound
c. applying pressure and bandaging the wound
d. applying pressure to pressure points in the body, such as on the side of the neck and on the inside of the elbow.

Even when the bleeding has stopped, the wound must be kept covered to prevent bacteria/germs entering the body through the open wound.

c. Treating bleeding wounds

Bleeding wounds are usually treated by bandaging. When bandaging, the following points should be taken into account:

1). The position of the wound

The site of the wound determines how it should be treated, and, if the person is conscious, it very important that they try to remain as still as possible, in a seated or standing position (head uppermost)

2). The anatomy of the human body

When treating a wound, the anatomy of the body should be taken into account, because this will determine how the wound should be bandaged. The parts of the body can be divided into three basic types:

a). cylindrical parts, such as arm, lower leg, upper leg, neck and trunk.
b). spherical parts, such as the head.
c). bending parts, such as joints, elbows, and knees.

3). The size of the wound (area and amount of bleeding)

The size of the wound determines the treatment, although the principles are the same: cover the wound and stop the bleeding. However, there are many ways to stop bleeding, depending on the size of the wound. There are four ways to stop bleeding: apply pressure, bandaging, bandaging with pressure, and applying a tourniquet.

To stop bleeding, make sure the bandage is tight enough to stop the bleeding, but not so tight as to prevent the flow of blood to the area round the wound. Ask the casualty whether the bandage feels to loose or too tight. If the casualty is unable to respond, tighten the bandage so that a pulse can still be felt in the area above the bandage.

1. Haemorrhaging

The previous section looked at the causes and types of bleeding wounds. In this section, we will focus on haemorrhaging. Wounds can be divided into three types, according to where the bleeding is coming from:

a. Arterial bleeding

Arterial bleeding comes from an external wound resulting from a cut or blow that tears or damages an artery. Signs of arterial bleeding include:

1). Blood sprays out
2). Blood spurts out with each beat of the heart
3). The blood is bright red in colour.

b. Venous bleeding

Venous bleeding comes from a wound resulting from damage to a vein. Signs of venous bleeding include:

1). Blood flows/drips/oozes out
2). The blood is dark red in colour
3). Blood does not spurt out with each beat of the heart

c. Capillary bleeding

Capillary bleeding comes from a wound resulting from a scratch to a capillary. The most obvious signs of capillary bleeding include:

1). A stinging/smarting feeling
2). Only spots of red are visible, perhaps with some blood oozing out
3). The blood is bright red in colour.

It is important to remember that however little the bleeding, it must be stopped immediately, otherwise it could be fatal. Also, wounds must be covered quickly, because an open wound is a window for germs to enter the body.

2. Breathing difficulties

There are three cause of breathing difficulties:

- a blockage in the airway

- a malfunctioning in the respiratory system
- an external cause interfering with the respiratory system or function (allergy).

More simply, there are two main causes of breathing difficulties: a blockage in the airway or a blockage in the lungs.

Medically speaking, there are two kinds of blockages:
- partial blockage, where the blockage is in the airway
- total blockage, where the blockage occurs as a result of malfunctioning or damage to the lungs.

Signs that someone is having difficulty breathing include:
- bulging eyes
- difficulty breathing, gasping
- difficulty speaking
- frequent uncontrolled/ abnormal movements

Breathing difficulties must be treated immediately because one of eh main function of breathing is to transport oxygen from the lungs to the heart where it will be pumped in the blood to all parts of the body. This is what keeps the organs functioning and keeps a person alive.

In theory, a person must breathe continually; if breathing stops for two minutes or more, the consequences could be fatal. However, in many places there are people who have the ability to hold their breath for more than five minutes; these include divers, people who live at a high elevation, singers, and Koran readers (qori' / qoriah). This is because the capacity of their lungs is larger, and also because they are accustomed to doing or have been trained to do this.

3. Heart failure

The causes of heart failure usually have to do with the person's emotional and physical condition, including:
- the person's age
- hypertension
- body weigh
- smoking and drinking habits
- high cholesterol
- under continual stress and pressure
- hardening of the blood vessels

Medically speaking, there are two causes of heart failure:
- failure of the heart function
- failure of other organs and tissues that cause the heart to malfunction

Put simply, organ/tissue failure that causes the heart to malfunction includes:
- blockages in the large blood vessels that reduce the supply of blood/oxygen to the heart
- clots resulting from thrombosis that block the flow of blood/oxygen
- clots resulting from a fractured bone

Failure of the heart function, in simple terms, can be caused by:
- problems with the muscles of the heart, commonly called a weak heart, which mean that the heart is unable pump

- a blood clot causing a blockage in the heart valve
- enlarged heart

Signs that a person is having a heart attack
- pain in the chest not due to trauma
- pain on the left side of the chest, usually spreading up to the head and down to the tips of the fingers on the left hand
- difficulty breathing, not breathlessness

Heart failure is a very serious condition, because when the heart stops functioning, other organs will be affected because they cannot function without the supply of oxygen the heart pumps through them in the blood. A heart attack can be fatal in just 4 minutes.

4. Shock

In simple terms, shock is a medical condition resulting from inadequate tissue perfusion (absorption from arteries to cells and from cells to veins). Inadequate tissue perfusion can be fatal because interference in the supply of oxygen to the brain can cause other organs to malfunction.

Differentiated by cause, there are four types of shock:

a. Hypovolaemic shock
   Hypovolaemic shock results from an insufficiency of fluids, especially blood, in the body as a result of loss of blood from a wound or other cause. An insufficient volume of blood in the body reduces and interferes with the supply of oxygen to the brain.

b. Neurogenic shock
   Neurogenic shock results from severe pain, which makes the body automatically try to ease the pain by telling the nervous system to constrict the blood vessels. This interferes with the supply of blood to the brain.

c. Anaphylactic shock
   Anaphylactic shock is the result of an antigen, such as poison or drugs, introduced into the body, causing the release of ephrine to constrict the blood vessels, thus interfering with the supply of blood to the brain.

d. Cardiogenic shock
   Cardiogenic shock is caused by a failure of the heart to pump blood effectively to other parts of the body, including the brain, thus interfering with the supply of blood to the brain.

The signs for these 4 types of shock are basically the same, and begin with loss of consciousness.

D. First Aid Techniques

1. First aid for arterial bleeding

a. Principles

As for treatment of any kind of wound, the principles when treating arterial bleeding are to stop the bleeding as quickly as possible and cover the wound.

The bleeding can be stopped by applying pressure to pulse points, or by applying direct pressure to the wound.

The wound should be covered with a sterile dressing to prevent infection; if possible, the wound should be cleaned first, at least with clean water.

When treating bleeding wounds, always pay attention to the tightness of the bandage. It should be tight enough to stop the bleeding, but not so tight as to cause damage to tissue below the wound.

b. Equipment

Simple first aid equipment can be used to stop bleeding and to clean and cover wounds. This is normally a triangular bandage or other sterile dressing. It is very important that the dressing sterile, which means clean, and either washed or ironed.

c. Procedure

The technique for treating arterial bleeding is basically the same as the treatment for other types of bleeding wounds:

- clean the wound
- stop the bleeding by applying pressure, bandaging, or applying pressure and bandaging.
- bandage as appropriate for the size and position of the wound
- remember that in terms of anatomy, the human body is divided into three types: cylindrical, spherical and jointed
- cover the wound with a triangular bandage or other clean dressing
- get the casualty to hospital as soon as possible, especially if the wound is large.

In special cases of arterial bleeding, such as in the case of a severed limb (arm or leg), the techniques include the following:

- clean the wound immediately
- place the severed limb in a plastic bag and immerse it in iced water
- wrap a tourniquet around the severed end
- covered the severed end with a clean dressing
- get the patient to hospital immediately, because the severed limb must be reattached within two hours, and under special conditions.

2. First aid for breathing difficulties

a. Principles

The main principle in the treatment of a patient with breathing difficulties is to clear the airway by identifying the cause of the problem. The patient is then given help breathing, by administering either artificial respiration or oxygen.

b. Equipment

No special equipment is needed to treat a person experiencing breathing difficulties. What you need are skills, knowledge of the patient's history, and perhaps a strong smelling substance to help get the lungs working again.

c. Procedure

Find out whether the patient is conscious, and if possible find out if the person has a history of respiratory problems or has ever experienced difficulty breathing.

1). If the patient is conscious

If the person is experiencing difficulty breathing because of a blocked airway, take action to clear the airway by checking the windpipe and trying

to clear the blockage if you can.

If you can't clear the blockage, apply pressure to the abdomen to push the object out by performing the hand Heimlich manoeuvre if the patient is an adult, or the back blow technique if the patient is a child/infant.

In the case of a total blockage, place the patient in a stable position and take the patient to hospital immediately to get medical help to remove the blockage.

2). If the patient is unconscious

In the case of an unconscious person who is suspected to be experiencing breathing difficulties, take the following steps:

- take the casualty to a safe, shady place in the fresh air
- make sure the airway is not blocked
- loosen the patient's clothing to allow air to circulate
- when the breathing is normal and a pulse is found, lay the patient on his or her side, with the face upwards
- if the patient still cannot breath, begin artificial respiration by breathing into the patient's mouth or nose to help force air into the lungs
- another way to help a person to breathe is to lay the patient on his back and lift the patient's chest or arms repeatedly. However, artificial respiration more effective because all the effort is directed at helping the lungs to resume breathing.
- when the patient starts to recover, administer smelling salts to encourage respiration
- when normal breathing is re-established, make sure there is a pulse and keep an eye on the patient.
- if possible, take the patient to hospital where oxygen can be administered to aid breathing

3. First aid for heart failure

a. Principles

Treatment of heart failure is basically aimed at getting the heart functioning normally again. The heart function affects the supply of oxygen that enters the lungs, so all efforts must be directed towards getting the heart functioning again by performing artificial respiration in the hope that if breathing resumes, the heart will start working again too.

b. Equipment

No special equipment is needed to treat heart failure, only the skill of the helper. But if an oxygen cylinder is available, administration of oxygen would be very beneficial.

c. Procedure

Treatment of a patient suffering a heart attack is as follows:

- tell the patient to stop all activity
- move the patient to a cool, airy place
- ask the patient to take long, steady breaths in and out
- if the patient is weak, lay him or her down face up and help him to breathe by raising his chest or moving his arms up and down repeatedly.
- if the patient gets weaker or breathing stops, immediately start artificial respiration while performing external heart massage in the hope of getting the lungs functioning and the heart pumping again.

4. First aid for shock

a. Principles

Shock requires medical treatment, but in principle first aid can be administered by:

- making sure the airway is not blocked
- giving the patient artificial respiration
- promoting auto transfusion in the body

b. Equipment

No equipment is needed for first aid treatment of shock. What the helper needs is to have is knowledge of the cause of shock and the skills to administer first aid.

c. Procedure

To treat shock:

- find out what caused the shock
- clear the airway
- loosen the patient's clothing
- administer oxygen, or perform artificial respiration
- lay the patient face up on his or her back, bend the knee at a 60 degree angle to promote auto transfusion or the flow of blood to the brain
- remember that shock reduces the supply of blood and oxygen to the brain.

E. Evacuation Techniques

1. What is evacuation?

Evacuation is the removal of a casualty from one location to another where they can receive further treatment to prevent his or her condition deteriorating or to avoid other hazards, such as landslide or fire.

2. The purpose of evacuation

The purpose of evacuation is to protect people from environmental conditions could cause further disaster, so they can obtain additional assistance as needed

3. Criteria for evacuation

For evacuation to take place, it is important that the victim is in a stable condition, for example, that breathing is normal, bleeding has been stopped, or that the casualty has regained consciousness. These criteria may be disregarded if the location of the casualty is still hazardous, for example in the case of fire.

4. Evacuation equipment

Evacuation equipment is the equipment used to move casualties to safety. The type of equipment used depends on the number of helpers and the condition of the casualty.

Two pieces of equipment commonly used in disasters are the long board and drag board, both of which function as a stretcher. Besides these two standard pieces of equipment, other simple equipment can be made using objects close to hand, such as doors, stairs, sofas, chairs, blankets, T-shirts, rice/fertiliser sacks.

5. How to evacuate casualties

A simple form of evacuation is to move the victim by lifting, with or without equipment. This is best done by 2 to 6 people. Under certain circumstances, for example in the case of heavy flooding, one person can attempt the evacuation. It is important to remember that the evacuator must be able to move the victim, otherwise he or she must seek assistance.

When evacuating a casualty, the key principles are as follows:

- save the victim from the disaster (flood, for example), not from his or her injuries
- the evacuator must be able to do the job
- the evacuator must have knowledge of the environmental condition
- the evacuator must be familiar with and able to use evacuation equipment
- the evacuator must be confident that he or she is able to help
- remember while helping to avoid further injury to the victim.

In the event of a flood, for example, first and foremost is rescuing the person, regardless of whether the person is in a stable condition. Only when safety is reached, begin treatment of the person's injuries.

F. Know What Equipment To Prepare In Advance

The equipment and materials prepared in readiness for treatment of flood victims are aimed at reducing the risks, preventing the condition of casualties from deteriorating, and administering first aid to people who are injured.

Standard equipment, such as tents, Mitella slings, masks, splints, gauze, plasters and first aid medicines must be prepared. Pupils should also be introduced to objects close to hand so they can be used as substitutes in an emergency.

In addition, equipment to reduce the flood risks that can be used in the rescue of individuals and groups is also needed.

LEARNING ACTIVITY
FIRST AID PROCEDURES AND EQUIPMENT

Equipment and Materials

- standard first aid equipment
- learning aids

Preparation

All aids (standard equipment and alternative equipment) for this module must be prepared in advance. This activity can be done inside or outside the classroom.

Learning Steps

Introduction

- The teacher starts the lesson by telling a story about three friends: a fish, the buffalo, and a monkey. One day it rained and the water in the river rose, making the fish jump for joy. But the buffalo and the monkey were worried because they thought their friend was in danger.

  Suddenly, the buffalo leapt into the water to try to save his friend, but the unfortunate buffalo drowned. Seeing this, the monkey tried to rescue his two friends using a net. But the monkey couldn't rescue the buffalo because he was too heavy. Finally he caught the fish in the net. But to the monkey's surprise, the fish died when he pulled it out of the water. The monkey was left alone mourning the loss of his two friends.

  Generate discussion among the participants by asking, "Why did the buffalo fail to help his friend?" Guide the discussion towards the conclusion that to help, you need not only willingness but also ability and skills. Then ask, "Why did the monkey fail to help his two friends?" Guide the discussion towards the conclusion that to help, you also need knowledge and strength.

- The trainer explains to the participants that the aim of this lesson is to learn about the principles and procedures of first aid, get familiar with the equipment used, and demonstrate and practise various first aid and evacuation techniques. The trainer also explains the importance of knowledge, ability and skills if you are to help without adding to the list of casualties.

Core Activities

- The teacher gives information about the principles of first aid, in terms of aims, components, criteria, equipment and priorities.

Activity 1: Treating arterial bleeding

- The teacher explains the theory of arterial bleeding, including the importance of administering first aid, the causes and signs of arterial bleeding, the first aid principles and the techniques for treating treat arterial bleeding.
- The teacher introduces the equipment, both standard and alternative, used to administer first aid in a case of arterial bleeding.

- The teacher then demonstrates the use of this equipment in the treatment of arterial bleeding, and the use of tourniquets.
- The teacher asks the participants to practise in pairs or groups.
- The teacher gives guidance, checks the participants' understanding, and gives constructive feedback.

Activity 2: Treating heart failure

- The teacher explains the theory of heart failure, including the importance of administering first aid, the causes and signs of heart failure, the first aid principles and the techniques for treating heart failure.
- The teacher introduces the equipment, both standard and alternative, used to administer first aid in a case of heart failure.
- The teacher then demonstrates the use of this equipment in the treatment of heart failure.
- The teacher asks the participants to practise in pairs or groups.
- The teacher gives guidance, checks the participants' understanding, and gives constructive feedback.

Activity 3: Treating breathing difficulties

- The teacher explains the theory of breathing difficulties, including the importance of administering first aid, the causes and signs of breathing difficulties, the first aid principles and the techniques for treating breathing difficulties.
- The teacher introduces the equipment, both standard and alternative, used to administer first aid in a case of breathing difficulties.
- The teacher then demonstrates the use of this equipment in the treatment of breathing difficulties.
- The teacher asks the participants to practise in pairs or groups.
- The teacher gives guidance, checks the participants' understanding, and gives constructive feedback.

Activity 4: Treating shock

- The teacher explains the theory of shock, including the importance of administering first aid, the causes and signs of shock, the first aid principles and the techniques for treating shock.
- The teacher introduces the equipment, both standard and alternative, used to administer first aid in a case of shock.
- The teacher then demonstrates the use of this equipment in the treatment of shock.
- The teacher asks the participants to practise in pairs or groups.
- The teacher gives guidance, checks the participants' understanding, and gives constructive feedback.

Activity 5: Treating loss of consciousness

- The teacher explains the theory of loss of consciousness/fainting, including the importance of administering first aid, the causes and signs of loss of consciousness, the first aid principles and the techniques for treating loss of consciousness.
- The teacher then demonstrates the use of this equipment in the treatment of loss of consciousness.
- The teacher asks the participants to practise in pairs or groups.
- The teacher gives guidance, checks the participants' understanding, and gives constructive feedback.

Assessment

Assessment of performance based on observation during the practical and group work sections of the lesson.

Sample performance assessment
Aspects appraised
1. Understanding of the first aid procedures
2. Understanding of potentially fatal conditions, and how to treat them
3. Understanding of evacuation techniques
4. Ability to identify the equipment to be prepared in advance.

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APPENDIX 1
TREATING AN UNCONSCIOUS CASUALTY

Aim

Participants are able to simulate the techniques for treating an unconscious casualty.

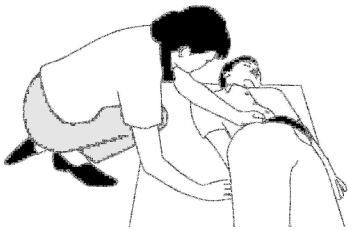
Equipment and Materials

Pictures of the treatment process.

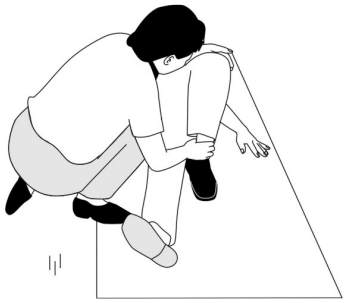
Activity Steps

1. Place the victim on his or her back, legs straight and arms by sides, loosen the person's clothing.

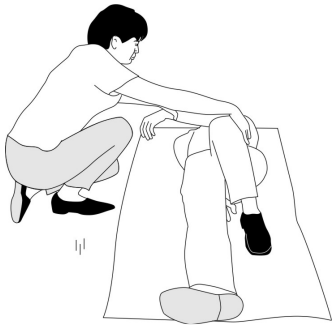
2. Check the victim is still breathing by putting your cheek near the victim's nose to feel whether he or she is exhaling, listening to the victim's breathing, and looking for the rise and fall of the victim's chest.



3. Place one of the victim's hands under his or her buttocks (for example the right hand under the right buttock).



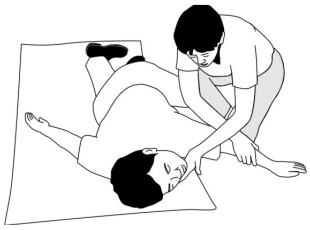
4. Bend the leg opposite to the hand that is under the buttock (for example if the right hand is under the right buttock, bend the left leg, and vice versa).



5. Roll the person towards you (for example if the right hand is under the right buttock, roll the person to the right).

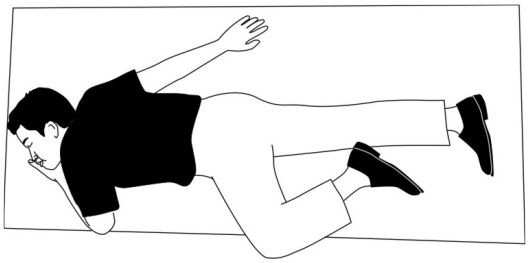
6. Position the left leg bracing the knee and the foot on the floor.

7. Tilt the person's head so they can breathe easily.



8. Move the right arm (that was under the buttock) behind, away from the body. Place the left hand under the left cheek.

9. The victim is now in a stable position.



APPENDIX 2
TOPIC: TREATING ARTERIAL BLEEDING

Aim

Participants are able to simulate the techniques for treating a casualty suffering arterial bleeding.

Equipment and Materials

Triangular bandage, first aid kit, pictures of the treatment process.

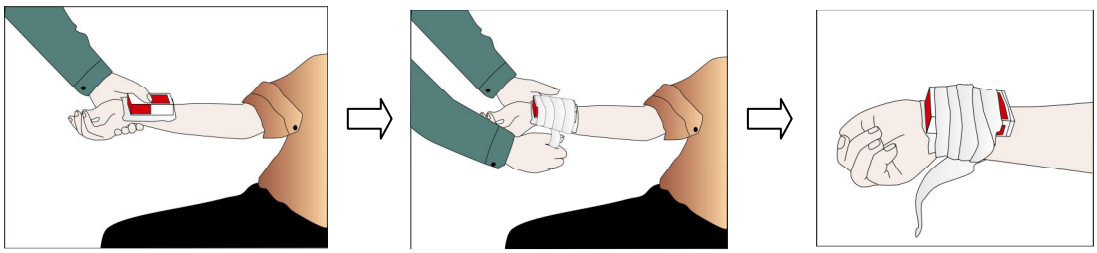
Activity Steps

A. Arterial bleeding in the arm:

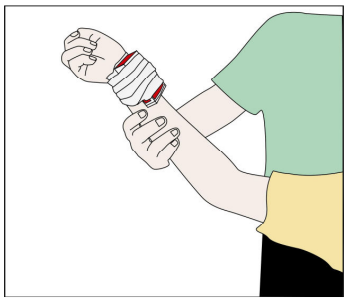
1. Using two hands firm pressure to the artery until the stops/ decreases.

2. Alternatively, wrap a bandage around the upper arm until the bleeding stops/decreases.

3. Continuing to apply pressure with the help of a firm object (such as a piece of wood), bandage the wound tightly.



4. Raise the injured limb above the victim's heart (chest).

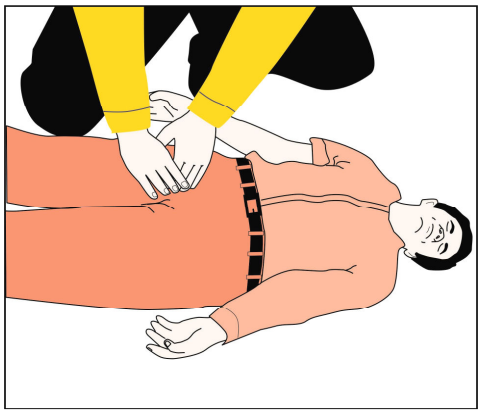


Note:
Steps 1 and 2 must not be maintained for too long, to prevent permanent damage to blood vessels in the area where pressure is being applied or the bandage has been wrapped.

B. Arterial bleeding in the leg:

The steps for treating arterial bleeding in the leg are basically the same as those for treating arterial bleeding in the arm:

1. Apply pressure to the artery on the inner thigh



2. Continuing to apply pressure with the help of a firm object (such as a piece of wood), bandage the wound tightly.

3. Raise the injured limb above the victim's heart (chest).

APPENDIX 3
TOPIC: TREATING A CASUALTY EXPERIENCING DIFFICULTY BREATHING

Aim

Participants are able to simulate the techniques for treating a casualty experiencing difficulty breathing.

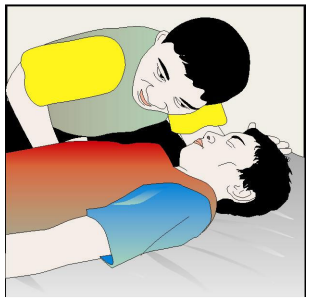
Equipment and Materials

Pictures of the treatment process.

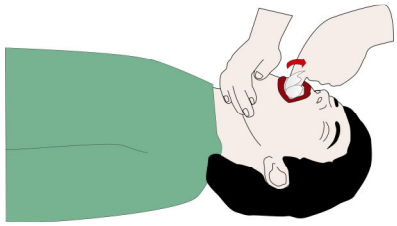
Activity Steps

Breathing difficulties may cause death, because if a person cannot breath their lungs will stop working. As a consequence, the heart is unable to pump blood, and therefore oxygen, to the organs and other parts of the body. So you need to administer immediate first aid to a person who is having difficulty breathing, using the following techniques.

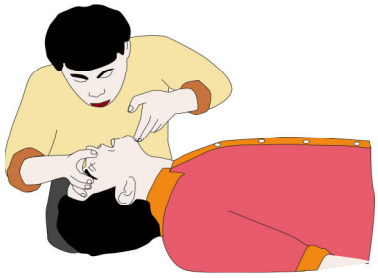
1. Check whether the person is still breathing by placing the back of your hand or your ear to his or her nose.

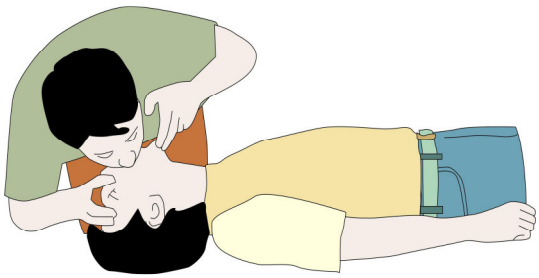


2. Open the person's mouth and clear any debris from inside the mouth.



3. Open the person's mouth and give mouth-to-mouth resuscitation.





APPENDIX 4
TOPIC: TREATING A HEART ATTACK

Aim

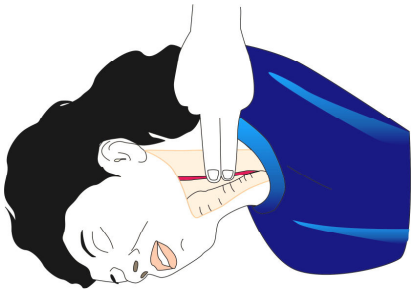
Participants are able to simulate the techniques for treating a person who is having a heart attack.

Equipment and Materials

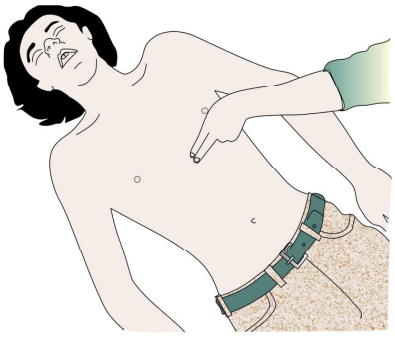
Pictures of the treatment process.

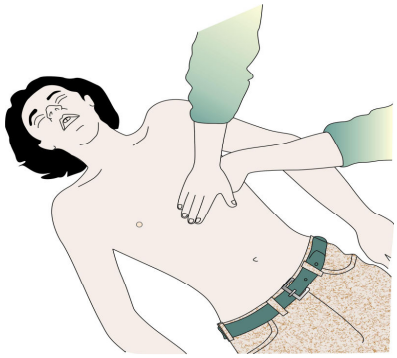
Activity Steps

1. Check for a pulse in the carotid artery in the neck by placing two fingers (forefinger and middle finger) between the Adam's apple and the tendon.

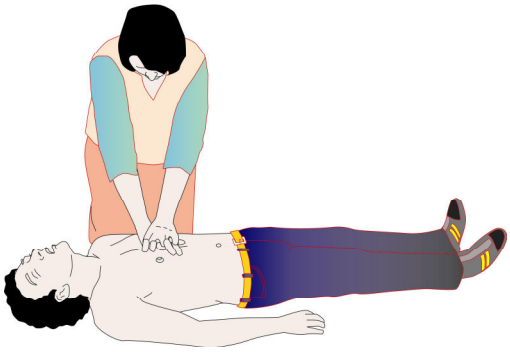


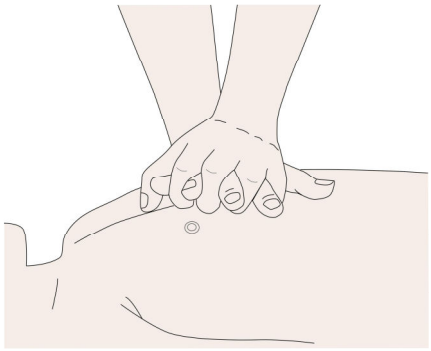
2. If no pulse can be felt in the carotid artery in the neck, begin cardiopulmonary resuscitation (CPR):
   a. Find the tip of the breastbone, move your hand two fingers upwards.
   b. Place the heel of the hand in this position.



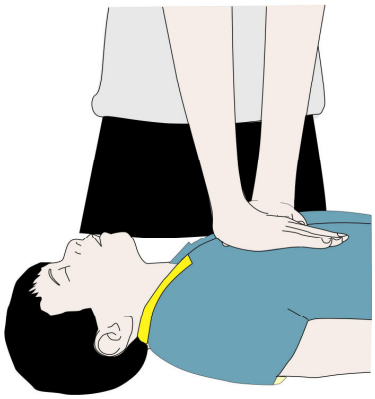


3. Straighten your arms and compress the chest in an even rhythm (once per second) using both hands until the heart starts pumping again and a pulse can be felt in the carotid artery.

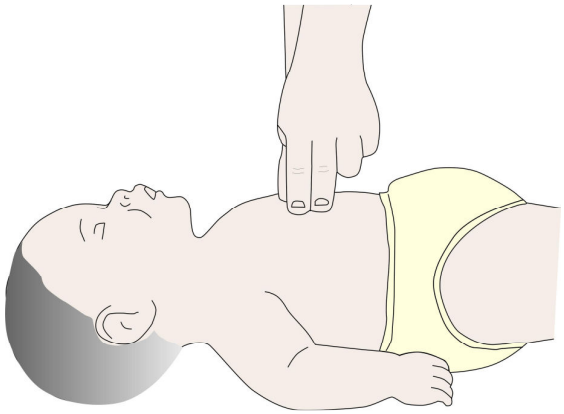




4. If the victim is a child, use only two fingers and compress the chest with the palm of the other hand.



5. If the victim is a baby, compress the chest using two fingers only (not with the palm of the hand).



APPENDIX 5
TOPIC: TREATING SHOCK

Aim

Participants are able to simulate the techniques for treating a person who is experiencing shock.

Equipment and Materials

Pictures of the treatment process.

Activity Steps

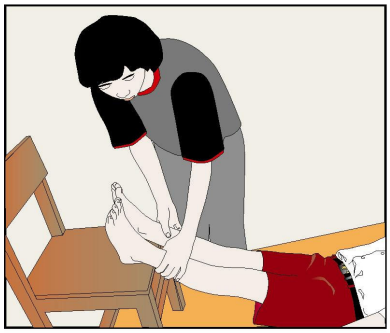
Shock is basically due to interference in the supply of blood to the heart. Here is a simple procedure for treating shock:

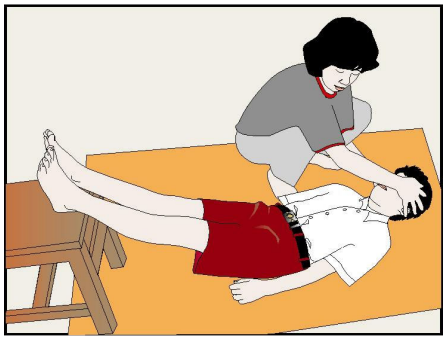
1. Lay the person down in a safe, shady spot.

2. Loosen the person's clothing.

3. Check that the person is not having difficulty breathing or heart problems.

4. Raise the person's legs at about a 60 degree angle to allow the blood to flow automatically to the brain (auto transformation).





5. If necessary, take the victim to the nearest health centre.

Contact:

German-Indonesian Cooperation for
Tsunami Early Warning System (GITEWS)
Capacity Building in Local Communities

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