

## Module 4 – TRN COMPETENCE, Learning unit 4.2: Safety

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### THEORETICAL COMPONENT

#### Principles and Values

The use of technology to improve people's quality of life is becoming a common trait of modern societies. Humanoid robots have already been shown to be useful in healthcare. To ensure successful interactions with humanoid robots, it is essential to understand the factors that influence users' sense of security. Ensuring patients' sense of security is considered a key principle of good caring. This learning unit provides a quick overview of the patient's safety.

The principles and values that guide this tool include:

- Safety of the patient—both physical safety and psychological safety
- Avoidance of harm
- Privacy and data protection
- Effectiveness
- Acceptance
- Communication
- Helping

#### Aims

This learning unit aims to develop your understanding of the safety of the use of robots for the care of the patient/client. You will be engaged in learning through reflection, knowledge acquisition, and practical activities.

#### Learning outcomes

At the end of this training, the participants will:

- Expand their own knowledge on the definition and the terms of safety.
- Discuss the main principles of safety.
- Identify specific safety functions that a robot performs.

#### Relevant definitions and terms

**Healthcare robot.** Healthcare robots are these robots used in the healthcare setting and are designed to support and care for people with health issues including assisting with their daily tasks and boosting their overall health and well-being

**Humanoid robot.** A robot which appearance resembles a human and can often carry out tasks like a human ([Ting et al., 2014](#)). Also referred to as an anthropomorphic robot, with a higher emphasis on emulating human structure, sensorimotor and cognitive skills.

**Patient safety.** Patient Safety is a healthcare discipline that emerged with the evolving complexity in health care systems and the resulting rise of patient harm in health care facilities. It aims to prevent and reduce risks, errors, and harm that occur to patients during the provision of health care. A cornerstone of the discipline is a continuous improvement based on learning from errors and adverse events. Patient safety is

fundamental to delivering quality essential health services ([WHO, 2019](#)). [ISO 13482:2014](#) specifies requirements and guidelines for the inherently safe design, protective measures, and information for use of personal care robots, in particular, the following three types of personal care robots: (i) mobile servant robot; (ii) physical assistant robot; (iii) person carrier robot. These robots typically perform tasks to improve the quality of life of intended users, irrespective of age or capability. ISO 13482:2014 describes hazards associated with the use of these robots and provides requirements to eliminate, or reduce, the risks associated with these hazards to an acceptable level.

Safety consideration in social assistive robots (SAR) includes two key underlying aspects: general safety and perceived safety. General safety in SAR is hoped to be achieved by following safety measures when designing robots to prevent any physical injuries to humans. In order to allow for safe, yet efficient inter-actions, human intention prediction capabilities are essential for robots. More elusive is the aspect of perceived safety, which in SRA is defined as a human's perception of the level of danger when interacting with a robot, and the humans' level of comfort during the interaction. To improve perceived security, in a scenario where a robot coexists in a workplace with humans, it is desirable for the robot to communicate its intentions in a clearly understandable way. Improving security perception is expected to increase robots' acceptance as trusted colleagues (Chadalavada et al., 2020).

**Socially assistive robot (SAR).** The combination of Assistive Robots and Social Robots is called a Socially Assistive Robot (SAR). SAR is a type of robot whose primary goal is to create close and effective interaction with a human user for the purpose of providing company, fostering independent living, giving assistance, and achieving measurable progress in convalescence, rehabilitation, learning, etc. alongside or instead of physical aid ([Winkle et al., 2020](#)).

SARs share with Assistive Robots the goal to provide assistance to human users but put the emphasis on assistance through social interaction.

SARs are complex types of robots since they need to mimic human behaviour as much as possible to create the image of a personality and human-like interaction. These two objectives allow the platform to generate empathy with the users and develop more efficient communication with them. Also, by adequately reacting not only to the person but the environment as well, the robot may be capable of performing multiple tasks.

### **What the research says**

- **M., Okamura, M., M.J., Matarić, M.J., and H.I. Christensen, H.I. (2010) Medical and Health-Care Robotics. *IEEE Robotics & Automation Magazine*, 17 (3), 26-37. doi: 10.1109/MRA.2010.937861.** The challenge of safe robot action and reaction is as old as the field of robotics itself. However, safety takes on a new dimension when directly close-up interactions with human users, often vulnerable ones, constitute the core of the robot's purpose. Providing an appropriate response to human behavior (e.g., knowing the difference between unintentional human behavior and specific intent) represents a new technical challenge. The robot must anticipate dangerous behavior or conditions (i.e., create virtual constraints) and respond to any urgent conditions in home environments under all conditions. Available [here](#).
- **Vargas, S. (2015) Robots in the workplace. *Safety and Health*.** Recently, technological advances have begun to allow for a greater diversity of robotic systems in the workplace. Robots can help prevent injuries or adverse health effects. Robots also can minimize risks stemming from human error. Available [here](#).
- **Rantanen, T., Lehto, P., Vuorinen, P., Coco, K. (2018) The adoption of care robots in home care—A survey on the attitudes of Finnish home care personnel. *J Clin Nurs.*, 27, (9-10).** This article reports how robot technology has been shown to improve patient safety. More recently, robotics for health care has been an important focus of development and innovation activities in Finland. Care robots enhance the safety of the medication and the safety of older people who live at home. Robots could also be used as promoters of safety. A care robot can help an older person communicate with relatives and friends or help observe an older person's state of health (i.e., through remote communication with a doctor or nurse or the real-time conveying of health information). Finally, it

can help with medication (e.g., giving medicine, recognising medicine, observing medicine use). Available [here](#).

- **Ebrahimi, A., Alambeigi, F., Zimmer-Galler, E.I., Gehlbach, P., Taylor, R.H. (2019) Toward Improving Patient Safety and Surgeon Comfort in a Synergic Robot-Assisted Eye Surgery: A Comparative Study. International Conference on Intelligent Robots and Systems (IROS) Macau, China, November 4-8, 2019.** The article reports how robots may ensure safety during surgeries: the robot's autonomous motion enhances patient safety but might inhibit the surgeon's tool manipulation and diminish surgeon comfort with the procedure. The introduction of technology has been shown to improve patient safety care robots that enhance the safety of medication (65.8%) and the safety of older people who live at home ([Ebrahimi et al., 2019](#)). Available [here](#).
- **Nyholm, L., Santamäki-Fischer, R. & Fagerström, L. (2021) Users' ambivalent sense of security with humanoid robots in healthcare. *Informatics for Health and Social Care*, 46 (2), 218-226.** The article discusses how, in order to ensure successful interactions with humanoid robots, it is essential to understand the factors that influence users' sense of security, a key principle of good caring. Then, a study is presented aimed to illuminate users' sense of security with humanoid robots in healthcare. To this end, twelve semi-structured interviews were conducted. Before being interviewed, the participants were shown a video vignette with Pepper, a fully developed humanoid robot used in the daily care of patients. The data material was analyzed using qualitative content analysis. Most participants perceived the use of humanoid robots in healthcare to be both positive and negative. The overarching theme was: Ambivalent sense of security with humanoid robots in healthcare. The four categories revealed were: Humanoid robots are both reliable and unreliable, Humanoid robots are both safe and unsafe, Humanoid robots are both likable and scary, and Humanoid robots are both caring and uncaring. The article increased knowledge of whether patients perceive a sense of security with humanoid robots in healthcare, including fears users have. Available [here](#).
- **Benetazzo, F., Ferracuti, F., Freddi, A., Giantomassi, A., Iarlori, S., Longhi, S., Monteriù, A., Ortenzi, D. (2015) AAL technologies for independent life of elderly people. *Springer*, 329–43.** The article argues that to ensure that humanoid robots are useful and of benefit in healthcare, a human rather than a technical point of view should be considered during their technical development. A discussion is included about the various factors that should be taken into account, such as safety and user preferences. Available [here](#).

### **What do national legislation and international/European treaties and conventions say on the topic?**

- **Regulation 2017/745 of the European parliament and of the council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC.** This regulation means that the devices shall achieve the performance intended by their manufacturer and shall be designed and manufactured so that, during normal conditions of use, they are suitable for their intended purpose. They shall be safe and effective and shall not compromise the clinical condition or the safety of patients, or the safety and health of users or, where applicable, other persons, provided that any risks which may be associated with their use constitute acceptable risks when weighed against the benefits to the patient and are compatible with a high level of protection of health and safety, taking into account the generally acknowledged state of the art. Available [here](#).
- **Proposal for a Regulation of the European Parliament and of the Council on machinery products (2021).** Machinery regulation ensures that the new generation of machinery products guarantees the safety of users and consumers and encourages innovation. Machinery products cover an extensive range of consumer and professional products, including robots. The Machinery regulation will adapt certain provisions in the scope, definitions, and safety requirements to bring greater legal clarity and capture the new features of machinery products. Available [here](#).

- **ISO 13482:2014, Robots and robotic devices — Safety requirements for personal care robots.** International standards exist to guarantee compliance of robots with safety requirements, which are covered by ISO13482:2014 Robots and robotic devices – Safety Requirements for personal care robots. Available [here](#).

## PRACTICAL COMPONENT

### Learning Activities

Activity 1: Find the secret words in a word search puzzle

- Find all words in the online puzzle (available [here](#)).
- Resource needed: The [Word Search](#), a tool for online word search puzzles.
- Duration: 5 minutes.

### Patient safety

H	J	X	Y	P	O	H	B	G	U	H	S	A	A
R	O	B	O	T	J	C	P	L	V	Z	A	N	S
C	D	H	C	Z	O	S	I	C	P	Q	F	S	S
A	W	S	A	Q	Y	O	A	V	R	N	E	A	I
R	W	U	I	T	R	Q	Z	V	O	P	T	P	S
E	K	P	Q	A	E	O	C	N	T	R	Y	R	T
G	R	P	G	Q	M	Y	O	W	E	E	O	I	A
I	U	O	H	G	I	Y	M	N	C	V	J	V	N
V	C	R	Q	G	N	L	P	K	T	E	S	A	C
I	R	T	T	F	D	Y	A	A	I	N	Y	C	E
N	I	R	C	U	E	Y	N	O	O	T	K	Y	T
G	S	G	R	E	R	B	Y	F	N	I	D	Q	W
A	K	J	F	J	Q	F	C	Q	I	O	B	L	U
A	S	H	O	P	K	Z	I	J	Y	N	P	Q	X

SAFETY  
PREVENTION  
PRIVACY  
ASSISTANCE  
REMINDER  
RISKS  
PROTECTION  
SUPPORT  
CAREGIVING  
COMPANY  
ROBOT

Activity 2: A robot providing care to older people

- Watch the following video about robots for health and social care (available [here](#)).
- Write a post on the social platform for collaborative learning.
  - Can you mention any mechanisms by which the robots increase safety?
  - Identify potential issues that might threaten patient/client physical and psychological safety and provide potential solutions.
- Read comments from other participants and reflect on their ideas.
- Resources: YouTube [video](#), social platform for collaborative learning.
- Duration: 40 minutes.

## ASSESSMENT COMPONENT

### Assessment Activities

Activity 1: True - False questions

- Answer the questions below.
- Resources needed: Word or similar software for writing, pen or pencil.
- Duration of activity: 5 minutes.

*True/False Questions*

- Robots can improve patient safety (True)
- Robots can prevent patients from falling (True)
- Robots are not able to help patient/client with his/her medication (False)
- Robots cannot be used during surgeries because they increase doctors' stress (False)
- Humanoid robots are useful and of benefit in healthcare, but not for older persons (False)

## EVALUATION COMPONENT

### *Participants to evaluation*

The online evaluation questionnaire of each Learning unit is completed by the MOOC participants (students and student/facilitators) on Survey Monkey

### *What to evaluate*

The Learning Unit's evaluation criteria are: coverage of the identified learning needs, innovation, quality of the content and training materials, intuitive and friendly presentation, relevance of learning activities, and efficiency for achieving established learning outputs.

Please, complete this online evaluation of the learning unit by clicking on this link:

<https://www.surveymonkey.com/r/LTTB68M>