Universitat de Girona

FINAL DEGREE PROJECT

EFFECTIVITY OF THE IMPLEMENTATION OF THE INITIAL ASSESSMENT CHECKLIST IN MOUNTAIN ACCIDENTS

UNIVERSITY OF GIRONA, FACULTY OF MEDICINE

Mountain Medicine Chair

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ÍNDEX

1. ABREVIATIONS

CISA-IKAR:	International Committee for Alpine Rescue
FEDME:	Federación Española de Deportes de Montaña y Escalada
GREIM:	Grupo de Rescate e Intervención en Montaña
GRAE:	Grup d'Actuacions Especials
FEEC:	Federació d'Entitats Excursionistes de Catalunya
EMF-FVM:	Euskal Mendizale Federazioa – Federación Vasca de Montaña
FEA:	Federación Española de Alpinismo
INE:	Instituto Nacional de Estadística
WHO:	World Health Organization
ATLS:	Advanced Trauma Life Support
ABCDE	Airway, Breathing, Circulation, Disability, Exposure
USA:	United States of America
CT:	Computed tomography
***IMB SPSS*:**	Statistical Package for Social Sciences
AEMET:	Agencia Estatal de Meteorología
AED:	Automatic External Defibrillator
CEIC:	Comitè Ètic d'Investigació Clínica

2. ABSTRACT

Background: mountain accidents are becoming a public health problem as consequence of pandemic lockdown, since society practises more mountain sports, and consequently, mountain accidents have increased. Among Spanish federated people occur an average of 7000 accidents a year, of which in 2020, of those assisted by GREIM, 4% found death, while in non-federated that data ascends to 8%. (1) The main cause of harm in mountain accidents are traumatisms, which are also the most common cause of death in the mountain. ABCDE (airway, breathing, circulatory, disability, exposure) is efficient to reduce mortality and to stablish a priority order to attend injuries (2) and checklist has been proved to be effective confronting procedures in complex situations. (3)

Objective: our main objective is to evaluate the effectivity of a based-ABCDE checklist implementation. Our goal is to prove that people who were taught and trained how to read and interpret this checklist know how to manage better a traumatic mountain victim than people that were not taught nor given our checklist. Effectivity will be evaluated in two forms. One will be in terms of "knowledge" evidenced through marks differences among "pre-training" and "post-training" test exams. The other will be by studying specific clinical actions carried out in mountain victims and also, by studying victim's mortality and disability.

Design: we will carry out our research through a randomized, controlled, longitudinal, prospective open-label interventional study leaded by *Mountain Medicine Chair* from *Universitat de Girona*, from March 2022 to February 2026.

Participants: our study subjects will be federated members of Federació d'Entitats Excursionistes de Catalunya (FEEC) and members of Federación Vasca de Montaña (EMF-FVM) from Basque Country.

Methods: we will perform a probabilistic simple aleatory method. The 784 participants will be assigned randomly by 1:1 ratio to one or another group. Checklist implementation will be carried out in intervention group A n=392 but not in control group B n=392. Online test exams and clinical actions performed by our study subjects will be followed-up to a year after checklist implementation. To study disability, mountain victims will be followed-up to a year after their accident.

Keywords: mountain accident, checklist, ABCDE, mountain medicine, polytrauma.

3. INTRODUCTION

3.1 MOUNTAIN ACCIDENT

3.1.1 DEFINITION OF MOUNTAIN ACCIDENT

CISA-IKAR, the International Committee for Alpine Rescue defines a mountain accident as a mischance that occurs in a difficult, hostile and isolated environment in the mountain, where someone is involuntarily physically damaged or injured. (4) (5) This definition therefore includes pathologies caused directly by the mountain environment, which can develop due to meteorology (hypothermia, frostbite, sun burns, heat stroke, fulguration) or can be caused by rugged terrains and landforms such as watercourses or cliffs (traumatisms, wounds, drownings), but they also, can happen because of inherent human health and medical condition. A mountain accident also considers those intrinsic human pathologies which can be exacerbated at this natural environment, such as heart stroke, cerebral stroke, cardiac arrest or another underlying medical condition the mountaineer may suffer, with the nuance that it occurs at the mountain.

3.1.2 EPIDEMIOLOGY OF MOUNTAIN ACCIDENTS AND RESCUES IN SPAIN.

It's quite difficult to estimate the overall data of mountain accidents and deaths, since we cannot really know the actual number of people that practise mountaineering or mountain sport worldwide, and we neither know the accurate number of victims in the mountain given that not every accident that happens is notified to the emergency services or security authorities. It is even complicated to obtain accurate data of international deaths that happen at the mountain.

In Spain, there are additional features that make it difficult to homogenize epidemiological mountain accident data and to know the real number of people that get injured in the mountains. For instance, there are multiple rescue forces, some of which, have autonomical competencies (i.e. Protección Civil) and there are some Autonomous Communities that have their own specifical rescue forces (Principality of Asturias, Cantabria, Basque Country, Foral Community of Navarre, Catalonia, Castile and León, Madrid, Valencian Community, Andalusia and Balearic and Canary Islands). Some of

these rescue forces are private institutions, others are leaded by firefighters, or by the polices, and some of them share competencies with other rescue institutions. As a consequence, all of them have their specific actuation protocols, dependences, their form of management, way to notify incidents, etc. (6)

Nevertheless, each year since 2017, Federación Española de Deportes de Montaña y Escalada (FEDME) makes a report where standardized mountain- related accident epidemiology in Spain is shown. This information is given by Grupo de Rescate e Intervención en Montaña (GREIM) Guardia Civil, Grup d'Actuacions Especials (GRAE) de Bombers de la Generalitat de Catalunya and Unidad de Montaña de la Unidad de Vigilancia y Rescate de la Ertzaintza, which are the main Spanish public rescue forces that lead most mountain rescue operations in Spain. (1)

The most recent data available from mountain accident rate is relative to year 2020. FEDME accidental report edition 2020 is more complete than the reports from years before since it also collects data from the following autonomous federations: Andalusia, Aragon, Canary Islands, Cantabria, Catalonia, Castile la Mancha, Castile and León, Valencian Community, Extremadura, Balearic Islands, La Rioja, Basque Country and Region of Murcia. In 2020 report we therefore have a more consistent analysis of accidentality studied by FEDME. (1)

Mountain rescues according to different regions and according to their different rescue forces.

Compared to the 2019 report, GRAE Bombers de Catalunya 2020 has increased their rescue interventions in 16% and Unidad de Montaña de la Ertzaintza 2020 data reports too an increase of 40% in rescue operations, carrying out up to 7 interventions in one day. These results show that Ertzaintza has participated in more rescue interventions than other rescue national forces. 90% of rescued people in the Basque Country were residents from Basque Country. GRAE geographical area of operation is Catalonia while Ertzaintza geographical area is Basque Country. Both Autonomous Communities Catalonia and Basque Country have a stablished mountaineering tradition (there are more than 75.000 people federated within both regions). (1)

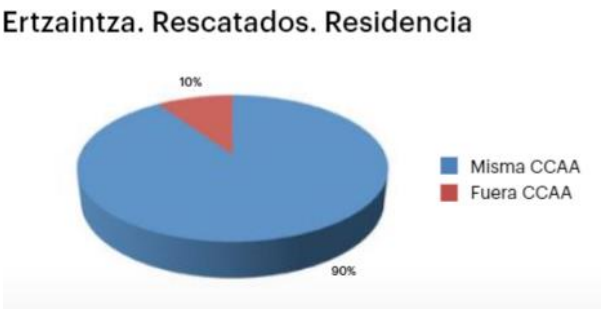

Figure 1: Rescued by Ertzaintza in 2020 depending on whether they were residents from Basque Country or not.(1)

With respect to 2019, there has been a decrease in GREIM's interventions (791 rescues in 2020 vs 973 in 2019) and in people rescued by this entity (1127 people rescued in 2020 vs 1437 rescued in 2019). In 2019, GREIM alone assisted 343 federated people: almost one a day. (6) GREIM works together with Equipo de Rescate e Intervención en Montaña (EREIM). Its main operation zones are mountain areas of Aragon , Foral Community of Navarre, Castile and León, Galicia, Cantabria, Granada, Tenerife, Mallorca, Madrid, La Rioja and Catalonia. (7) Huesca is the province that counts with the most of rescue operations leaded by Guardia Civil (40% of their interventions were in that province). In 2020, almost 44% of rescues and 42% of people rescued have been in Huesca's mountains.

Mountain accidents of non-federated people that needed to be rescued by GREIM in 2020.

As reported by GREIM, 75% of people rescued in 2020 were not federated and they were mostly men, representing 58%. Mortality percentages of non-federated people due to those accidents involves 8% which double than in federated. 49% of non-federated people rescued by GREIM were totally unharmed while 42% of people were injured. (1)

Figure 2: Outcome of non-federated people rescued by GREIM in 2020 based on whether they were unharmed, injured or they deceased. (1)

The activities that needed most the assistance from rescue forces in non-federated people were the less technical ones. 77% of GREIM's rescues within this sort of people were due to hiking practise, followed by "progression through rugged terrain" (10%) (this activity includes activities between hiking and climbing that may need the help of crampons and piolet) and canyoning (7%). (1)

Figure 3: Activity that non-federated people were practising that lead them to be rescued by GREIM in 2020. (1)

Mountain accidents of federated people that needed to be rescued in 2020.

Each year autonomical federations report more than 7000 accidents, computing an average of 19 accidents a day. This number considers every accident, independently of whether a rescue service is needed or not.

In particular, in 2020 FEDME counted with 248.983 federated people and there were about 9200 sportive accidents: which means 1 accident per 27 federated people. We

have the following information of federated accidents since they needed to be attended by health assistance, which included from mild injuries to life-threating lesions and deceases.

Like the past years, in 2020 the main activity where mountain accidents happened was hiking (31%), followed by mountain trail (24%) and rock climbing (13%). Hiking is the most accessible activity and climbing and trail are becoming more and more popular. (1)

In 2020, federated members suffered accidents mostly in the autonomous community where they lived, representing 91% of accidents in their region vs 9% in another community. (1)

GREIM results show that 22% of the victims they assisted in 2020 were federated. This rescue group attended mostly federated people that practised hiking (32%), progression through abrupt terrain (21%) and alpinism (17%). We have to keep in mind that pandemic strict lockdown took place during March and April 2020 and there was a decrease both of skiing and alpinism practise as a consequence.

Figure 4: Activity that federated people were practising that lead them to be rescued by GREIM in 2020. (1)

According to activities, GREIM make differences profiles of rescued people:

- In climbing: rescued federated people tended to be younger as technical difficulty requires it, so 50% of climbers rescued were from 19 to 30 years old. 40% of rescued climbers were women. The outcome of the accident shows that half of people rescued were injured and the other half unhurt.
- In alpinism (includes climbing at high mountain, ridge climbing and ice climbing): there was few presence of women, as only 18% of people were women. 63% of

rescued people who practised alpinism were about 31 – 50 years old. 49% of rescued turned out unhurt, 44% injured and 7% dead.

- In trail running and ski mountaineering highlights the presence of young people that needed to be rescued: 31% were younger than 30 years old and 62% younger than 40 years old. 81% of people that needed to be rescued while practising skiing mountaineering were injured and 19% were unhurt.
- In canyoning we found that 2 out of 3 people that needed rescue assistance were hurt.
- In hiking the profile is more aged, there were 77% of rescued people over 40 years old. But 43% were unhurt: lost and fatigue were the main causes of rescue in unhurt hikers.
- In "progression through rugged terrain" we find that only 19% of victims were women, and the majority (30%) were between 31 and 40 years old, although here we find the most homogeneous profile in terms of adult ages. This activity was the one with the most percentage of deaths: 11% of people died because of the accident while 42% of rescued were injured.

Figure 5: Outcome of federated people rescued by GREIM in 2020 while practising sport in rugged terrain depending on whether they were unharmed, injured or they deceased. (1)

Members of FEDME carry out their training in more complex terrains than non-federated, but the accidents that FEDME federates suffer are less severe than in non-federated. (1) Federated members also make a more rational and efficient use of emergency services. Mortality among federated people reported by GREIM supposes 4%, which may suggest that federated have better mountain training and environment knowledges. (1)

Mountain accidents depending on the age of the victim in 2020.

46% of people rescued by Ertzaintza were over 50 years old. As reported by GREIM, non-federated people under 30 years old are the most rescued people, specially under 18 years old, fact that is quite worrying. Within federated people, the group that need the most to be rescued are those about 40 years old, which supposes 29%. People over 71 years old are the least rescued, both in federated and non-federated people. (1)

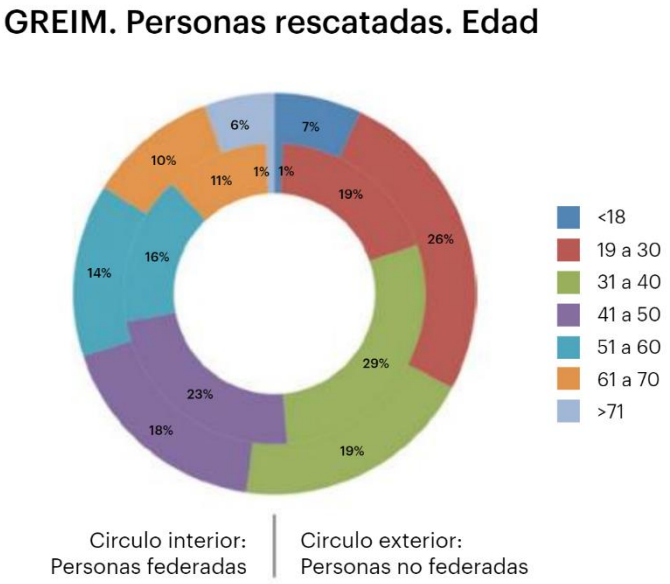

Figure 6: Rescued people by GREIM according to their age, in federated and in non-federated. (1)

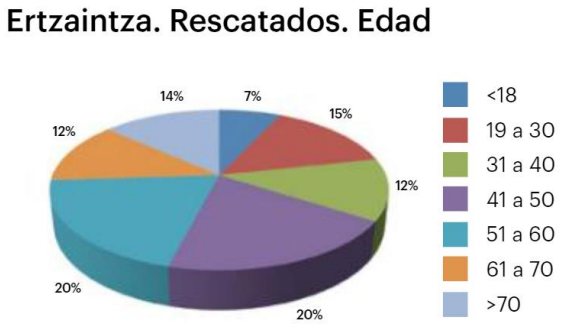

Figure 7: Rescued people by Ertzaintza according to their age. (1)

3.1.3 RISK FACTORS OF MOUNTAIN ACCIDENTS AND CAUSES OF NEEDING TO BE RESCUED.

When an accident occurs, we can commonly find at least two drivers of the accident. Firstly, we find the direct cause that triggers the accident that can be easily identified in most cases (p. ex. the impact of a thunder) and secondly, we notice the accident precursor which sometimes needs to be studied or investigated (p. ex. not consider meteorology before starting the activity). (1) We have also to make a difference between "risk" and "danger". Danger is any potential harming event, and it can be objective (intrinsic to environment, derivate of geology or meteorology) or subjective (due to human behaviour). Risk is the possibility for danger to happen and specially, to harm people. (7)

Human factor.

It is frequently believed that a mountain accident usually and mostly happens because of natural incidents such as avalanches, falls from high rocks, storms, etc. or because we over force and test ourselves till the limit of our capabilities. But the reality is that mountain accidents occur due to reckless mistakes, distraction and excess of motivation. Human factor is the most determinant item that can trigger a mountain accident. (8)

Direct cause of a mountain accident.

According to Guardia Civil and Ertzaintza, stumbling and misplacement involve the 50% of causes that can lead into a rescue. (1)

Figure 8: Rescued people in 2020 by GREIM according to the main cause of needing to be rescued. (1)

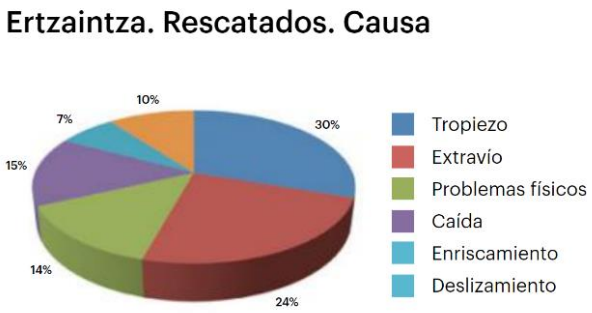

Figure 9: Rescued people in 2020 by Ertzaintza according to the main cause of needing to be rescued. (1)

When asked, federated members report to federations misplacement as the main reason of accident, whereas the rest of accident causes that they perceive, disagree with Guardia Civil and Ertzaintza: sporters report glissades, base disease-physical limitations, falls and collision as main causes of mountain accident. (1)

Most of rescued victims that are injured suffer pathologies due to traumatisms. It is less frequent that people got rescued because of a non-traumatic pathology, which includes those that happen because of the ambience and those pathologies that the victim already suffers or can develop at the mountain. (9) A study leaded in Aragon among August 1999 and July 2008 that included 2135 mountain rescues showed that mostly of attended victim suffered traumatic pathology (83,3%). Medical and ambiental pathologies supposed 1,4 and 5,3%, respectively. (10)

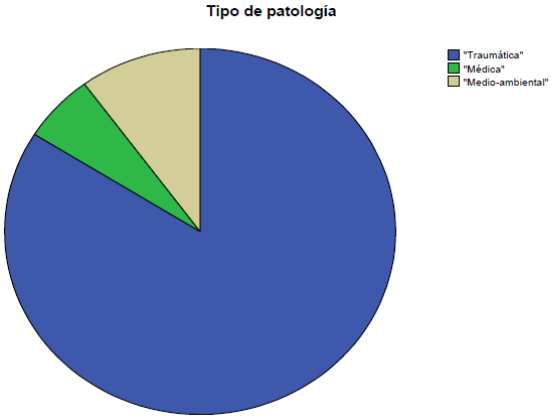

Figure 10: Pathologies that suffered people rescued in Aragon between August 1999 and July 2008. (10)

Ambiental factor.

In a descriptive retrospective study during July 2010 – December 2016 in Aragon, it was shown that 7,8% of people rescued in the mountains (164 people) had a non-traumatic medical condition, whereas 36,6% of those conditions (60 people) suffered pathology because of environment conditions: cold was an important cause and hypothermia was the most frequent pathology due to it (68,8 %). People that suffered fatigue because of the ambiance supposed 13,3%, and this data was the same for people who suffered dehydration and syncope. (9)

The pathologies caused by cold or snow are more frequent in summer (65%), as opposed to winter (10%) and spring (24,1%). (9)

Patología relacionada con el medio	N = 60 n (%)
Hipotermia	20 (33,3)
Agotamiento	8 (13,3)
Deshidratación	8 (13,3)
Síncope	8 (13,3)
Congelación	5 (8,3)
Ahogado	3 (5)
Golpe de calor	3 (5)
Fallecimientos por congelación/hipotermia	2 (3,3)
Queratitis actínica	2 (3,33)
Calambres	1 (1,6)

Table 1: Pathology related to environment in rescued people in Aragon mountains during July 2010- December 2016. (9)

The height of the mountain also can be related to accidents and rescues: 61% of rescues according to the study happened over 2000 meters. (9)

Human inherent pathology.

In the same descriptive retrospective study mentioned before, 20,7% of those people that needed to be rescued with non-traumatic medical condition suffered cardiac disease and 12,8% digestive problems. Psychiatric pathology such as anxiety represented 7,9% of non-traumatic medical diseases and neurological problems such as convulsion were present in 7,3% of victims. (9)

Cardiac disease is the most remarkable cause of human intrinsic pathology that needed the intervention of rescue forces. Within this kind of pathology, acute coronary syndrome was the most frequent (35,3%) followed by decease or sudden death (32,3%). (9)

Tabla 2. Patologías médicas no traumáticas

	N = 164 n (%)
Patología relacionada con el medio	60 (36,5)
Patología cardiológica	34 (20,7)
Problemas digestivos	21 (12,8)
Problemas psiquiátricos (ansiedad)	13 (7,9)
Problemas neurológicos	12 (7,3)
Patología nefrourológica	9 (5,4)
Lumbalgia, contracturas musculares	6 (3,6)
Patología respiratoria (asma)	1 (0,6)
Otros	8 (4,8)

Table 2: Non-traumatic medical pathology in rescued people in Aragon mountains during July 2010- December 2016. (9)

3.1.4 MOUNTAIN ACCIDENTS IN SPAIN DURING COVID-19 PANDEMIC IN SUMMER 2020 AND ITS RELATION WITH LOCKDOWN.

Territorial confinement in 2020 due to COVID-19 pandemic focalised the rescues within the areas with more population and with more mountaineering popularity. If we consider data related to federated people, we find the examples of Andalusian and Catalonian Communities, that have a huge number of federated people: 75% of Andalusian federated members suffered mountain accidents in their Andalusian province residence, while in Catalonia 89% of injured federated members suffered the incident in Catalonia.

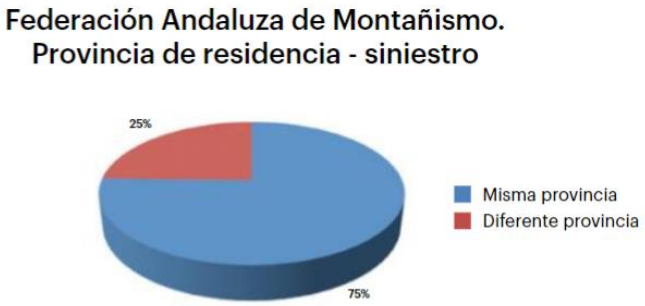

Figure 11: Mountain accidents in 2020 among Andalusian federated members depending on whether the accident was in their province of residency or in a different one. (1)

Figure 12: Mountain accidents in 2020 among Catalonian federated members depending on whether the accident was in Catalonia or in a different autonomous community. (1)

Another fact to consider is that during pandemic alert period only people that were federated to FEDME were allowed to travel to other regions in order to practise activities in natural environment.

In March 2020, during alarm period, Spanish population was completely confined at home which explains that the number of attended emergencies in the natural environment was almost none. (1) But when lockdown ended and mobility among different regions started to be possible, that situation changed. According to GREIM reports, it seems that there was an increasing number of people practising activities in the mountain in summer 2020 due to the fact that Spanish population had been lockdown from March to June because of COVID-19. Some social causes that explain what leaded to Spanish people to practise more mountain activities were that in the mountain they did not feel they had to wear a mask (or it was not obligatory at all in

some regions) and they did not feel guarded by security forces. People began to frequent more the mountain as a response to lockdown. (1)

The Aragonese Pyrenees' GREIM claim that their rescue interventions increased by 15,09% from 15th June 2020 to 15th September 2020 compared to the same period in 2019. GREIM statistics also suggest that the number of people practising mountain sport has notably increased and that the average level of preparation for the activities that are carried out is quite poor, leading to the practice of low complexity or low technical requirement activities.

In Basque Country we also find that in July 2020 (concurring with the final pandemic Spanish phase deescalate) there was an increase of 140% in the need of rescue services use compared to July 2019. In addition, Ertzaintza claims that there is an overall increase of people practising sport outdoors, which explains the increase of rescue manoeuvres.

As GRAE Bombers de la Generalitat de Catalunya report, in Summer 2020 mountain rescues increased by 16% and river rescues by 55% with regards to 2019, while maritime rescues decreased (related with the population preference of "mountain holidays" versus "sea holidays" in Summer 2020).

At a national Spanish level, we have to consider again that there are different rescue entities that have their own statistics, but Guardia Civil reports that the period within 15th June to 15th September 2020 showed an increment of rescue operations of 5,84% and an increment of injured people of 15,69%.

Some Spanish regions such as Basque Country noticed that during alert period due to the deescalating phases, the reduction of mobility restrictions, the little time to practise outdoor activities (since it was limited to few hours a day), the poor physical condition and experience of some population and the people's eager to go outdoors, together leaded to situations that required the use of mountain rescue services and of their resources. (1)

3.2 HISTORICAL CONTEXT OF MOUNTAINEERING

Humanity has always had a special bond with mountains. To human being, the mountain has had since magical - religious properties to scientific, historical humanistic connotations. Nowadays, mountain also can be considered as a social, political and economical environment too. In our context, the topic that concern us is the social and sportive aspect of mountain, mountaineering practise and its relation with disease. (11)

In 18th century, a part of society started to have their primary needing covered so wealthy and intellectual European middle-classes started to frequent nature. Concretely, they had preference for visiting Alps' surroundings and adopted going to the mountain as a pleasuring activity (as an inspiration to write poetry or draw pictures,) or as a place to study botanic, and later, some of them experienced that surmounting peaks was an enjoyable challenge. It is said that mountaineering was born the 8th August 1786, with Mont Blanc ascension (4807 meters) by Balmat and Paccard. Subsequently, first European scientific hiking societies were created, and in 19th century first hiking societies appeared in Spain. Those associations were more common in the North of Spain, concretely in the Pyrenees and in Picos de Europa, and were related to industrialization since it promoted urbanization, and also, they were influenced by European tendences and fashion. Together romanticism stream and influence and the support of Institución Libre de Enseñanza among other factors led to the foundation of Federación Española de Alpinismo (FEA) (nowadays FEDME). As a consequence of FEA creation in 1922 mountaineering practise started to spread in Spanish regions. Since then, in middle 20th century, the increasing of industrialization in another regions, the restructuration of agriculture, the rural development, the progressive democratisation and the emerging of foreign tourism in our country promoted the officialization and entrenchment of mountaineering culture in Spain. (11)

From 1989 to 1999, as Instituto Nacional de Estadística (INE) reports, there was an increasing from 3,5 million to 9,6 million (63,4%) of visitants in natural Spanish parks. Concretely, the most visited parks in 1999 were Picos de Europa and Covadonga and Ordesa and Monte Perdido, specially in vacancies, festivities and weekends. The last seventy years, mountaineering has suffered some processes. The causes that explain those changes are the massification of mountain regions by visitants, the increasing of

federated community, the development of infrastructures such as mountain huts, the regulation and promotion of natural spaces, the emerging of mountaineering collectives, the economic growth of tourism and of mountainous areas, the access to mountain devices, etcetera. But also, while popularity of mountaineering has grown this last seventy years, there has been consequently an increment of accidents that occur in natural spaces too. Between 1985 and 2000 there was an increasing of 80% in mountain accidents, of which 5,3% turned out deceased and 30,7% injured. (11)

Last seventy years has been an evolution in mountain accident victim profile too: in the eighteens mostly of accidented were federated (70%) but that changed in the nineteens. In 2000, non- federated were the main characters of mountain accident in Spain (64%). (11) Nowadays, in 2020, as mentioned before, GREIM'S report that the 75% of people that needed to be rescued were non-federated, so the current tendence of accidentality and needing to be attended by rescue forces in non-federated has increased in the last forty years. (1)

3.3 FEDME

FEDME is the acronym for Federación Española de Deportes de Montaña y Escalada. It is a private non-profit organization that rules and promotes the following outdoors sport modalities in Spain: alpinism, mountaineering, hiking, canyoning, ski mountaineering, Nordic walking, climbing, trekking.

It was created the 1st July in 1922, and it was first named Federación Española de Alpinismo, later Federación Española de Montañismo, and nowadays it is called Federación Española de Deportes de Montaña y Escalada.

FEDME also contemplates non sportive activities that are related to mountain and climbing sports such as investigation, trainings, acts, etc.

Includes the following autonomous federations that have competencies inside a Autonomous Community, Foral Community or Autonomous City:

- Federación Andaluza de Montañismo (FAM)
- Federación Aragonesa de Montañismo (FAM)

- Federación de Deportes de Montaña, Escalada y Senderismo del Principado de Asturias (FEMPA)
- Federación Balear de Montañismo y Escalada (FBM)
- Federación Aragonesa de Montañismo (FAM)
- Federación Canaria de Montañismo (FECAMON)
- Federación Cántabra de Deportes de Montaña y Escalada (FCDME)
- Federación de Entidades Excursionistas de Cataluña (FEEC)
- Federación de Montaña Castilla-La Mancha (FDMCM)
- Federación de Deportes de Montaña, Escalada y Senderismo de Castilla y León (FDMESCYL)
- Federación de Deportes de Montaña y Escalada de Ceuta (FDMEC)
- Federación Vasca de Montaña (EMF-FVM)
- Federación Extremeña de Montaña y Escalada (FEXME)
- Federación Gallega de Montañismo (FGM)
- Federación Riojana de Montañismo (FERIMON)
- Federación Madrileña de Montañismo (FMM)
- Federación de Montañismo de la Región de Murcia (FMRM)
- Federación de Montañismo y Escalada de Melilla (FMEM)
- Federación Navarra de Deportes de Montaña y Escalada (FNDME)
- Federación de Deportes de Montaña y Escalada de la Comunidad Valenciana (FEMECV)

The functions of autonommical federations are parallel to FEDME's, with the nuance that they work inside their own territory and coordinate their clubs. They also manage the trails of their territories. Furthermore, federations collect all accidentality data since they transact all the information relative to victims and accidents in order to provide insurance assistance to injured federated. (12)

3.4 CHECKLISTS ORIGINS AND IMPLEMENTATION

A checklist is a work tool that is designed to reduce human mistakes in situations where it can be difficult to remember a simple procedure or where our attention can be altered such as in a complex procedure.

In 1935 Ohio, prototype airplane Boeing 299 (XB-17) crashed due to human failure, as the pilots forgot to disable burst locks. Lately, this human failure was identified as "distraction". (13) This airplane accident supposed the origin of using checklist in aeronautics area. Since then, checklist has become quite popular in finances, industry and in medicine field, among others.

In 2004, World Health Organization (WHO) created the Worldwide Alliance for Patient Security, in order to ensure patient's safety. That is why they launched in 2008 the goal to guarantee security in surgery (pre, during and post-surgery), and suggested to implement a checklist that included security surgical measures and invited to apply it worldwide to reach their objective. (14) Studies led later by WHO in eight big cities found out that using checklist in surgery reduced significantly mortality. (3) That is why globally, health institutions have promoted the use of checklist in surgery field. In 2010, the European Board of Anaesthesiology (EBA) and the European Anaesthesiology Society agreed in Helsinki Declaration to adopt checklist use too. (13). In medicine, nowadays, checklist use is popular in anaesthesiology, surgery and emergencies.

3.5 ADVANCED TRAUMA LIFE SUPPORT (ATLS) AND ABCDE MNEMONIC

The Advance Trauma Life Support (ATLS) course owes its origin to a tragic plane crash that took place in 1976 in the United States of America (USA). The pilot of the plane was an orthopaedic surgeon (J. Styner) and suffered severe injuries, her wife died and their children were critical injured. He noticed both a deficient first assessment in the place of the accident and also a deficient attention from the hospital that treated them. Thanks to Styner, to some surgeons and to other physicians and with the help of Lincoln Medical Education Foundation and the University of Nebraska, ATLS specialized courses began to be imparted in 1977. The first intention of forming in ATLS was to train physicians that did not have knowledge in trauma at all, to teach them how to perform a first manage of severely injured patients. Later, the ATLS courses started to expand around all USA. In 1980 the studies that were made to evaluate ATLS training proved that the pilot ATLS course training improved rural trauma cares knowledges but also improved the quality of traumatological attention in specialized centres of traumatology in USA. After that, ATLS was implemented in United Kingdom and then in more countries, showing it effectiveness both in develop and developing countries. Nowadays, ATLS is the standard method for the initial evaluation and manage to attend severely injured worldwide. (2)

The main goal of ATLS creation was to help physicians to recognize threat-life injuries and to identify the lesions that were a priority to provide a quick first assessment and resuscitation in case it is needed. (2) Another ATLS consideration is that it does not matter the main cause of a pathology, the priority is to identify the injury it and to treat it. (15) This way of confronting a severely damaged patient was firstly controverted as differential diagnosis in medicine is based on the principles of elaborating a solid clinical history and performing a complete physical examination, but there is evidence that approaching a patient by ATLS is effective. (2)

Firstly, ATLS courses were only theoretical but lately, as their goal was to train based-on practise, courses started to be practical. In addition, these courses included feedback from the instructor but also among course attendees, fact that improves both learning and motivation. The courses are imparted primarily for doctors, but when nurses,

paramedic, firemen and police participated the course as observers, there was shown a significant improvement in their trauma assistance knowledges. The skills taught in ATLS courses are based on ABCDE mnemotechnic, which allows us in stressful situations to remember easily how we must evaluate and treat a trauma patient, based on priorities. Firstly, “A” for airway and cervical spine control, secondly, “B” for breathing evaluation, thirdly, “C” for circulatory system assessment and bleeding control, followed by “D” for neurological disability checking, and finally, “E” for patient exposure verification and for preventing him from hypothermia.

After passing the course successfully, attendees are accredited with a certificate which validation lasts for four years. It has been studied that knowledge gets deteriorated if ATLS skills are not practiced regularly, and it is necessary to get a re-certification in order to have certification updated. ATLS course syllabus also gets actualized as science and new knowledges are discovered and evidenced. (2)

In Spain, ATLS courses are only for doctors, and there are about thirty-three courses a year, distributed in the capitals of some provinces. The courses include a previous exam before starting the course and another exam at the end of the course. They also include conferences, practical cases, discussions, life-saving skills training, practical laboratory experiences and a final practical evaluation. (16)

4. JUSTIFICATION

Nowadays mountaineering (involving every activity that takes place in the mountain) is turning popular, it is a cheap activity and almost everybody has access to it. Even though mountains and natural parks are generally accessible, they are inherent dangerous, people can get accidented and they can even find death there. (17) In fact, in 2020, 4% of federated in mountain sports and 8% of non-federated people who suffered a mountain accident in Spain attended by GREIM found death. Epidemiology of mountain accidents, shows that each year occur an average of 7000 accidents among federated (19 accidents a day), so we can admit that mountain accidents are significant. (1) Currently, hiking is a sport which is becoming popular since it is one of the less technical and one of the most economical mountain activities, and it is the mountain activity where people get accidented the most. (1) Also, it is known that the main overall accident problem is traumatism, and most of rescued injured mountaineers owe their consequently pathology to traumatism. (9) (10) Traumatisms due to mountain accidents are a notable problem that can lead into death within the first ten minutes (immediate death) in 15% of cases or within the first hours (early death) in 65% of cases. (10)

It is evident that mountain accidentality is a public health problem, which has gotten worse with the health crisis we are suffering at this moment. Pandemic has affected to mountain accidents: in 2020 there were 2000 accidents more than in 2019, and GRAE and Ertzainza, (which operate in common mountaineering areas) have also performed more interventions in 2020. This increment of accidentality and of rescue operations was first noticed coinciding with unlockdown in Summer, but also, in winter 2020-21 there was an increase of mountain accidents. Due to pandemic, the health public system is collapsed from time to time and some services are suffering a decrease of quality assistance or patients' assistance delay. In a mountain accident, the difficult transference of the victim to the hospital can lead into an even more delayed patient's assistance, and some accident consequences can lead quickly into death. Additionally, people that frequent mountain sport do not have basic first aid skills nor knowledge to assist a traumatized victim in the mountain. Another problem is when asked the people who attend first aid basic courses, they find that those trainings should be more practical

and shorter. (18). Sometimes, even for health professionals it can be difficult to act properly when we face an injured, especially at the mountain where medical sources are little or not available at all. Teaching mountaineers a quick medical assessment through a checklist based on ABCDE could be really useful to reduce victim's sequels and even deaths. Actually, checklist has proven to be helpful confronting a stressful and complex event, where our memory can be deficient. (3) But also, there is evidence that ABCDE is efficient to manage traumatic victims in order to attend firstly the injuries that can be more severe and potentially mortal. (2)

Even though we do not know if the increasing numbers of mountain accidents triggered by pandemic will be maintained, people that practice mountain activity should be taught how to manage and how to provide first care to a traumatized victim in the mountain. For that, we propose to implement through a training among Basque and Catalan federated in mountain sports a checklist based on ABCDE, to check its effectivity to attend traumatic victims in the mountain. This training will optimize learning by including feedback from instructors and participants, and it will be practical.

5. HYPOTHESIS

Implementing among mountaineers through a training a checklist based on ABCDE for a first assessment of traumatized victim is effective in comparison with not implementing it.

6. OBJECTIVES

6.1 PRIMARY GENERAL OBJECTIVE

To evaluate the effectivity of the implementation of the checklist. To prove that people who were taught how to read and interpret a checklist by training know how to manage a traumatic mountain victim better than people that were not trained nor given our checklist.

6.2 SECONDARY SPECIFIC OBJECTIVES

1) **SPECIFIC OBJECTIVE 1:** Evaluate the effectivity of checklist implementation in terms of acquiring knowledge. It will be studied based on whether there is difference or not of knowledge among people that have been trained and non-trained, before and after six months of the training. It will be evaluated through an online test exam based on ten questions and four options (only one option will be correct).
2) **SPECIFIC OBJECTIVE 2:** Evaluate the clinical effectivity of checklist implementation, through studying whether the study sample has carried out or not if required at least one of the following clinical actions: opening an airway blocked, stabilizing a spine, closing a broken pelvis, splinting a broken bone, performing a valve to treat an open pneumothorax. It will be studied till a year after the training.
3) **SPECIFIC OBJECTIVE 3:** Evaluate whether there exist or not differences in deaths because of the accidents till a year after the training among both groups trained and not trained.
4) **SPECIFIC OBJECTIVE 4:** Evaluate whether exist or not differences of disability because of the accidents till a year after their accident, among victims assisted by both groups trained and not trained.

7. MATERIAL AND METHODS

7.1 STUDY DESIGN

We will carry out this intervention through a randomized, controlled, longitudinal prospective open-label interventional study.

We will have our study subjects randomized into two groups ratio 1:1 after they have decided to join our study and after they have signed the consent form to be part of it.

- **Group A:** the federated in mountain sports and climbing will receive a checklist through a training programme, they will be taught how to read our specific checklist, and will be given after the training the checklist in paper for themselves. The 50% of this group must belong to Catalan federation (FEEC) and the other 50% to Basque federation (EMF-FVM)
- **Group B:** the federated in mountain sports and climbing will not receive a checklist nor a training programme to learn how to read it. The 50% of them must be part of Catalan federation and the other 50% of Basque federation.

All our study subjects' interventions in accidents will be followed up to a year since the training.

The victims that our study subjects assist will be followed up to a year of their accident in order to study "disability".

7.2 STUDY SETTING

The study setting will include the Catalan and Basque federations, which are part from FEDME:

- **FEEC (Federació d'Entitats Excursionistes de Catalunya)**. It is organized in twelve "vegueries". It includes 429 federated clubs.
  - Regió I - Baix Llobregat.
  - Regió I – Barcelonès.
  - Regió I – Vallès.
  - Regió I - Maresme.
  - Regió II - Alt Empordà, Baix Empordà, Garrotxa, Gironès, Pla de l'Estany, Selva.
  - Regió III - Alt Penedès, Baix Penedès, Garraf.
  - Regió IV - Alt Camp, Baix Camp, Conca de Barberà, Priorat, Ribera d'Ebre, Tarragonès.
  - Regió V - Baix Ebre, Montsià, Terra Alta.
  - Regió VI Cerdanya, Osona, Ripollès.
  - Regió VII: Anoia, Bages, Berguedà, Moianès, Solsonès.
  - Regió VIII: Garrigues, Noguera, Pla d'Urgell, Segarra, Segrià, Urgell.
  - Regió IV: Alt Urgell, Alta Ribagorça, Pallars Jussà, Pallars Sobirà, Val d'Aran.
- **EMF-FVM (Euskal Mendizale Federazioa – Federación Vasca de Montaña)**. It is organized in three provinces. It includes 289 federated clubs.
  - Federación Alavesa de Montaña.
  - Federación Bizkaina de Montaña.
  - Federación Guipuzkoana de Montaña.

There will be a main clinic coordinator that will lead the project and he/she will be a physician expert in urgency and emergency medicine. He/she must have a valid ATLS course and will be member of the *Medicine Faculty* of *Universitat de Girona*. There also will be two research assistants from *Universitat de Girona* too. Both clinical coordinator and research assistants will contact FEEC and EMF-FVM coordinators in order to arrange the training for group A and to request data relative to accidents assisted by our study subjects if needed. We will also count with two data manager that will organise and manage personal data and data related to accident. A statistician will be hired too.

7.3 STUDY POPULATION

The study population will be the membership of Catalan and Basque federations. Total population included will be 82.551 federated members.

- FEEC: 42.313 federated people (2021).
- EMF-FVM: 40.238 federated people (2021).

7.4 STUDY SUBJECTS

The study subjects will be the federated people including those aged 18 years old and over, who are members of previously mentioned federations. All study subjects must meet the following inclusion criteria and do not meet exclusion criteria.

7.4.1 INCLUSION CRITERIA

- Federated people in 2023, members from FEEC or EMF-FVM.
- People at least 18 years old.
- Women or men.
- People who have signed the informed consent form.

7.4.2 EXCLUSION CRITERIA

- People under 18 years old.
- People that have validated ATLS course (he/she attended ATLS course less than four years ago from the moment of the recruiting).
- Federated that already suffer or that develop any medical condition before the training that does not allow them to practise any kind of sports or go to the mountain.

7.4.3 PARTICIPANTS WITHDRAWAL OR TERMINATION

- People who decide to withdrawal.
- Federated from whom we lose follow-up.
- People who get infected from COVID-19 the day of the instruction, unless health system allows to not be lockdown when suffering COVID-19 in 2023.
- People who do not carry out the “pre-training” online test exam.

7.5 SAMPLE

7.5.1 SAMPLE SIZE

In a bilateral test, accepting an alpha risk of 5%, a statistical power of 80% and assuming that the percentage of accidents is close to 3.5% we would need 392 subjects for each arm (784 subjects in total). However, because the non-response of our invitation to participate in our study could be very high (we assume a 50% of non-response), we will send a total of 1176 invitations (588 subjects for each arm). Nevertheless, we expect a very little rate of non-response to our invitation.

Summarizing, we would need between 392 and 588 subjects for each arm. We will assume that we will need 392 subjects for group A and 392 subjects for group B.

7.5.2 SAMPLE SELECTION AND RECRUITMENT

For the sample selection we will use a probabilistic simple aleatory method. We will propose to participate in the intervention those federated people from the federations mentioned before. Invitations will be sent to both Catalan (FEEC) and Basque federations (EMF-FVM) and they will send in turn the invitations to their federated members for them to sign up. To make this project possible, we will start recruiting the sample the 1st January 2023 since the federative license uses to be renewed each year by January (the federative process is available since December from the previous year). Federated will have up to three months to get enlisted by filling an online questionnaire (**ANNEX 2**).

Once the registration period is over, we will perform an aleatory selection among the people enlisted that meet inclusion criteria and do not meet exclusion criteria in order to obtain our sample subjects, that will be a total 784 subjects. Half of them will be members of the Catalan federation and half of them will be members of the Basque federation. When federated people are willing to be part of our Project, they must read the information sheet (**ANNEX 1**) and sign the informed consent form (**ANNEX 3**).

7.5.3 RANDOMIZATION METHODS

Once the federated that had been aleatory selected among the people enlisted, and once they had signed and decided to join the study, they will be randomized and will be assigned to one of the two groups available for the study in a 1:1 ratio (group A or group B mentioned before). Half of group A will be members of Catalan federation and half of group B too.

Randomization will be performed by the statistician in charge and through *IMB SPSS* ® 27.0 version. This program will provide each federated person an identification number that they will know and they will have to memorize. This number will assure confidentiality of participants subjects.

7.5.4 MASKING TECHNIQUES

Our Project will consist on implementing among group A a checklist through a training in order to teach them how to read our specific checklist. Group B will not receive this training. As consequence, during the training, the medical professional instructors and the federated will know which group they belong.

Statistician that will evaluate all the data will be blind. The two research assistants and the main clinical researcher will be blinded. We will adopt these measures in order to reduce the possibility of bias.

7.6 DATA COLLECTION

We will collect personal information about the federated people in order to enter the study through an online questionnaire (**ANNEX 2**).

Data relating to "pre-training" and "post-training" **(see 7.7 INTERVENTION**) online test exam will also be collected in a database.

We will also collect further personal information related to the victim and information related to the accident during the years that last the intervention. We will carry out this collection through the accident report (**ANNEX 7**) that will be filled together by the federated, by the doctor that attend the victim and by the rescue service provider. The federated that provides the first care assistance must notify to the health assistance and

to the rescue forces that accident report must be filled. This information will be notified to us by e-mail and also to Basque and Catalan federations, since they have their own accident report. If any data is not filled and if it is possible to find it out (i.e. temperature), we will perform a research. Information related to deaths because of the accident and presence of disability after a year of victim's accident will also be filled in accident report form and will enter our database.

7.7 INTERVENTION AND FOLLOW-UP

Our goal is to study the effectivity of implementing a specific checklist (**ANNEX 6**) among federated in Basque Country and in Catalonia. We will count with the support of *Faculty of Medicine* of *University of Girona* and *Servei Català de la Salut.* Before making use of the checklist, we will have to validate it.

Our whole intervention will consist of seven differentiated phases.

1) Firstly, we will collect ten physicians and ten nurses both specialized in urgencies and emergencies that must have accredited and operative ATLS course. The half of those health professionals will be part of the *Servei Català de la Salut* and the other half will be part of *Servicio Vasco de Salud.* In summary, there will be five physicians and five nurses from *Servei Català de la Salut* and five physicians and five nurses from S*ervicio Vasco de Salud.*

   Those health professionals will attend a one-morning-meeting where they will be told how to implement and explain checklist in group A through training (**ANNEX 5**). This training and specific checklist must be validated before being taught to subjects from group A. The main clinical coordinator of the project will be in charge of giving the instructions and explain the contents to those health professionals in the meeting.

2) Once instructors got trained, the inscriptions to collect the federated that will be part of our study will be available. We will send to them an e-mail that will contain the study intervention information (**ANNEX 1**), the questionnaire to get enlisted (**ANNEX 2**) and the informed consent form (**ANNEX 3**) When inscription time ends,

the study subjects will be chosen aleatory within the people that meet inclusion criteria and not meet exclusion criteria. Before entering the study, they must read the information sheet and must sign informed consent form.

Randomization within the study subjects will take place in order to join group A or group B, following a 1:1 ratio:

- Group A: The checklist will be implemented among them through a training. Checklist will be given to them physically the day of the training and they also could access to it through our study online platform. They will be told to take the checklist with themselves when they go to the mountain and to follow it and fill it when they meet an accident.
- Group B: they will not receive the checklist nor a training programme. They will not have access to checklist in our online platform.

Both group A and B will be told through intervention information sheet (**ANNEX 1**) that they must assist and help every victim accident they meet in the mountain in order to carry out the study. Federated will have to take with them to the mountain and to fill within health services and rescue forces the "accident report" (**ANNEX 7**) and will have to send us a copy of it through e-mail.

Our study subjects will be given an identification number that will guarantee their anonymity and that will be required to perform online exams. They will also have to remember it because it will be requested in the accident report.

3) Once our subjects have been assigned to group A or B, they will have to carry out an online test exam based on ten questions, before the training. This will be the "pre-training exam" (**ANNEX 4**). It will be performed in the online platform that we will create specifically to carry out this project. Before making use of this exam, it must be validated.

4) Later, the training will be carried out as we have defined in **ANNEX 5.** The content will be developed in this annex to. We will have to validate this training contents.

The training will be imparted by the health professionals from *Servei Català de la Salut* and from *Servicio Vasco de Salud* mentioned before. The group A will be distributed in groups of ten and they will be trained by a nurse together with a

physician. So, the training ratio will be: one physician, one nurse, ten federated (except two groups, where there will be eleven federated). The health professionals will be distributed aleatory in those groups of ten federated. The Catalan federated will be trained in Catalonia and the Basque federated will be trained in Basque Country. Nevertheless, the twenty health professionals will train both in Catalonia and Basque Country.

It will be performed an agreement with Medicine and Nursery faculties within Basque Country and Catalonia in order to implement the training in their classrooms and in order to use their simulation tools. The trainings will last a morning and will be imparted from 6th May 2023 to 6th July 2023, on weekends.

The material that instructors will need to perform the training will be:

- A mannequin.
- A computer and a projector to show a Power Point.
- A clock to check heart rate and breathing rate.
- A pelvic belt.
- Ropes.
- Gazes.
- A splint.
- Non occlusive gazes.
- Scissors.
- Sticking plaster.
- A pen to fill checklist and accident report.

5) Six months after the training, group A will take in our online platform the same online test exam (**ANNEX 4**) that they performed before their training. As mentioned before, it will have to be validated. They will have up to five days to complete the exam. This will be the "post-training exam". This exam will take place from 6th November 2023 to 6th January 2024 (the exam will be available exactly six months after their training, depending on which moment they assisted the training). Group B will perform this exam in December 2023. They will perform the same online test in order to study whether there exists or not "increment of knowledge" among group A, and marks changes between "pre-training" and "post-training" will be

compared both in group A and B. They will not be told that the “pre-training” and “post-training” exam will be the same.

6) Up to a year after the training, thanks to “accident report” it will be evaluated the assistance given by our subjects (group A and B) to the victims they have faced in the mountain. This evaluation will consider the clinical actions that our subjects have carried out in the victims assisted. Those actions are collected and defined in “dependent variables”. It will also be evaluated mortality because of the accident among assisted victims. That way, there will be studied whether there exist or not assistance differences among group A and B.

7) A year after the last accident (that can take place up to two years after the training), it will be determined the existence of disable people among victims treated by federated that have received checklist implementation and federated that have not received checklist implementation.

Victim assistance and further information related to accidentality will be collected in the accident report.

7.8 VARIABLES

7.8.1 INDEPENDENT VARIABLE

The independent variable that we will consider in our study is the implementation of a checklist through a training programme.

Independent variable is a qualitative nominal dichotomous variable that will adopt one or another value depending on whether the federated has received checklist through a training: YES/NO.

This variable has been previously mentioned and detailed in **7.7 INTERVENTION.**

7.8.2 DEPENDENT VARIABLES

Difference of marks between online exam test before and after the training among trained and not trained. It is a nominal discrete quantitative variate. It will be studied indirectly by comparing the marks within the same exam before and after the training. Marks will be measured in numbers from 0 to 10 and will only take the form of whole numbers (0, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10).

Applying checklist in the accident. It will be a qualitative nominal dichotomous variable that will adopt one or another value depending on whether the federated has applied it or not: YES/NO

Achieving concrete clinical competencies by federated people. It will be admitted "not required" if the victim does not need it. All of them will be qualitative nominal polychotomous variables. They will be measured depending on whether the competency has been achieved or not: YES/NO/not required. Those concrete clinical competencies are explained how they must be performed in **ANNEX 5**, they will be checked by the doctor that attends the victim immediately after the accident, and will be filled in the accident report sheet.

- **Open an airway blocked.** We will consider "YES" for opened airway previously blocked when the federated has carried out mandible elevation or forehead-chin manoeuvre correctly if needed. It will be considered "NO" when it was needed but not carried out or when it has been performed in a wrong or useless way.
- **Cervical spine stabilization.** We will admit that this variate takes the value "YES" when the federated people have assumed that the victim needs to receive or to guide a cervical spine stabilization and has done it correctly (encouraging the victim to not move the neck if conscious, or if unconscious, placing cervical spine well aligned with mid-line body, placing both rescuer hands in mastoid apophyisis and occipital skull bone from the victim), and "NO" when needed but not carried out or carried out in a wrong way.
- **Closing a pelvis fracture.** This variable will be considered as "YES" when the federated had tight the pelvis correctly (both at a pelvis level and at a calf level) when required. If it was necessary to close a pelvis fracture but it was not carried out, we will consider this variate as "not performed". If the closing pelvis was required but it

was not performed or if it was needed but the federated carried out in the wrong way, we will admit that the variate is “not performed”.

- **Splinting a broken bone.** We will admit that this variety takes the value “YES” when a broken/traumatized hurting bone from the limbs had been detected and the federated has splint it correctly. It will be assumed it as “NO” when the victim needs to be treated with a splint but the federated have not placed it or when it has been wrongly performed.
- **Placing a valve in a thorax open wound.** It will be considered “YES” when the federated has notified that the victim suffers a thorax open wound and breaths with difficulty, and he performs a valve. This valve should be performed with a non-occlusive dressing or a plastic bag if nor available and it has to be fixed it in three points, leaving one point free. If the federated has not carried out this action or it has been done wrongly, we will consider this variate as “NO”.

Disability of victims attended by federated people. It will be a qualitative nominal dichotomous variable that will adopt one of the following values depending on whether disability is present after a year of the accident or not: YES/NO. Disability will be defined as a situation of disadvantage that makes difficult or does not allow to the victim to interact with the environment in a physical, neurological or intellectual way, considering an interaction that should be normally performed according to their age, gender and social and cultural factors. As a consequence, it will include people with a diagnosed disability of at least 1%, or with any neurological deficiency (memory, understanding learning, speaking, motor or sensitive including those people that stay paraplegic) or intellectual deficiencies or physical limitations because of the accident.

Mortality of victims attended by federated people

Mortality will be defined as the death of the victim. It is a qualitative nominal dichotomous variable that can adopt one of the following values: mortality related to the accident or not. If the victim dies because of the accident, it will be incorporated to our accident report copy.

7.8.3 COVARIABLES

Covariates related to the victim:

They will be filled and supervised in the report of the accident by the physician who assist the victim.

- **Gender**. It is a qualitative nominal dichotomous variate. It will take one of the following values: FEMALE/MALE.
- **Age.** It is a continuous quantitative variate. It will be expressed in years.
- **Osteoarticular underlying pathology.** It is a qualitative nominal dichotomous variate. It will be measured as present or absent (YES/NO) for the following pathologies: arthrosis, previous fractures, osteoporosis, prosthesis.

Covariates related to the rescuer:

It will be filled in the report accident by the federated that assist the victim.

- **Health professional**. It is a qualitative nominal dichotomous variate. It can take one of the two following values YES/NO.

Covariates related to the situation:

It will be filled in the report accident together by the victim if he/she can talk, by the federated that assist the victim, the health professional, the rescue forces and if not, available they will be asked, investigated or searched by manager data.

- **Individual or group activity**. It is a qualitative nominal dichotomous variate. It will take the value of INDIVIDUAL/GROUPED ACTIVITY.
- **Kind of activity**. It is a qualitative nominal polychotomous variate. It can take the value of the following activities: hiking, trekking, canyoning, trail running, mountain bike, climbing (including ice and rock climbing), skiing (including Alpine, cross country and ski touring), snowboard, snow rackets and alpinism.
- **Time of activity performed**. It is a quantitative continuous variate. It will be expressed in hours.
- **Night activity**. It is a qualitative nominal dichotomous variate. It can take the value of YES or NO.
- **Orography**. It is a qualitative nominal polychotomous variate. It can take three different values depending on how steep the terrain is: easily accessible terrain (it can be even be accessible without the need of technical shoes) difficult accessible

terrain (it may need the use of ropes, ice ax, crampons) or moderate accessible terrain.

- **Altitude of the mountain.** It is a qualitative nominal polychotomous variate. It can take the following values: low mountain (less than 1500 meters), medium mountain (from 1500 to 2500 meters) and high mountain (more than 2500 meters).
- **Meteorology.** It is a qualitative nominal polychotomous variate. It can take the following values: clear sky, cloudy without precipitations, fog, wind, storm (snow, rain or hail). When it would take more than one value, we will assume the main trigger of the accident. If unknown, can be consulted in Agencia Estatal de Meteorología (AEMET).
- **Temperature.** It is a continuous quantitative variate.
  - When ambiance temperature takes values within +10ºC and -50ºC we will considerate wind chill. It will be measured without unities, and it is the relation among air temperature in Celsius and wind velocity in kilometres per hour. It will help us to estimate the additional cooling effect on the skin because of the wind contact with ambient air. If unknown, can be consulted in AEMET.

$$STF = 13{,}1267 + 0{,}6215 \cdot T - 11{,}37 \cdot V0{,}16 + 0{,}3965 \cdot T \cdot V0{,}16$$

STF is the wind chill index, T is temperature of ambience air in Celsius and V is wind velocity in kilometres per hour measured 10 meters above the ground. (19)

  - When ambiance temperature takes values over 26ºC and humidity over 40% we will calculate heat index. It measures the effect over the skin because of the combination of ambiance temperature and relative air humidity.

$$STC = -8{,}78469476 + 1{,}61139411 \cdot T + 2{,}338548839 \cdot HR - 0{,}14611605 \cdot T \cdot HR - 0{,}012308094 \cdot T2 - 0{,}016424828 \cdot HR2 + + 0{,}002211732 \cdot T2 \cdot R + 0{,}00072546 \cdot T \cdot HR2 - 0{,}000003582 \cdot T2 \cdot HR2$$

STC is heat index, T is air ambiance in Celsius and HR is relative air humidity in percentage. (19)

- **Time of arrival to a health centre or hospital**. It is a qualitative nominal polychotomous variate. It will be defined in time and it will take one of the following values: accessible in less than thirty minutes, accessible in more than thirty minutes but less than an hour, accessible in more than an hour but less than ninety minutes or accessible in more than ninety minutes. It will be determined when the victim arrives to the health centre by the physician who assist the victim there.

7.9 STATISTICAL ANALYSIS

There will be a statistician that will perform the statistical analysis, he will be blind in order to reduce any potential bias. He/she will carry out the analysis through *IMB SPSS* ® 27.0 version.

7.9.1 UNIVARIATE DESCRIPTIVE ANALYSIS

We will summarize the dependent qualitative variates relating along with the covariates using proportions.

Quantitative variables will be summarized using means, standard derivations, medians and interquartile range. Concretely, those quantitative covariates ("age" and "years practising mountain sport") will be summarized by means and standard derivations. They will be stratified by the independent variable and will be categorized in quartiles.

We will calculate the differences between pre-training and post-training exam results among trained and non-trained federated.

The dependent variables of the specific objectives 2, 3 and 4 will be also summarized stratifying by the groups of the independent variable ("having been trained with checklist or not"). We will also stratify those analysis by covariates.

7.9.2 BIVARIATE INFERENCE

The differences between pre-training and post-training exam results between trained and non-trained will be tested using a t student's (means) and the Mann-Whitney' U (medians).

The different proportions of the dependent variates relatives to specific objectives 2, 3 and 4 among the trained (group A) and the non-trained people (group B) will be tested by employing a Chi-square test ($\chi 2$). With the purpose of comparing the frequency of occurrence of each dependent variable between group A and group B, data will be summarized in contingency tables.

We will compute the Fisher's exact test when the number of expected counts in each cell is lower than 5.

The difference of proportions of the dependent variables relatives to specific objectives 2, 3,4 and specific objective 1 between group A and group B will be also tested using a ($\chi 2$) Chi-square test, or the Fisher's exact test if needed.

To check whether there are significant differences between group A and group B, we will stratify the analysis by the covariates.

7.9.3 MULTIVARIATE ANALYSIS

The differences between pre-training and post-training exam results among trained and non-trained will be adjusted in a linear regression, controlling for covariates.

The effectivity of the implementation of the checklist will be assessed by means of logistic regressions.

We will perform a multivariate analysis to predict dependent qualitative variables based on independent ones, and we will adjust variables for covariates to control them to avoid potential confounding factors that can alter the results.

A confidence interval of 95% and a $p<0.05$ statistically significant will be adopted.

8. WORK PLAN AND CHRONOGRAM

Our whole study will last 4 years, from March 2022 to February 2026. We will divide the procedure into different phases:

STAGE I: STUDY DESIGN AND FISRT COORDINATION (March 2022 – August 2022)

- **Activity 1 (March 2022).** There will be stablished the main coordinator of our study (he or she will be a physician from *Medicine Faculty* from *Universitat de Girona.* There will also be defined two research assistants and two data managers. The bibliographic research about checklist, ABCDE methodology and its application in trauma victim's support will take place.
- **Activity 2 (April 2022).** The study design will be developed by the main coordinator, who will determinate and elaborate the hypothesis, objectives, study population and sample, variates, covariates, methodology and methods, statistical analysis design, training contents. Test and checklist will be validated.
- **Activity 3 (May 2022 – August 2022)**. Ethical revision and approbation will take place. Our interventional protocol will be presented to the Clinical Research Ethics Committee at *Hospital Universitari Doctor Josep Trueta* (Girona).

STAGE II: ADDITIONAL STAFF COORDINATION (September 2022 –December 2022)

- **Activity 4 (September 2022 – November 2022).** The seek and recruitment of Basque and Catalan physicians and nurses, experts in emergencies will take place. It will be performed the agreement among *Faculty of Medicine* of *Universitat de Girona* and Catalan and Basque public universities.
- **Activity 5 (December 2022).** Emergency health professionals will assist the meeting where they will be given and explained the training content.

STAGE III: PARTICIPANTS RECRUITMENT AND DATA COLLECTION (January 2023 – July 2025).

- **Activity 6 (January 2023).** Our online platform will be created.
- **Activity 7 (January 2023 – March 2023).** Invitations to join the study will be sent to Basque and Catalan federations, and they will send in return the invitations to their federated by email. People invited who want to join the study will get enlisted and will fill an online questionnaire.

- **Activity 8 (April 2023).** All federated that meet inclusion criteria and do not meet exclusion criteria will be requested to sign informed consent inform. The sample will be selected aleatory within the people who had agreed to enter the study. Randomization will be performed to assign group A or B.
- **Activity 9 (1st May 2023 – 5th May 2023).** Sample selection (both group A and B) will perform "pre-training" online test exam.
- **Activity 10 (6th May 2023 – 6th July 2023).** Group A of federated will be trained.
- **Activity 11 (6th May 2023 – 6th July 2025).** Data collection will be performed thanks to data managers. Accidents will be studied from 7th May 2023 till July 2024. All dependent variates will be studied from the accidents that occur till that date. Existence of disability data will be studied up to a year of victim's accident (7th July 2025).
- **Activity 12 (6th November 2023 – 6th January 2024).** Both group A and B will perform a "post-training" online test exam. Each subject from group A will have access to online exam exactly six months after their training and will have up to five days to perform it. Group B will perform it in December 2023, and will also have up to a week to complete it.

STAGE IV: STATISTICAL ANALYSIS AND INTERPRETATION (July 2025 – November 2025)

- **Activity 13 (7th July 2025 – September 2025).** A qualified statistician will be in charge of process the available data contained in our database through a univariate, bivariate and multivariate analysis.
- **Activity 14 (October 2025 – November 2025).** The analysed data will be studied, evaluated and discussed by the study coordinators. The result discussion and the conclusions will be elaborate by study coordinators together with the statistician.

STAGE V: ARTICLE ELABORATION AND RESULTS PUBLICATION (December 2025 – February 2026)

- **Activity 15 (December 2025 – January 2026).** Final article will be redacted and reviewed.
- **Activity 16 (February 2026).** The article will be published.

STAGES AND ACTIVITIES		2022					2023								2024		2025					2026	
		Mar	Apr	May-Au	Sep-Nov	Dec	Jan	Feb-Mar	Apr	May	Jun-July	Au	Nov	Dec	Jan	Feb-Dec	Jan-July	July	Au-Sep	Oct-Nov	Dec	Jan	Feb
STAGE I	1. Bibliographic research																						
	2. Study design																						
	3. CEIC																						
STAGE II	4. Instructors recruitment																						
	5. Instructors training																						
STAGE III	6.Online platform creation																						
	7.Sample recruitment																						
	8.Sample randomization																						
	9.Pre-training exam																						
	10. Group A training																						
	11.Data collection																						
	12.Post-training exam																						
STAGE IV	13.Analysis data																						
	14.Data discussion																						
STAGE V	15.Article redaction																						
	16.Article publication																						

Table 3: Chronogram

9. LEGAL AND ETHICAL CONSIDERATIONS

We will present this research protocol to *Comitè Ètic d'Investigació Clínica (CEIC)* from *Hospital Universitario Dr. Josep Trueta*, and we will only carry it out with its approval. CEIC will guarantee that our project respects the four *Principles of Biomedical Ethics* of autonomy, beneficence, non-maleficence and justice, redacted by Tom L. Beauchamp and James F. Childress, in order to respect *World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects.*

Before entering the study, we will inform to our study subjects how it is going to be carried out through the intervention information sheet (**ANNEX 1**) to guarantee the cumpliment of *Ley 41/2002, de 14 de noviembre, básica reguladora de la autonomía del paciente y derechos y obligaciones en materia de información y documentación clínica*. Once read the intervention information sheet and understood it, people who agree to be part of the project must get enlisted (**ANNEX 2**) and sign informed consent form (**ANNEX 3**). They will be told that they are free to refuse our invitation to be part of the study as well as free to withdraw from the study whenever they decide.

All personal data will be treated, processed and collected solely with the purpose of carrying out this study. It will be always guaranteed study subjects' anonymity and confidentiality, according to *Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales* and particulary in its Additional Provision 17.2 and also according *Regulation (EU) 2016/679 of parliament and the European Council, April 27, 2016, concerning the protection of natural people with regard to the processing of personal data*. We will also guarantee the compliance with those mentioned laws to the victims that got assisted by our study subjects.

We declare that the results that we will obtain will be published transparently. We also announce that we do not have any conflict of interest.

10. STRENGTHS AND LIMITATIONS

Designing this project, we have found a number of strengths and limitations.

Some of the strengths that we consider this study to have, are:

- Firstly, we will carry out this project through a randomized study, so it will provide us a homogenization of confounding factors in order to guarantee study validity. Even though not all mountaineers have the same probabilities to enter the study, we have been urged to focus in mountaineers from Catalonia and Basque country to prove the efficacy of checklist implementation. Nevertheless, all enlisted people within Catalan federation and within Basque federation will have the same probability to enter the study.
- Secondly, since we will count with the collaboration of public universities that will lend us their infrastructures. Adding it to the fact that it will not be a long study, this research will turn out to be cheap as a result.
- Thirdly, this study will help public system to collect and to make uniform mountain accident data. Till the date, accident data are reported individually and heterogeneously by each of the rescue forces that operate in Spain. Additionally, federated annual reports include mostly accident referring to federated, since they have to notify them to federations to receive medical assistance. Thanks to our accident report we will also consider the operating rescue force that has leaded the rescue, and our research will include both accidentality related to federated and to non-federated mountaineers, depending on the victim.
- Furthermore, this project will give mountain society a voice, due to the fact that trust will be placed in non-medical people so they can attend in a basically but also fundamental way to mountain victims.

The limitations that we have found while designing this study are the following:

- First of all, it has been difficult for us to show representative and homogeneous data regarding mountain accidents, both worldwide and in Spain. We have accessed to mountain accidents data in Spain referring to 2020, since 2021 report will be published in July 2022. We know that in Spain, together mountaineers, mountain accidents and deaths because of those accidents have increase notably since 1980. We have also observed that because of the impact of lockdown in

society, mountain accidents have increased too. Even though we do not know whether this tendency because of COVID-19 crisis is going to be maintained, we support carrying out this study.

- In the second place, we cannot blind the study subjects nor the people that are going to teach checklist, nor the two data manager, but it will be guaranteed that both statistician, main clinical researcher and the two research assistants will be blinded.
- In the third place, we have thought about there may exist differences of checklist training among groups, since we will count with the help of ten training-teams. Nevertheless, our ten groups of instructors will be firstly attending a meeting where they will be told what they have to explain, how they must do it and they will be giving exactly training contents. (**ANNEX 5**).
- Additionally, we have also noticed that it may be difficulties to fill accident report, but since all those reports will be send to us, manager data will be sure that the reports are filled properly and completely.
- Also, our invitations to get enlisted will be sent via e-mail, which is the easiest way to access to our study sample. It is possible that because of that people that are more active within internet will be more likely to join our study.
- Finally, we will have to get our “pre-training” and “post-training exam” (**ANNEX 4**), our checklist (**ANNEX 6**) and our training contents (**ANNEX 5**) validated before implementing them.

11. FEASIBILITY

We consider that this study is feasible. It will be leaded by *Faculty of Medicine* of *Universitat de Girona.* The main clinical coordinator will be a physician expert in urgency and emergency medicine, so he/she will know how to manage ABCDE-checklist training and will know how to coordinate the health professionals that will later instruct the intervention group A. The instructors will also be experts in emergencies and urgencies.

784 participants will be recruited in three months and we will reach them through e-mail, since their federations have access to their e-mails. They will be sent the information intervention sheet, the online questionnaire in order to get enlisted and the consent informed form.

We will have up to three months to train intervention group. The two research assistants from *Universitat de Girona* will contact FEEC and EMF-FVM in order to manage the training. The training will be possible and affordable as we will count with ten teams of one physician and one nurse. They will be training federated in groups of ten people on weekends, and they will have up to three months to perform it. Training will last four hours for each group of ten federated.

We will make an agreement within both Catalan and Basque universities in order to make use of their infrastructures, concreting simulating classrooms, computers, projectors, mannequins, pelvic belts, dressings, gazes and manufacturer tourniquets.

The “pre-training” and “post-training online test will be available in the internet platform that we will create to carry out our study. The study subjects will access to it thanks to their identification number.

We will be able to collect the data relating to victims with the help of accident report. To manage and organise the collected data we will need the help of two data manager. We will need up to a year to collect enough information to perform statistical analysis. For determine disability because of the accident, we will need up to a year after victim’s accident.

To perform statistical analysis, we will count with the help of a statistician, since he/she will be member of *Universitat de Girona,* he/she will make use of computer equipment and infrastructures from the university.

12. BUDGET

The main researcher physician and the two research assistants will receive a payment because of their study participation.

It will be needed to pay expenses cost because of travelling to the people that will train group A, so we will pay five nurses from *Servei Català de la Salut* and five physicians and five nurses from S*ervicio Vasco de Salud.*

Since the training will be carried out in public Catalan and Basque universities, we will not need additional material. We will make an agreement for use their simulation classrooms and their materials.

. It will also be necessary to count with the help of two data manager to organise and manage accident report data and personal data from study subjects. We will also need to hire a statistician to carry out randomisation of group A and B, to create database and to perform statistical analysis

The literature review will have no cost. It will be needed to carry out with the expenses of publication and congress inscription.

	Budget	**Required**	**Cost**
Main researcher	900 € a year	3 years	2700 €
Two research assistants	18 €/h	60 hours	2160 €
Twenty health professionals	15 €/h	16 hours each one	4800 €
Informatic to create online platform	30 €/h	10 hours	300 €
Checklist and accident report printing	0,08 € one colour page	4 pages for 412 people	131,84 €
Statistician	30 €/h	50 hours	1500 €
Two data managers	18 €/h	50 hours each one	1800 €
Publication expenses			2000 €
Congress inscription			1500 €
Total			**16891,84 €**

Table 4: Budget

13. IMPACT ON HEALTH SYSTEM

Performing procedures by following a checklist has been proved to saves lives in different fields of knowledge, as well as ABCDE mnemotechnic based on ATLS has demonstrated to be helpful to manage a traumatized victim.

Both checklist and ABCDE have been implemented in plenty of medicine disciplines, but only among health professionals. Because of that, we have felt the urge of implementing these tools within non-experts too. We expect that people without any or few knowledge about first aids will be able to remember the information taught after six months. We also look forward that when they face a victim, with the help of our checklist, they perform approximation about victim severity, to establish a priority order to assist the victim, to help to reduce sequels (including disabilities), promote indirectly victim's quicker recovering, and if given the case, it may help to save lives. If our study turns out to be effective, the people that got trained with our checklist would have been able to contribute with emergency and rescue systems, to manage vital risk situations and to notice them when they find an injured that needs to be urgently assisted.

If our main hypothesis is correct and verified, in the future we would implement this checklist also in the rest of our society to improve basic assistance in traumatic victims in the mountain. Firstly, we would study the regions with more mountain accidents and secondly, we would contact with governments, universities, city councils and organizations in order to train them too.

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15. ANNEXES

15.1 ANNEX 1: INTERVENTION INFORMATION SHEET

Universitat de Girona. Facultat de Medicina UdG
Càtedra de Medicina de Muntanya i del Medi Natural i Simulació Clínica
Carrer Emili Grahit, 77. 17071 (GIRONA)

INFORMACIÓN SOBRE EL ESTUDIO AL PARTICIPANTE

ESTUDIO: Efectividad de la implementación de una lista de verificación para la evaluación inicial en accidentes de montaña.

INVESTIGADORES: miembros del departamento de *Càtedra de Medicina de Muntanya i del Medi Natural i Simulació Clínica* de la *Universitat de Girona*.

Estimado federado en montaña:

Ha sido invitado a participar a través de la federación de su comunidad autónoma en este proyecto de investigación. Para que pueda decidir libremente si quiere colaborar con nosotros, es necesario que lea los siguientes contenidos donde le explicaremos en qué consistirá nuestra investigación, cómo puede ayudarnos y de qué manera puede contribuir sin ser usted profesional de la salud a mejorar la asistencia y seguridad sanitaria en la montaña.

FINALIDAD DEL ESTUDIO

La finalidad de nuestro proyecto es comprobar si es efectivo el uso de una lista de verificación para valorar a la víctima de un accidente de montaña. Nuestro objetivo es que usted aprenda a identificar si el herido sufre lesiones que puedan amenazar su vida y que usted sepa cuándo notificarlo a los servicios de emergencia. Del mismo modo, podrá asistirle con primeros auxilios, básicos pero que pueden tener un gran impacto en la salud del herido y en futuras secuelas. Esta lista de verificación se basa en la regla mnemotécnica ABCDE, donde se prioriza la comprobación de unos parámetros por encima de otros y se prioriza llevar a cabo ciertas acciones de primeros auxilios. El ABCDE contempla que, en primer lugar, es importante ver si la víctima tiene la vía aérea abierta

(A) a la vez que nos aseguramos de que su columna cervical no sufra daño, después valoramos su respiración (B), seguido de comprobar su circulación sanguínea (C) y posibles sangrados, acto seguido evaluamos si existe deterioro (D) neurológico para finalizar con la comprobación de la exposición (E) al medio, es decir, prevenir si fuera necesario la bajada de temperatura corporal (hipotermia).

Esta metodología ABCDE ha sido ampliamente estudiada y ha demostrado que aplicado en las personas que sufren traumatismos (es decir, lesiones por golpes de diferentes intensidades) ayuda la atención a la víctima y sirve para priorizar qué lesiones deben ser atendidas antes. Así mismo, ha demostrado salvar vidas.

Dado que es una metodología fácil de recordar, que la mayoría de accidentes de montaña implican traumatismos, y que se ha evidenciado un aumento de personas que practican deportes de montaña así como un aumento de los accidentes de montaña consecuencia del confinamiento por la pandemia del COVID-19, nos hemos visto motivados a llevar a cabo este proyecto.

DESCRIPCIÓN DEL ESTUDIO

Si decide colaborar con nosotros, lo primero de todo deberá inscribirse. Hay un límite de plazas, por lo que los participantes serán seleccionados aleatoriamente de entre los que rellenen el cuestionario de alistamiento que le hemos enviado en PDF. Si resulta ser seleccionado, le enviaremos el consentimiento y deberá firmar su participación. Después, será aleatoriamente asignado al grupo A o al grupo B, y se le dará un código de identificación para que pueda acceder a nuestra plataforma de estudio. Deberá memorizarlo para el seguimiento del estudio.

Aprovechamos desde este momento para informarle de que deberá siempre que encuentre una víctima de un accidente en montaña a asistirla, en la medida de lo posible, con los conocimientos que tenga, y que realice sólo aquello que sabe hacer. Si no tiene ningún conocimiento médico, es mejor que notifique el accidente al 112 y que permanezca simplemente al lado de la víctima, siempre velando por su

seguridad (llevando mascarilla facial, no arriesgando su vida si el ambiente es peligroso, etc). Además, si encuentra un accidentado en la montaña deberá rellenar el parte de accidentalidad que le enviaremos próximamente a su correo electrónico.

Pertenezca al grupo A o al B, en primer lugar, realizará un examen online tipo test de diez preguntas en nuestra plataforma.

En segundo lugar, si pertenece al grupo A, le contactaremos para que acuda a una formación en alguna de las universidades públicas de su comunidad autónoma, donde profesionales de la salud especialistas en urgencias y emergencias le enseñarán cómo interpretar nuestra lista de verificación basada en la metodología ABCDE.

En tercer lugar, realizará un examen online tipo test de diez preguntas en nuestra plataforma.

Como ya hemos citado antes, para el estudio necesitaremos que durante un año (mayo de 2023 a julio de 2024) asista a cada víctima que encuentre en la montaña, según sus posibilidades y en la medida de sus conocimientos. Es muy importante que durante el año que dura la parte de su intervención se asegure de que usted junto con las autoridades sanitarias y de rescate rellenen el parte de accidentalidad. Así mismo, deberá enviarnos una copia o foto del parte relleno a nosotros para poder llevar a cabo el estudio. Podrá acceder a él mediante nuestra plataforma online.

PARTICIPACIÓN EN EL ESTUDIO, REVOCACIÓN DE PARTICIPACIÓN Y ÉTICA

En primer lugar, la participación en este proyecto es voluntaria. Puede decidir no participar en él incluso inmediatamente después de firmar el acuerdo de participación, o aun habiendo comenzado el proyecto, puede revocar su firma y dejar de ser parte del estudio. La decisión de no participar o de dejar de ser parte del proyecto no le supondrá de ningún modo ningún perjuicio.

BENEFICIOS DE SU PARTICIPACIÓN EN EL ESTUDIO

Mediante su participación en el estudio, podrá, si pertenece al grupo A obtener conocimientos sobre la metodología ABCDE y contribuir a la asistencia a víctimas en montaña, de manera básica. Es posible que gracias a usted personas se beneficien de sus acciones. Sin embargo, no garantizamos que con este proyecto vaya a adquirir todos los conocimientos que le explicaremos ni que vaya aplicarlos de manera adecuada.

RIESGOS DE PARTICIPACIÓN

Participar en este estudio no implica ningún riesgo para la salud. Usted simplemente deberá realizar dos exámenes online, recibir formación si pertenece al grupo A, y cada vez que acuda a la montaña llevar con usted el parte de accidente, y si observa algún accidentado, prestarle ayuda y cerciorarse de que el parte de accidentes es rellenado por las autoridades sanitarias y de rescate.

CONFIDENCIALIDAD DE SUS DATOS

Recogeremos sus datos personales requeridos en el cuestionario en nuestra base de datos y los analizaremos y trataremos de manera anónima y confidencial, acorde con la Ley Orgánica 03/2018 de Protección de Datos Personales. Es posible que durante el estudio le solicitemos datos personales adicionales, en todo caso, se tratarán de la misma manera y acorde con la ley anteriormente citada.

COMPENSACIÓN ECONÓMICA

No será recompensado económicamente por participar en nuestro estudio.

CONTACTO

Podrá contactarnos mediante el mismo correo electrónico con el que nos hemos dirigido a usted, así como a través de la *Facultat de Medicina* de la *Universitat de Girona*.

15.2 ANNEX 2: QUESTIONNAIRE TO GET ENLISTED

In order to get enlisted to our study, you will have to fill the following online questionnaire. Your personal confidential information will be respected according to *Ley Orgánica 3/2018 de 5 de diciembre, de Protección de Datos Personales Garantía de los Derechos Digitales,* particularly Additional Provision 17.2 and "*Regulation (EU) 2016/679 of parliament and the European Council, April 27, 2016, concerning the protection of natural people with regard to the processing of personal data"*.

You will have to send us this questionnaire through e-mail.

Your personal information will be only used for study including and excluding criteria in order to enter the study and for research purposes of our interventional study.

Name and Surname:

Age:

E-mail:

You belong to FEEC or to EMF-FVM:

Residence province:

Have you at the moment a valid ATLS course certification? (it is valid if coursed less than four years ago) (yes or no)

Have you any underlying pathology? (yes or no) **Which one?**

Are you a health professional? Which kind of health professional?

15.3 ANNEX 3: INFORMED CONSENT FORM

Universitat de Girona. Facultat de Medicina UdG
Càtedra de Medicina de Muntanya i del Medi Natural i Simulació Clínica
Carrer Emili Grahit, 77. 17071 (GIRONA)

CONSENTIMIENTO INFORMADO AL PARTICIPANTE

ESTUDIO: Efectividad de la implementación de una lista de verificación para la evaluación inicial en accidentes de montaña.

Yo, (nombre y apellidos)_____

con DNI/NIE_____declaro que:

1. He leído en su totalidad el documento "INFORMACIÓN SOBRE EL ESTUDIO AL PARTICIPANTE".
2. He comprendido todos y cada uno de los párrafos contenidos en documento "INFORMACIÓN SOBRE EL ESTUDIO AL PARTICIPANTE".
3. He preguntado sobre aquellos contenidos de "INFORMACIÓN SOBRE EL ESTUDIO AL PARTICIPANTE" en los que he tenido dudas o que no he llegado a comprender.
4. Comprendo que mi participación es voluntaria y que no recibiré ningún tipo de bonificación económica.
5. Soy consciente de que puedo revocar mi consentimiento cuando así lo considere, sin tener que justificarlo y sin que ello implique un perjuicio en mi persona.
6. Comprendo que todos mis datos personales que se recojan en el estudio serán confidenciales.

Consecuentemente:

1. Estoy conforme con mi participación en este estudio y consiento que se gestione mi información personal acorde a lo detallado en el documento "INFORMACIÓN SOBRE EL ESTUDIO AL PARTICIPANTE".
2. Consiento que los investigadores del proyecto puedan ponerse en contacto conmigo si el desarrollo del estudio así lo requiere.

Lo firmo, en _____en la fecha _____/_____/_____

Firma del participante: Firma del investigador

15.4 ANNEX 4: ONLINE PRE-TRAINING AND POST-TRAINING TEST EXAM.

You will perform individually and without the help of any information tool a ten-question test exam. There will be four options for each question. Only one option will be the correct answer. You can uncheck the answer if you want. You will dispose of ten minutes to perform the complete exam. Marks can get from a 0 to a 10. Good luck!

QUESTION 1. You find a victim lying on the floor next to his bicycle. He is unconscious and respiratory movements are not observed. First of all, we should:

a) Check heart rate.
b) Open airway.
c) Look for wounds.
d) Cover him with clothes.

Correct answer: b). (The examined will not see this).

QUESTION 2. If you suspect that someone unconscious who is lying on the floor has suffered a head traumatism you must not:

a) Stabilise cervical spine.
b) Check breathing rate.
c) Move the victim.
d) Check airway.

Correct answer: c). (The examined will not see this).

QUESTION 3. Which are the main three steps that must be performed when we face an accident?

a) Protect ourselves and people surrounding, alert emergency services, help the victim.
b) Alert emergency services, check pupils and start CPR.
c) Protect ourselves, look for wounds and alert emergency services.
d) Help the victim, look for an AED (automatic external defibrillator) and protect ourselves.

Correct answer: a). (The examined will not see this).

QUESTION 4. What do we have to do to a victim who is bleeding a bit from a little wound in the thigh?

a) Apply manual pressure over the wound with gazes.
b) Perform a tourniquet.
c) Close the pelvis.
d) Apply 70º alcohol over the wound.

Correct answer: a). (The examined will not see this).

QUESTION 5. What do we have to suspect when the victim breaths fast and asymmetrically, the thorax hurts and cracks and the victim has suffered a thoracic traumatism?

a) Cardiorespiratory arrest.
b) Brain stroke.
c) Broken pelvis.
d) Pneumothorax.

Correct answer: d). (The examined will not see this).

QUESTION 6. We find someone who has fell from a heigh, whose right pelvis hurts, and we observe a deformity in the right leg. What do we have to perform?

a) We have to close the pelvis with a belt and also perform CPR.
b) We have to close the pelvis with a belt and also tight the calfs of the legs.
c) We have to close the pelvis with a belt and also open airway.
d) We have to close the pelvis with a belt and sit the victim.

Correct answer: b). (The examined will not see this).

QUESTION 7. When you observe a deformity in someone's arm and it seems he/she has broken her radius bone, you must not:

a) Calm the victim.
b) Protect the zone.
c) Straighten the deformity.
d) Splint the arm.

Correct answer: c). (The examined will not see this).

QUESTION 8. Which is the most important action of the following ones to perform in an open pneumothorax due to a wound?

a) Open airway.
b) Perform a valve with an occlusive gaze and stick it in two points of the gaze.
c) Perform a valve with a non-occlusive gaze and stick it in three points of the gaze.
d) Perform a valve with a non-occlusive gaze and stick it in four points of the gaze.

Correct answer: c). (The examined will not see this).

QUESTION 9. Which of the following sentences about tourniquets is false?

a) Tourniquets are performed when there is a massive, life-risk haemorrhage.
b) Tourniquets are performed in every bleeding wound.
c) Tourniquets are performed if the bleeding requires it and it is possible to arrive to the hospital in less than two hours.
d) Tourniquets are only performed if manual pressure, gazes and dressings have failed to control a huge haemorrhage.

Correct answer: b). (The examined will not see this).

QUESTION 10. AVDN neurological evaluation means:

a) Alert, verbal response, pain response, no response.
b) Alarm, verbal response, pain response, never response.
c) Airway, verbal response, neurological disability, no response.
d) Alarm, verbal response, pain response, no response.

Correct answer: a). (The examined will not see this)

15.5 ANNEX 5: TRAINING

ORGANIZATION

Group A will attend our checklist implementation carried out through a training. Our course training will take place from 10 hours a.m. to 14 hours. This training will take place in medicine and/or nursery faculties simulating classrooms within the same Autonomous Community of the federated.

Group A will be divided in groups of ten people, excepting two groups that will be provided of eleven people. They will be trained by one physician together with one nurse.

Medical instructors will firstly teach some concrete first aids notions and it will be the same content for every formation group. After explaining this consensual theory, federated will be given our specific checklist based on ABCDE and later, they will do some practical cases.

It will be always guaranteed the compliance with the valid law in order to prevent the COVID-19 infection.

MATERIAL NEEDED

The theory will be explained preferably with a Power-Point or another interactional dispositive so the federated can read the main information on a screen as the health professional is verbally explaining the theory. At least all the figures shown in this annex must be exposed on the screen.

For the clinical practical cases it will be needed:

- A mannequin.
- A pelvic belt.
- Dressings.
- Gazes.
- Sticking plaster.
- Manufacturer tourniquet.

TRAINING CONTENTS

The index of the information that we will give to the federated will be the following:

1) **Confronting an accident.**
2) **Defining the vital risk of the victim.**
3) **Attending a polytraumatic victim, first assessment.**
4) **Explaining our check-list contents.**
5) **Performing five practical cases: make an airway permeable + cervical stabilisation, controlling a pelvic bleeding, applying manual pressure on a bleeding wound, splinting a broken bone, performing a valve.**
6) **Explaining the material that they must take with them when they go to the mountain.**

TIMINGS

The first 3 points will be explained from 10 h to 11:30 h. There will be a quick rest from 11:30 to 11:45. The checklist will be explained from 11:45 h to 12:00 h. Each practical case will be discussed in 15 minutes so cases will be explained and solved by 13:15 h. From 13:15 h to 14 h medical professionals will solve doubts may federated have.

TIME	ACTIVITY
10:00 to 11:30	Confronting an accident Defining the vital risk of the victim First assessment of polytraumatic victim
11:30 to 11:45	Time break
11:45 to 12:00	Checklist explanation
12:00 to 13:15	Performing five practical cases (each one 15 minutes)
13:15 to 14:00	Doubts resolution

Table 5: Training timetable

FIRST AIDS EXPLANATION

Note to the instructor. *This will be the* ***most important*** *part of our project and this will be the most relevant information that will be explained. The checklist will be given to federated will summarise the following knowledges.*

First aids are the cares that we can apply when an acute injury happens. Its goals are **keeping the victim alive, reduce or calm suffering, preventing additional injuries and contribute to a faster recovery**.

1. CONFRONTING AN ACCIDENT.

The moment we face an accident victim, we have to follow three steps. The first one will be P for "**protection**", the second A for "**alert**" and the third one S to "**help**" the victim ("socorrer").

P: the most urgent thing is to **protect ourselves** from any potential danger, **to protect the victim** from any risk and to **protect the people surrounding** the scene, in order to not aggrandize the accident and to avoid additional accidents. It is important to **advice** and to **signpost** the accident place. If it is a very dangerous scenario, it is more important to keep security rather than attending immediately the victim. We have to remember protection with **individual masks** to prevent infection from COVID-19.

A: alert and ask for help calling 112. If we do not have a phone or we have not access to coverage, we can send people to look for additional help.

S: we will **help and assist the victim** following the next explanations. (20)

Figure 13: Proteger, avisar, socorrer.

2. DEFINING THE VITAL RISK OF THE VICTIM.

Firstly, when we face a mountain accident, we have to keep in mind some aspects in order to detect and try to solve life-risk injuries. In general, there exist **3 main causes of death due to traumatic accidents:**

- **First seconds to minutes:** apnea (breathing pause) due to severe brain or spinal injuries, heart problems, rupture of aorta artery and great vessels (superior and inferior vein cava, pulmonary arteries and pulmonary veins).
- **Within first minutes to some hours**: hemopneumothorax, cardiac tamponade, severe haemorrhage (spleen rupture, liver rupture, pelvic fracture, multiple lesions that involve severe bleeding).
- **In third term**: sepsis, multi-organic failure. (20)

Generally, people that suffer an accident get **polytraumatised**. Polytraumatised definition includes someone injured because of a high-energy traumatism that has at least two important traumatic lesions and that one or their multiple life functions are altered.

When we assist a victim, we have to define the severity of the injuries, but sometimes it is not easy to establish it. We have to keep in mind the following considerations:

- **A variety of lesions can coexist**:
  - Apparently **innocent lesions** such as hematomas **can appear associated** to other hematomas **and can suppose victim's vital risk**, since a hematoma can accumulate great amount of blood and can lead into a hypovolemic shock. A shock happens when the blood does not arrive properly to the organs, so they start to failure as they require oxygen and enough of blood to accomplish their functions. Shock can be caused by loss of fluids (such as bleeding), and that is what we call an "hypovolemic shock", because there is not enough of blood in our vessels.
  - **One lesion can aggravate another**, for example, if there is an injury in the thorax coexisting with a brain injury, the victim may have breathing difficulty due to thorax lesions, and an unproper breathing can lead in the lack of oxygen, which can worsen the brain injury.

- Sometimes **injuries can be masked by other lesions**: if the victim suffers a spinal cord injury and it coexist with a huge abdominal injury, the spinal section will “silence” the abdominal pain and we may will not be able to detect the abdominal injury, since the victim will not complain about abdominal pain or discomfort.

- **Even if vital signs are** apparently **correct** (he is breathing normally, the cardiac pulse is correct, speaks properly, is orientated, it seems that we do not evidence any bleeding) suddenly, he **can enter into a cardiorespiratory arrest**.
- Other situations that can **aggravate** the victim are:
  - **Hypothermia** state, comprehending central temperature under 36ºC.
  - Being in a **highness above** sea level greater than **2500 meters**.
  - Victim with **pain:** as a consequence of the pain, the victim may **move** and **change its position.** If there is a **fracture**, because of the moving, the bones can be displaced and the bone marrow can be exposed. If bone marrow gets exposed its components can enter the blood circulation, leading to a **fat embolism** which can be lethal and which can also develop a shock.
  - A victim with an **abnormal coagulation**: for example, if the victim is being treated with anticoagulants, antiaggregants or has any haematological disease.
  - A victim suffering **metabolic disorders** such as metabolic acidosis. That means that the victim has too much acid substances in the blood (hydrogen ions). That excess of acids leads into a situation that increases partial preassure of carbon dioxygen, and that excess of this substance can cause hypotension, heart failure, vomits, and mental state alterations (confusion, stupor, coma. (21)
  - **Stress and fatigue** of the victim.
  - A **delay in victim assessment and evacuation**.
  - Unfavourable **meteorological and access** conditions. (20)

3. ATTENDING THE POLYTRAUMATIC VICTIM: FIRST ASSESSMENT.

The first victim's attention is based on the **ABCDE assessment**.

First of all, we have to difference whether if the victim is **conscious or not**, and we have to check-up the existence of **massive haemorrhages** potentially lethal. These two verifications are simply, quick and basic.

Then, we will follow ABCDE checking. (20)

A: FOR AIRWAY. We have to get sure that the victim's **airway is permeable** and at the same time, we must make **stable the cervical spine**.

What is a permeable airway?

A permeable airway means that there is not **obstruction that could be blocking the nose, pharynx, larynx, trachea, bronchi, bronchioles**. An obstruction in the nose or in mouth-pharynx-larynx could be more evident than an obstruction located in the lower airway. We can unblock the airway in its higher levels.

In **unconscious victims**, we always have to consider that the **lack of muscle force** causes the obstruction of retro pharynx, leading into asphyxia. **Injuries in the face** or in a pharynx-larynx level can also be the cause of a blocked airway. Another examples of entities that can obstruct airway are **blood, vomits, secretions, strange bodies such as snow, teeth, sand**, etc. (20)

How do we know whether the airway is permeable or not?

If the victim is conscient, talking and breathing normally we will consider that the airway is permeable. If the victim shows **signs of difficulty breathing or is unconscious**, if the victim is in **apnea** or we do **not observe breathing movements** at all, it suggests blocked airway. (20)

How do we make airway permeable?

If we notice that the polytraumatic victim's airway is blocked, we must **elevate the mandible**. We do this manoeuvre because as the victim is polytraumatised, it is possible that he suffers a spinal cord lesion. (22) In this procedure, we will place our hands in both sides of the face, with the thumbs over maxillary bone and with the index fingers under mandibular branches (*figure 14*). Index displace mandible forwards and at the same time, we keep cervical stabilization and alienation.

Mandible elevation can also be made just grabbing the jaw and pulling up towards (*figure 15*). (20)

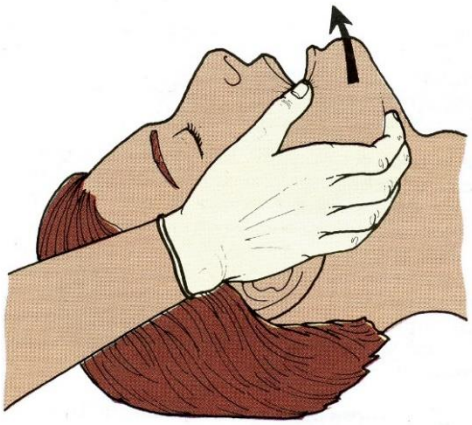

Figure 14: Mandible elevation

Figure 15: Mandible elevation by grabbing (23)

If elevation mandible manoeuvre is not effective in order to open airway, we will proceed with **forehead-chin manoeuvre**. With this procedure we make a neck hyperextension so the air can enter the lungs (*figure 16*) (20)

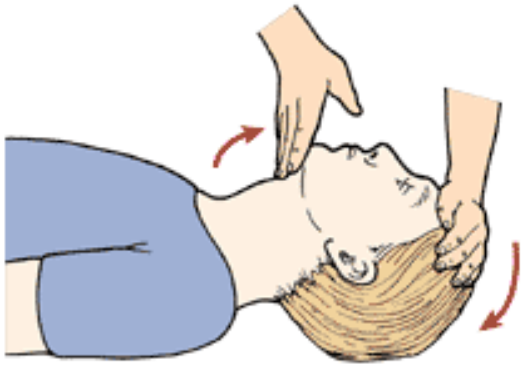

Figure 16: Manoeuvre forehead – chin (24)

Do we always need a cervical spine stabilisation?

2% of traumatized victims have a cervical spine lesion, but as we cannot know it until they are made a Compute Tomography (CT) at the hospital, we will act as **every polytraumatized victim needs a cervical spine stabilisation**, especially in **unconscious** people. (20)

How do we stabilise cervical spine?

We have to keep cervical spine in its natural position, **well aligned with mid-line body**. If patient is conscient, we will **encourage him** to not to move the neck and to keep it stable. (25) If the patient is not conscient, we have to **make it manually**: we will place both hands in victim's head (*figure 17*) in mastoid apophysis and occipital skull bone, avoiding traction or abrupt movements. In that way, we will try to assure that the cervical spine will not displace while rescue forces arrive. (20) If there is any cervical lesion that may worsen with cervical mobility, with this procedure we will **prevent devastating consequences** such as tetraplegia or even death. It is not recommended to apply a cervical collar (spinal immobilization) when we provide first aids. (25)

Figure 17: Manual cervical control (26)

B: FOR BREATHING. We have to check whether the victim is breathing or not and how is the breathing.

How do we know if someone is breathing?

We may have checked the airway and it seems to be permeable, but it does not mean that the victim is breathing. To evaluate whether the person is breathing or not, we have to keep the airway opened, **observe if thorax breathing movements** (inspiration, expiration movements) are present, **listen to breathing sounds** or feeling **victim's breath in our cheeks** (this can be made parallel to opening airway manoeuvres). Sometimes the patient shows agonic breathing movements, which are

less than 6 breathings per minute, but those breathings are not effective. We will **observe those signs mentioned before during 10 seconds.**

If the victim is unconscious and does not breath, we will assume that has cardiorespiratory arrest and we will have to **start RCP**. (20)

How do we know that someone who is breathing does it correctly?

Firstly, we will notice that thorax **movements are symmetric, harmonic**, neither excessively fast nor too slow. We could look for any **open thorax wound** that could be causing breathing difficulty. It is possible to **suspect lung contusion** when we find a **paradox breathing**, that means that thorax gets sink when inspirating and gets swell in expiration. We will also **determinate respiratory rate**: if it is more than 27 breathings per minute or less than 10, it suggests severe thorax lesion.

If the victim **breaths with difficulty, the breathing is fast and the thorax hurts**, we suspect that he has **a pneumothorax** which is an emergency that needs to be treated. A pneumothorax happens when air enters the space between lungs and thorax wall, (the pleural cavity), and it leads to complete or partial lung collapse (*figure 18*). **In complete pneumothorax**, air pressure can compress contralateral lung (**tension pneumothorax**) and trigger shock, as the heart cannot bomb blood efficiently because of the air occupation. The air that enters this space can come from outside because of an external wound (**open pneumothorax**) or from inside. We could also touch the thorax to assess the breathing: if we notice **crackling** when we palpate it, it suggests that there is a pneumothorax. (20)

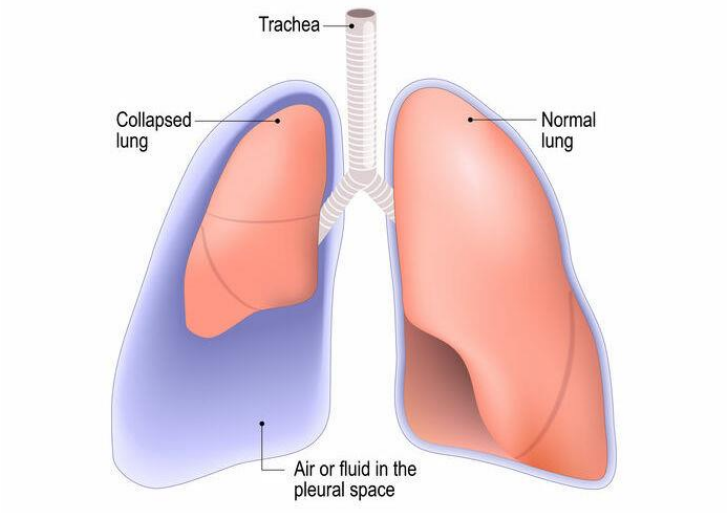

Figure 18: Collapsed lung in a pneumothorax. (27)

How do we know that a victim needs to be treated quickly by emergency services?

In summary, we face an urgence when we notice **asymmetric breathing**, when **breathing rate is abnormal,** when we observe an important **thorax wound** in a victim.

What can we do to improve breathing and to reduce sequels or even death?

The **most important thing is suspect pneumothorax** in order to detect severity of injuries. That is why it is really important to observe breathing. We can suspect an open pneumothorax by noticing a thorax wound that coexist with some relevant signs that can be detected just by observation. Those clinical findings include a victim that **breaths with difficulty,** with **a high-rate breathing; concretely >20 breathings per minute** (this is valid only if pneumothorax has been developed recently), he may complain about **thorax pain** and maybe we feel **crackling** when palpating the thorax. Open wounds should be covered immediately with a **non-occlusive dressing with Vaseline gazes**, (or a plastic bag if not available) we will **fix them to skin in three points** of the square of the gaze with a sticking plaster, leaving always one side free to perform a valve function mechanism in order to let the air go out of the pleural cavity and not allow it to enter the thorax. (20) (28)

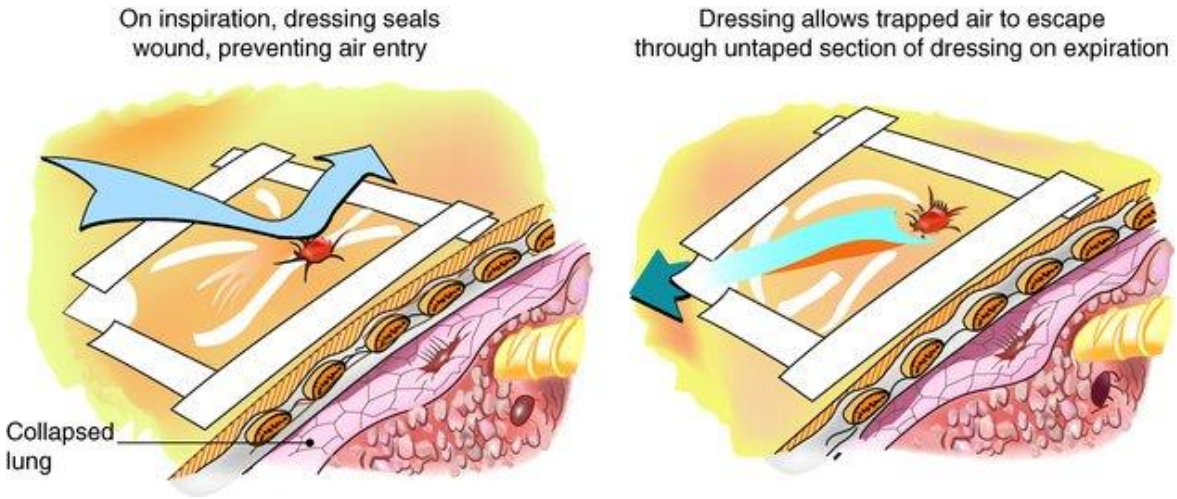

Figure 19: Valve function in open pneumothorax. (29)

C: FOR CIRCULATION AND BLEEDING CONTROL

How do we know if the heart is beating correctly?

The simpler and easiest procedure we can do is to **check heart rate**. The best anatomic place to notice the pulse in polytraumatic is the **carotid artery**, since this area is not covered by clothes and it is a very prominent artery, due to the fact that is quite near to the heart. To find carotid artery, we have to place two fingers in the larynx, concretely in Adam's apple, which is located in the centre of the neck. Then we will slide them laterally into the depression that we find between Adam's apple and sternocleidomastoid muscle. We must do it gently, if we do it sharply the victim may get dizzy. The normal resting heart rate oscillates **between 50 and 95 beats per minute**. Depending on heart rate, we can find an **absent pulse** (if coexist with unconscious victim and breathless victim it must be started RCP because the person is suffering **cardiorespiratory arrest**), a heart rate **on range** or a heart rate elevated, which is technically called **tachycardia**. When the heart beats more than **120 beats** per minute, we will suspect the existence of an **important haemorrhage**. (20)

How do we know that the arterial pressure is alright?

The normal arterial pressure is **120 mmHg for systolic** and **80 mmHg for diastolic**. When arterial pressure starts to fall, that means that something is going wrong: the victim is may loosing too much blood and it is not being distributed around the organism. It is useful to notice whether some arterial pulses are present or not by palpating, in order to check approximate arterial pressure.

- If carotidal is pulse present: systolic arterial pressure is about 70-80 mmHg
- If femoral pulse present: systolic arterial pressure is about 60-70 mmHg.
- If radial pulse is present: systolic arterial pressure is of 50-60 mmHg. (20)

Figure 20: Pulses (30)

What can we do if we notice that the heart is beating too fast?

If we detect a tachycardia, we have **to look for haemorrhages**: when someone loses blood, since there is less blood to be distributed, the heart beats more quickly in order to compensate the loss of blood and the lack of blood distribution. (20)

How do we face a haemorrhage?

When we find a visible bleeding, we have to **stop it**. If it is really massive, external and it supposes vital risk, firstly we will apply direct **manual pressure** with the help of gazes. When the gazes get wet, we have to put more gazes over the wound without taking out the gazes that were already there previously. If necessary, we can perform **compressive dressing.** (20) If **haemostatic dressing** is available, we will place it directly to the bleeding, and later we will apply manual pressure. We can use a pressure dressing only when the bleeding gets controlled. A **manufactured torniquet can be placed in the limbs**, but it should be only performed if the haemorrhage does not stop with the previous procedures mentioned before, if there is victim's vital risk or if the limb is amputated. (25) The torniquet must be **applied 5-7 cm over the wound**, proximal to the injury, but no over a joint. The manufactured torniquet has a tie tape with Velcro in order to adjust it to the affected limb, and it is provided with a device in order to twist it and tighten it. Once twisted, the device must be fixed with the tie tape. We will only improvise a tourniquet if we do not have a manufactured tourniquet. To improvise a tourniquet, we will tie up dressings to the bleeding limb, at least 5 cm over the wound, and we will close it with a knot. We can help ourselves with **a stick to twist**: we will place the stick inside the knot and twist until the necessary pressure is achieved. It is important to **note the hour** of the colocation and to ask for medical help quickly. The torniquet must only be released by medical professionals. If we have access to a manufactured torniquet, it will be preferred rather than an improvised one.

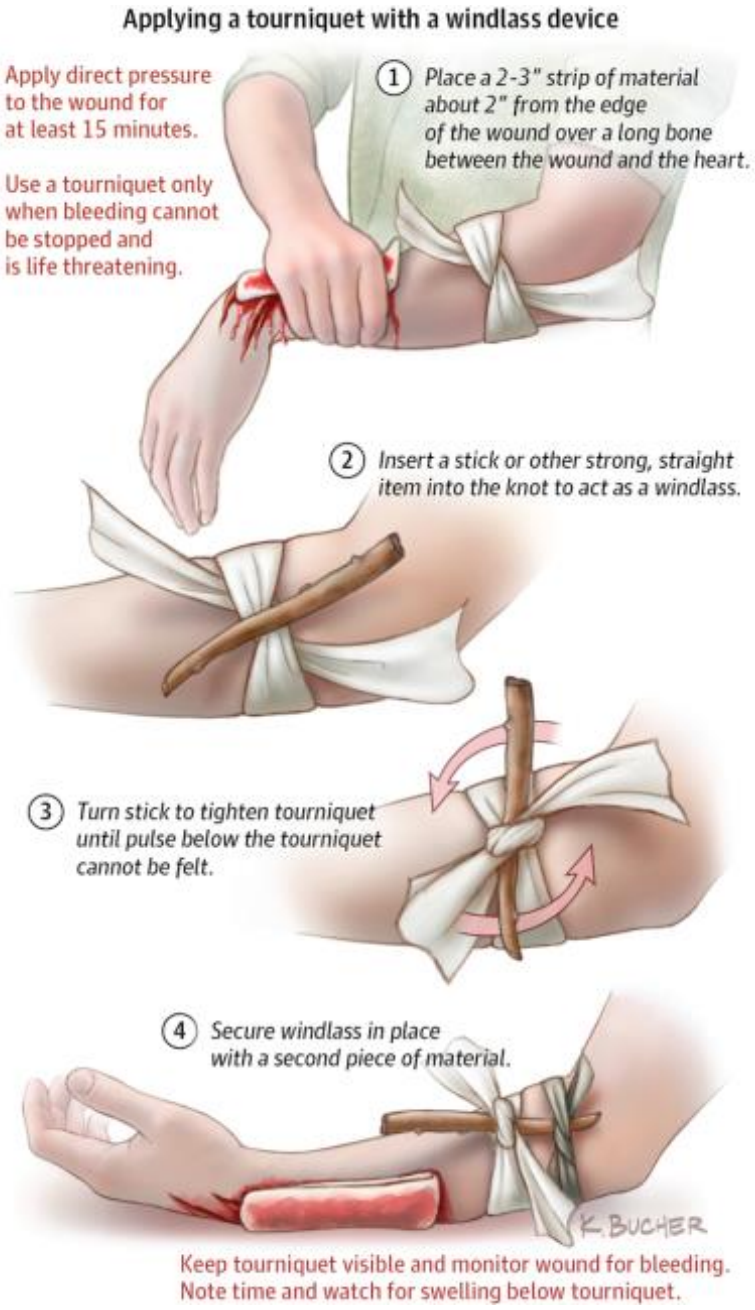

Figure 21: Applying and performing a tourniquet (31)

What can we do if someone is suffering shock?

We can put the victim into **supine position**, that means lying on back. (25)

What happens it is seems that a long bone is broken?

If we suspect that femur, tibia, fibula, humerus, ulna or radius are broken, we should **immobilize them** in the position that they were found by splinting it, assuring that the broken limb moves as less as possible. We should **not try to realign** the fracture, and specially not to make straight an angulated long bone fracture. (20)

What kind of haemorrhage we have always to suspect and to treat?

When someone suffers an impact on the pelvis, vessels intrinsic from the pelvic bones or from the internal irrigation from the hips (iliac vessels) can be broken. The bleeding of those vessels involves an important loss of blood volume. When someone complains about **hip pain**, he has suffered a fall from a **considerable height** and there is a **leg deformity**, we have always to **suspect the existence of a pelvic fracture** in order to treat it because when those vessels break, since the pelvis is a huge space, it can accumulate almost all of the organism's blood and it can lead to a hypovolemic shock. We should place the victim a **pelvic belt** in order to not let more blood be accumulated in pelvic cavity. If we do not have a pelvic belt, we can improvise one by tying clothes. We will place it with the patient lying on his back. The pelvic belt is gently placed around the pelvis, at the height of the major trochanters, which are located a little bit lower than the iliac crest bones, which are the hip bones that are more prominent (*Figure 22).* We will **tight the legs together** at the height of the **calf muscles**, to secure the pelvic closure. (20)

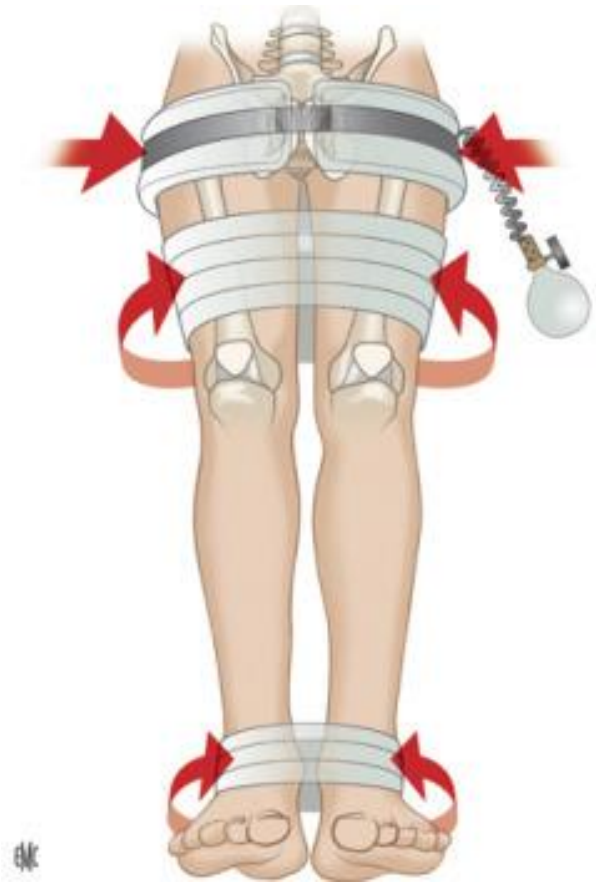

Figure 22: Closing a pelvic fracture (32)

D: FOR DISABILITY. We will perform the victim's neurological evaluation. When someone has suffered a cranioencephalic traumatism, this evaluation can provide us some information.

What do we have to check?

Firstly, we will observe whether the patient is **conscious or not**, fact that will orientate us more or less the severity of the accident. Secondly, we will use the scale **AVDN,** which means "**alerta, respuesta verbal, respuesta al dolor, no respuesta**" therefore "alert, verbal response, pain response, no response" in English. So, a victim is better if he is awake and aware, he is medically more serious if he responses when he is talked, he is worse if he responses when he suffers pain but not when he is talked and he is even worse if he does not response to verbal nor painful stimulus. Thirdly, we will **check the eye pupils**; if they are **symmetric** and they both enlarge their size in absence of light and decrease in size with light. If the victim presents a rapid deterioration in AVDN scale or has **vomits** or there is presence of **seizures**, it is indicative of neurological damage. We also have to consider that if the victim has not **recently eaten** (is hypoglycaemic) or he has recently **consumed alcohol,** both can be the cause of impaired consciousness. In neurological evaluation it is also important to check quickly dermic sensibility. We have to check too whether the victim can move or not the limbs if conscient, as absence of movements can reveal spinal cord lesion. (20)

E FOR AMBIENTAL EXPOSURE.

We should **protect the patient from hypothermia** since it can appear in huge **haemorrhages** due to the loose of blood and also in **cold environments**. It is essential to look for painful areas or body parts suspected of damage. (20)

ABCDE REASSESSMENT

Once we have finished this evaluation, we have to **re-evaluate A, B, C, D, E periodically** while rescue forces are arriving, in order to not forget anything and in order to check victim's recovery or deterioration. The reappraisal is also fundamental after any action while checking, such as immobilization or therapeutical actions. (20)

4. **EXPLAINING CHECKLIST (ANNEX 6).** The instructors will give the checklist to group A and will explain it to them.

5. **PERFORMING FIVE PRACTICAL CASES.**

- Make an airway permeable + cervical stabilisation.
- Closing a pelvis fracture.
- Controlling a massive bleeding by applying manually pressure.
- Splinting a broken bone.
- Performing a valve in an open pneumothorax.

The cases will be represented firstly with mannequins and secondly there will be a volunteer that will perform as a victim, as far as possible.

When the instructor had read the case and asked what must be done, the group should in every case firstly say that they will protect the zone, advise emergencies and later help the injured. Then, they will lead an ABCDE complete assessment. All instructed should follow and read checklist while performing the cases. We will not tell them the title of the case, just the text written.

CASE 1. AIRWAY + SPINAL CORD STABILISATION.

You are descending a mountain with your mountain bike in Spring time, the weather is about 20ºC. The terrain is really rugged and there are a lot of rocks. Suddenly, you notice a biker who is lying on the floor. You stop, and go to help him. You ask him whether he is alright or not, but he does not response, he seems unconscious. What you do next?

Note to the instructor: the group should be able to detect an airway obstruction and should perform a jaw elevation followed by a cervical manual stabilisation. Then they will ask for B, C, D and E. The instructor will tell them that with airway control, it seems that the thorax victim's starts to move (B). He has just a little wound on this right leg, but very superficial, without affecting the subcutaneous tissues (C). To evaluate C, they will also have to check the cardiac frequency, which is 85 bpm. They will later evaluate disability (D), we will tell them that he is still with closed eyes. In D, they should evaluate AVDN, we will tell them that when the victim is pinched, it seems that he moans silently

(painful response). They will open victim's eyes and will see that pupils are apparently asymmetric. To finish, they will ask for exposure (E), we will tell him that as the victim is not bleeding and the weather is nice, there is no risk of hypothermia. The group should be encouraged to ree-valuate the victim. When they ask about (A), we will tell them that he now breaths normally and that he is alert now, but that he does not move. We will remember them to ree-evaluate ABCDE all the time until rescue forces arrive and remember them to keep cervical spine well aligned.

CASE 2: CLOSING A PELVIS FRACTURE.

It is a summer day and you and two colleagues are practising climbing on a rock. You are about 3 meters above the floor. One of them abruptly has his braid broken, slides with his left arm and falls to the floor hitting on his left pelvis. He has his back straight, and he remains in a position like sited in a chair. You ask him whether he is alright or not, and he claims of pain "My hip! It hurts a lot!". You and you other friend decide to descent but you two get too nervous and do not know how to descend. What you do next?

Note to the instructor: the instructed should be able to identify that there is a potential multi-accident, since the climbers are nervous. It is very important that they remember to keep calm, protect themselves, ask for help and attend the victim. You will explain that the climbers get to arrive to his friend. The instructed will say that the victim's airway is alright since he is talking. They will check that he is also normally breathing. They will pass to C. Apparently, has not any wound. They will check cardiac frequency; we will tell them that is about 95 bpm. They will pass to D, the victim is conscient as he is complaining and talking and the pupils are symmetric. Then we will pass to E. Federated will have to re-evaluate with ABCDE. When arriving again to C, cardiac frequency is 130 bpm, and the victim still complains a lot of a big pain in his left hip. The group should suspect from pelvic fracture, should place the patient in supine decubitus and should perform a pelvic belt. They will also have to join both legs tied at the height of calf muscles. We should insist on the prevention of hypothermia as it is a massive haemorrhage and insist on the importance of continuous reassessment ABCDE. It is

important to remember them that when there are two assistants, one can take the lead and can read loudly the checklist while the other makes the evaluation.

CASE 3. APPLYING MANUAL PRESSURE ON A BLEEDING WOUND.

You and a friend are practicing mountain skiing in a place where there are no more people. You challenge him to arrive faster than you down-hill to the valley. So, you both start descending quickly, but your friend loses control and falls curling up with its legs. You stop and go to help him. He only claims of an acute pain on the right shinbone and starts to notice a “wet and cold” feeling in the leg.

Note to the instructor: the group must start ABCDE. He is conscient and talking so instructed pass to B, he is breathing also normally. When it comes C, they must check the cardiac frequency. It is about 80 bpm. But as the leg pains a lot and he feels it “wet”, they must raise the pants to undercover his right calf. They discover a bleeding because of an irregular cut. Instructed should have to recognise that they should perform a manually pressing over the wound until it stops bleeding. The bleeding does not stop immediately so they continue checking D and E while performing manual pressure. They ree-valuate all the time until medical services arrive and suture their wound.

CASE 4. SPLINTING A BROKEN BONE

You are trekking with three friends on a summer hot day. You all wear cool clothes. You are now turning back and you have started to descend, it has been a long day. One of your friends stumbles and falls of a big unevenness and leans on his left leg and remains sited that way. He shouts of pain and starts to cry.

Note to the instructor: is important to remember the importance of protect before any other process when there are more people present and when the accident happens in a risky aera. The people that go to attend the victim must be sure that they can manage the unevenness and that they can descend without risking their lives. After that, the group must start ABCDE. The victim is complaining so airway is opened and he is breathing a bit fast, because of the pain and the crying. They will ask for C: the heart

rate is about 100 bpm. The instructed observe the limbs looking for bleedings, but there is no wound nor bleeding. But a deformity is observed in the middle third of the femur: it is angulated. Federated must identify that they have to perform a splint to the femur in the way found and not to re-angulate the deformity. If splinting cannot be performed, they will ask the victim to not move. They will check later D and E: the pupils will be symmetric and there will not be risk of hypothermia.

CASE 5: PERFORMING A VALVE IN A THORAX OPEN WOUND.

You and a friend are practising running trail in a summer day. You have been running for four hours and you both start to get tired. Suddenly, your friend trips, falls and hits on her thorax heavily against a sharp rock. She remains sited in the ground. She is conscient and speaking but she is screaming as she suffers a lot of pain in the thorax.

Note to the instructor: the group must apply ABCDE. The victim speaks so airway is opened. In B, it will be noticed that the victim breathing is turning too fast. When checked, she breaths difficulty and about 25 breaths per minute. They will have to suspect from pneumothorax since she breaths quickly and with difficulty and since she has suffered a thoracic traumatism. They will undercover the victim to find an open chest wound. Federated will have to perform a valve and place it over the thorax open wound and will call for 112. Later, they will go to C, and they will check heart rate which be 80 bpm. Then, they will check D; the victim will be orientated and the pupils will be alright. In E they will not be risk of hypothermia for the victim. It is very important that instructor remembers to the federated the importance of suspect pneumothorax and notify it to authorities when coexist an open chest wound, fast breathing, and thorax important pain in a victim that has suffered a thoracic traumatism.

6. EXPLAINING THE MATERIAL THAT THEY MUST TAKE WITH THEM WHEN THEY GO TO THE MOUNTAIN AND WHAT THEY HAVE TO DO WHEN THEY ASSIST A MOUNTAIN VICTIM.

It will be explained to the group A members that they will have always to take with them **the checklist** when they go to the mountain in order to apply it if an accident occurs. They will also have to take with them **the accident report** in order to fill it together with emergency services and rescue services. If it is not possible to take both checklist and accident report in paper, they could take it in mobile phone or in another electronic device. In case they lose it, they will find both checklist and accident report available in our online platform.

If possible, they will also carry in their backpacks:

- a **mobile phone** to call 112 if necessary
- a **pen** to fill checklist and accident report
- a **clock** to check heart rate and breath
- a **pelvic belt and ropes** to close a pelvis (if a pelvic belt is not available, a **common belt**)
- **gazes** to apply manual pressure if a wound bleeds
- **manufacturer tourniquet**
- **ropes and a splint** to immobilize a broken bone
- **non-occlusive gazes** or **plastic bag,** and **scissors and sticking plaster** to perform a valve if suspected open pneumothorax.

15.6 ANNEX 6: CHECKLIST

Mountain accident checklist

1. FACING THE ACCIDENT: PAS

- **PROTECT:**
  spotsign the accident
  make sure there won't be more injured
  protect yourself
- **ALARM**
  112
  other mountaineers
- **HELP --> ABCDE**

2. ABCDE

A: AIRWAY

1.TALKS, CONSCIOUS, BREATHS?

YES: AIRWAY OK

NO or difficult breathing: perform

- mandible elevation manoeuvre or
- chin-forehead manoeuvre

2.POLITRAUMATIC VICTIM?

NO: go to **B**

YES: stabilise cervical spine

- if conscious, encourage him not to move
- if unconscious do it manually

B: BREATHING. Write breath rate ...

CHECK BREATHING 10 SECONDS

- observe thorax movements
- listen to breathing sounds
- feel the breath in your cheeks

BREATHS NORMALLY: go to **C**

DOES NOT BREATH:

- start CPR

DIFFICULT BREATHING:

look for thorax open wounds

- **YES:** perform a valve over 7 cm above the wound and stick in 3 points

C: CIRCULATION. Write heart rate...

1.CHECK HEART RATE IN CAROTID PULSE

60 to 100: OK, go to **D**

>120: look for haemorrhage

- nake the victim, if found haemorrhage:
  - apply manual compression

if found a broken bone:

- splint it, not move nor angulate

if not found or suspected, check pelvis

if suspected pelvis fracture

- close pelvis with a belt +
- tight calf muscles

ABSENT PULSE: if unconscious+ breathless

- start CPR

D: DISABILITY

1.CHECK RESPONSE (AVDN)

- alert
- verbal response
- painful response
- no response

Write response:

2.OBSERVE PUPILS

- **SYMMETRICAL:** OK, go to **E**
- **ASYMMETRICAL**: suspect neurological damage

E: EXPOSURE:

COLD AMBIANCE? HAEMORRHAGE?

- **YES**: protect from cold, cover the victim

REASSURE ABCDE AGAIN AND AGAIN TILL RESCUE OR HEALTH SERVICES COME

REMEMBER

NOTIFY THE ACCIDENT TO 112.

USE FACE MASK.

ASSIST ACCORDING TO YOUR KNOWLEDGES. DON'T DO WHAT YOU DON'T KNOW.

START PCR IF UNCONSCIOUS, BREATHLESS AND ABSENT PULSE.

SUSPECT PNEUMOTHORAX WHEN VICTIM SUFFERS THORACIC WOUND, THORACIC PAIN, CRACKLING HEMITHORAX, DIFFICULT BREATHING. PERFORM A VALVE.

SUSPECT HAEMORRHAGE WHEN HEART RATE IS >120 BEATS PER MINUTE. LOOK FOR THE HAEMORRHAGE.

SUSPECT BROKEN PELVIS WHEN PELVIS HURTS AND HEART RATE IS >120. CLOSE PELVIS AND CALFS.

DO NOT MOVE A BROKEN BONE. SPLINT THE BONE OR KEEP IT IMMOBILIZE.

MAKE SURE THAT ACCIDENT REPORT IS FILLED TOGETHER WITH RESCUE SERVICES AND HEALTH ASSISTANTS.

15.7 ANNEX 7: ACCIDENT REPORT

ACCIDENT REPORT

FEDERATED NUMBER IDENTIFICATION:

DATA OF ACCIDENT: **HOUR OF ACCIDENT:**

FEDERATED INFORMATION	Write here.
Was the federated trained with checklist?	
Is the federated a health professional?	
If affirmative, which kind of health professional?	
Hour that the federated assisted the victim	

VICTIM INFORMATION	
Gender	
Age	
Osteoarticular pathology? (Including arthrosis, osteoporosis, previous fractures, prosthesis)	
Death because of the accident?	
Disable because of the accident, after a year of the accident?	

ACCIDENT INFORMATION	
Place and province of the accident	
Kind of accident	
Sport practised by the victim: hiking, trekking, canyoning, trail running, mountain bike, climbing (including ice and rock climbing), skiing (including Alpine, cross country and ski touring), snowboard, snow rackets and alpinism)	
Night activity?	
Group or individual activity?	
Time (hours) of activity when accident happened	

ASSISTANCE INFORMATION

Rescue force and/or health service that assist

Hour of rescue/health service arrival

Has the federated applied the checklist in the accident?

Kind of lesion (s)

Assistance provided to the victim by the federated:

- Open airway?
- Cervical spine stabilization?
- Perform a valve for pneumothorax?
- Pelvis closure?
- Splint a broken bone?
- Others: specify

Time of arrival to the hospital/health centre in minutes

(<30 min, 30 min to 60 min, 60 min to 90 min, >90 min)

AMBIENCE ACCIDENT INFORMATION

Coordinates

Orography of the terrain

- Easily accessible terrain (can even be accessible without the need of technical shoes)
- Difficult accessible terrain (it may need the use of ropes, ice axe or crampons)
- Moderate accessible terrain

Height of the terrain

- High mountain: >2500 meters
- Medium mountain: 1500-2500 meters
- Low mountain: <1500 meters

Meteorology: clear sky? cloudy day without precipitations? windy day? stormy day (snow, rain or hail)?

Temperature in Celsius:

Windchill or heat index: