# ITEA Smart Health customer workshop report

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## 1. Introduction of the workshop

### 1.1. Organisation and participants

On 15 June and 16 June 2022, ITEA organised its 8th international customer workshop in Eindhoven and this year it focused on Smart health, an important challenge of ITEA. The workshop was co-organised with Atos, Barco, Esri Canada, NXP and Philips and luckily it was possible again to organise it as a physical workshop, with some of the customers joining remotely.

The event gathered around twenty end users of Smart Health solutions representing the points of view of the customers and around twenty solutions providers - large companies, research organisations and SMEs – of the Smart Health sector. The following organisations took part:

| Smart Health end users / Customers | Industry- Research | SMEs |
|---|---|---|
| Academic Medical Center of the University of Amsterdam | Barco | BeWell innovations |
| AZ Damiaan, Oostende | Demcon | KnowL Solution |
| Barco- Groeninge Hostipal | Materialise | Macadamian Technologies |
| Charite hospital | NXP | Medirex Systems Inc |
| Inspire2Live | Philips | My Viva Inc. |
| Kempenhaeghe/TUE | Televic Healthcare N.V. | NewCompliance |
| Lapland University of Applied Sciences | ThermoFisher | Noldus |
| Leiden University Medical Center (LUMC) | imec | Rehabtronics Inc. |
| Maastricht University | Sirris | Sopheon |
| Maxima Medical Center (MMC) | | Thunderbyte |
| National eHealth Living Lab (NeLL) | | |
| Radboud UMCU | | |
| Tampere university | | |
| Universidad de Castilla-La Mancha | | |
| University Medical Center Groningen, University of Groningen | | |
| University Medical Centre Utrecht | | |

More information about why and how this workshop was set up, can be found in our ITEA Magazine article 'Smart health new challenges ahead'. This report will focus on the addressed challenges, solutions and project ideas.

## 2. End-user round table discussions addressing the challenges

During the first day of the workshop, five round tables have been organised on the topics Telehealth, Hospital optimisation, Digital pathology, Towards prevention and Data exploitation. In each round table end-users presented their point of view before having a discussion between them and the other workshop participants. These round tables were an opportunity to listen to end-users who have shared their insights on the key challenges and to come up with a common vision of what are the more important problems and issues to solve.

### 2.1.  Telehealth

This round table gathered five participants from hospitals or research organisations linked to an hospital or national health initiatives.

Telehealth has already been experimented to monitor patients with a chronic cardiovascular disease. All the basic technological elements to develop a "remote patient monitoring" (RPM) are there. These solutions have already demonstrated important savings with a reduction of the number of admissions, of the duration of hospital stays, of the number of tests or of the specialist consultations. They have also additional costs linked to the increased number of specialised nurse consultations or the time spent in remote meetings with patients but overall, they provide savings and more comfort to patients.

To develop these RPM solutions there are several challenges. First you must change the organisation of the hospitals with specific staff to manage the remote monitoring.  Second, you must adapt the solution to each patient context to take into account potential other diseases or personalised behaviours. Third, you must face the digital illiteracy of the targeted patients. Forth, you need to have an active participation of the patient to the rehabilitation programme. Even if there are some known strategies to increase the motivation, some progresses are needed to better adapt them to each patient.

The National eHealth Living Lab has developed a solution called "the box" which consists of daily measurement, e-visits, instructions by a healthcare professional and a smartphone application. The solution has been experimented for two categories of cardiac diseases.  The results are quite promising both on primary outcomes (normalisation of the patient health) and secondary outcomes (satisfaction of patient, of healthcare staff, medication adherence, activity, and cost-effectiveness). The challenges are now to scale-up while being able to personalise the solution.

In Finland, due to the low population density and the distance to the hospitals for the patients, telehealth is a promising solution to improve healthcare. However, there are strong challenges such as lack of adoption of technology in remote areas, no networks coverage in remote areas, digital illiteracy, and lack of resources for developing solutions in healthcare institutions. To address some challenges long term investments are needed. More short term approaches based on technologies like virtual reality of gamified solutions can also be developed.

For sleep disease diagnosis and treatment, telehealth is also an interesting solution as it can allow to have the patient in more natural conditions and to increase the number of measurements. However, there are important challenges. One is related to the quality of the measurements and the data flow

for which progresses are still needed. Some others are linked with the patient interactions with the sleep lab technicians and the physicians which are more complex and require training on both sides. To get some benefits from this telehealth approach, it is also mandatory to develop automated decision support that will prioritise the more interesting data to the medical staff.

Hospitals investigate the integration of wearable devices in their current processes and their use in pre and post hospitalisation. However, such an evolution needs new expertise in professional medical staff and also some IT environments which are still missing. One of the crucial challenges is to select the interesting parameters to monitor and to adapt the relevant values to each patient. Again, to have cost-effective solutions and to reduce the workload a good data platform with a decision support system is mandatory.

**In summary, the round table on Telehealth highlighted that telehealth is very promising if we can tackle some important challenges:**

- Digital literacy of patients
- Reorganisation of the hospital and training of staff to patient monitoring
- Quality of the measurement system and of the data transmission
- Personalisation of the monitoring process
- Decision support to effectively reduce the medical staff workload
- Integration with other IT solutions
- Scale-up of the first experiments

## 2.2. Hospital optimisation

Hospital is the central pillar of healthcare and any solution that can increase the efficiency at the hospital can have a great impact. Six panellists took part of this round table and shared their views on the main challenges.

One important change is the rise of "value-based healthcare". In this approach, you need to assess the outcomes and the benefits for the patients and to balance them with the costs of the treatment. It has important impact at all the levels of the healthcare value chain (caregivers, hospital management, insurers, pharmaceutical companies, medical device industry). The way you collect data, and the decision support tools need to be adapted to this new vision. Moving in this direction means developing new solutions.

At the hospital level, it is important to find a good balance between several viewpoints: patient, physician, insurer and data/protocols. For the patient, it is important to reduce the time spent at the hospital as well as the number of tests or treatments. In addition, the patient not only expects some diagnosis but also some prognosis. The physicians still need to have access to all information available regarding a patient and his specific disease. There is also a challenge to organise collaborative decision when several experts are needed to decide on the best treatment. At the level of the hospital, there are also challenges to manage the data, to supervise the protocols and the activities and to transform

this into valuable information to increase the efficiency. The insurer is also a stakeholder who needs to get some insights into the treatment efficiency, and this can impact the hospital management system.

One panellist focused on the problem of optimising the exams for a given patient. We have older patients, more complex cases (co-morbidity), more options for imaging technologies and dispersion of healthcare providers. We can also observe longer waiting times for getting some medical images, unused slots in medical imaging departments, longer time for diagnostic and scattered patient journey. A new approach must be proposed to solve these problems. One direction would be a multi-stakeholder (patient, referring physician, insurer/government, hospital medical department) platform that will manage all the constraints and optimise the whole process.

At the level of the hospital, five problems remain crucial: recruitment, training of medical staffs, managing low level of investment funding, lack of patient perspective, management of the digital transformation and measuring the outcomes from the digitalisation. The staff's problem is mainly related to the shortage of nurses and the challenges are to keep them well educated and to offer attractive working environment and true perspectives. In its digital transformation, the hospital faces several challenges. As the capacity of investment is low, the transformation is slow. It is also difficult to measure the return on investment and so to justify additional investments. There are also challenges to develop a more patient centric vision in the hospital. The patient safety performance indicators are underrepresented in the reimbursement system leading to not enough emphasis on quality. The hospitals still have to promote a patients' perspective in their processes to differentiate from competitors. The digital transformation of the hospital goes beyond the technical dimension, and the human factors need more attention. The transformation needs to be handled with specific change management methods and not only as the introduction of new digital solutions.

Another panellist discussed the interest of some key solutions as Virtual/Augmented reality, gamified approaches and mobile applications to help to solve problems in the hospitals. Virtual reality offers interesting opportunities for medical staff training. Augmented reality can also be used for operation support. More globally, digital twins can be developed to model some hospital processes/systems and to analyse how these systems can be optimised.

The hospitals face increasing constraints with a rising number of patients (mainly due to aging population), difficulty to find skilled personnel and limited budget growth. The more sophisticated treatments also have impact like an increased workload and addition of idle time because you need a lot of people with expertise in only every part of the complex protocols. One interesting direction is to continue to develop image guided therapies that can lead to better curation, better quality of life and with lower costs. Another direction to handle the complexity is to develop the automation under human supervision of the complex instruments used for some treatments (such as selection of electron density in radiotherapy).

To overcome the hospital financial constraint, you must develop prevention, minimise the number and length of the hospital visits by developing care at home and optimise the operation within the hospital. Progress can still be made in managing the patient flow in the hospital, the planning of the hospital resources and the utilisation of the operating rooms. A more integrated route from diagnosis, treatment planning, treatment itself and treatment evaluation is a way to increase the efficiency. As

the clinical procedures in operating rooms are more complex and multi-disciplinary, there is a need for solutions to manage such complexity and propose adaptive scheduling considering expected and unexpected events.

**In summary, hospitals face important optimisation challenges that can be partly solved by software innovations:**

- Training of staff
- Staff motivation management
- Development of a patient centric approach
- Measurement of the efficiency of change/protocols/treatment
- Data harmonisation/standardisation
- Multi-user platforms for care planning and for collaborative decision support
- Therapy automation under human control
- Change management

## 2.3. Digital pathology

This round table gathered only two participants but was very helpful to assess the State-of-the-Art in digital pathology and to discuss some of the challenges to tackle.

One game changer in digital pathology is the adoption of AI methods that have been proven to be effective in radiology. This can help the pathologists in their diagnosis either in suggesting classification or in spotting the more relevant data to focus on. The development of AI faces several important challenges.

The first one is the availability of data to train robust models. The quantity and the quality of data are currently problematic to produce AI models with the same level of robustness as in other application areas.

The second main challenge is related to the integration of AI into the pathologist's workflow. As there are no standards used by the different vendors of pathologist workflow software, it is difficult to integrate AI models with the current IT infrastructure supporting the work of pathologists. Another implementing problem is related to the volume of data that needs to be handled in pathology. In the management of the data there is also the issue to comply to GDPR (General Data Protection Regulation) which can limit the externalisation (e.g. use of cloud solution) of the IT infrastructure.

The third challenge is to prove the return on investment to introduce new innovative AI-based methods. The cost benefit is still to be demonstrated and validation studies must be put in place.

The second panellist mentioned the trend to use biomarker quantification in pathology to improve the diagnosis of cancers. It was also highlighted that the robustness of AI models must be improved. One direction is to put more effort in the analysis of adversarial samples (classification errors). The use of synthetic data can be interesting to discover some weaknesses of the AI models through the analysis of small modifications that would result in wrong classification. As already mentioned as the quality of

the labelled data is not perfect, AI methods that can overcome mislabelled data are of great interest for digital pathology.

The use of Digital Imaging and Communications in Medicine (DICOM, a standard for the representation, storage, and communication of medical images and related information) in digital pathology is also promising. This is helpful to implement Picture Archive and Communications Systems (PACS). However, some efforts are needed to cope with the natural complexity of digital pathology data.

**In summary, digital pathology is advancing towards more powerful decision support solutions for the pathologist but has still to address some challenges:**

- Quality and quantity of data to develop AI models
- Robustness of the AI models
- Standardisation of the pathologist's workflow
- Standardisation of the data representation and management system
- Assessment of the return on investment

## 2.4. Towards prevention

During this round table some of the challenges to develop prevention were discussed. Four panellists plus another participant who provided a pre-recorded video message shared their view on this interesting topic.

For heart attacks, we have seen in the last 30 years a decrease by a factor of four of the number of deaths with at the same time an increase of the number of hospital admissions for heart failure. Prevention is an element to explain such an evolution. People are more involved to prevent risk factors (smoking, diabetes, weight, hypertension) that will increase the lethality of further heart failures. To completely benefit from prevention there are several challenges. The first one is that you need to develop a very robust assessment of the risks for each patient to choose the best protocols for rehabilitation. The second challenge is to put in place personalised feedback for each patient. The third challenge is to find the appropriate motivation strategy to get an active participation of the patient to the rehabilitation protocols.

Today, activity reporting applications are the most used prevention applications. It is just a small part of what prevention could be. Even at this early stage there are important challenges. One of them is to define how we want prevention to be integrated in the healthcare framework. A more combined approach between prevention and healthcare would require significant changes in the healthcare system. The financing of the prevention is also a very central question, and its answer will greatly influence the interplay between prevention and healthcare.

The workplace can be a good place to start developing prevention. Psychosocial load is a key factor that impairs working capacity, health and productivity and wellbeing. Estimated 50% of lost working days are related to work stress. At the same time, the workplace is central to the promotion of well-

being and health of the work-age population. To develop smart prevention solutions at work, several factors need to be considered: personalised actions (based on individual needs and prevention levels), timely identification of risks, lean, trusted and feasible data collection, proof of effectiveness. The Mad@Work ITEA project currently develops an automatic stress detection system. Other concerns (personalisation, motivation strategy, effectiveness assessment) could be covered by complementary projects.

There is a wide range of health applications (over 150,000) that already target prevention. This multiplicity creates a problem for the potential users to identify the relevant ones for them. Assessment frameworks for health apps have already been developed but each with its own focus area and quality criteria, so not solving the end-user's choice problem. The apps are also not integrated in the guidelines of health authorities and in the regular care system. Some standardisation efforts, inspired by energy consumption indicators, are underway with assessment of several characteristic of the apps (health impact, ease of use, data security, robustness) but more international collaboration would be welcome in this domain.

We all know that activity or dietetic food are good for health, but this is not enough for changing our behaviour. To have a stronger impact on changing our behaviour, we need new sensors/devices that can give immediate feedback when we do something bad or good for our health. New wearable devices can help us to navigate between health and disease and a direct information on the status of your health is a big incentive to change for a healthier lifestyle.

**The presentations and the discussions of the round table Towards prevention stressed that the most important challenges are:**

- Personalisation of the prevention/rehabilitation protocols
- Finding right and personalised motivation strategy
- Assessing the impact of prevention (at personal and global levels)
- Integration of prevention and healthcare system
- Funding mechanisms for prevention
- Standardisation of the health apps evaluation
- Providing immediate feedback on the health impact to help us to change behaviours with new wearable devices

## 2.5. Data exploitation

As already stated, data is nowadays everywhere and part of the four previous topics. This round table has focused on transversal challenges to improve the way we exploit data for healthcare. Four participants have shared their point of view.

Due to the substantial complexity increase in healthcare, progressing in data exploitation is mandatory. We see more medical disciplines involved in a single diagnosis, more treatment options, more follow-up activities and more patients. At the same time, the amount of data, the heterogeneity of data and the data fragmentation over the healthcare chain are growing. We also observe difficulties

in storing data exchange verbally and in interfacing different IT systems. As a result, it is still a challenge today to access all the relevant data to decide on a patient treatment. The ease of use of current tools is not adequate, leading medical doctors to spend more time in managing Electronic Health Records than on patient care. Innovations are necessary to overcome all these problems related to data exploitation. Some new solutions are also expected to support image guided therapy procedures. The complexity of 3D anatomy visualisation in combination with other data could be reduced with new image interpretation systems.

One of the trends in data exploitation is the use of AI methods. This evolution can solve some of the challenges but also creates new ones. Amongst the questions opened by AI usage are ethics and governance, how to monitor AI applications, automation bias or accountability. There are also some challenges to effectively adapt AI methods to some of healthcare domains especially in very complex ones like oncology. The quality and standardisation of data are other concerns for developing efficient AI solutions.

The current practices on data exploitation show several difficulties coming from the current regulation especially the GDPR. This legal framework creates fear of data misuse and the IT systems supporting the data management are not ready to handle the patient ownership of their personal data. In addition, the cyber security protection of hospital ICT systems has to be improved as well as the training of the ICT departments to all these security and privacy concerns. There is also a need to collect, in addition to the data themselves, some meta-data such as how the data have been obtained and how they have been used so far. The incorporation of domain knowledge into IT systems is another challenge. However, data-driven healthcare is a mandatory evolution, and these challenges need to be addressed. The development of synthetic data and their usage could be a way to progress and to tackle some of the challenges.

There are strong opportunities with data exploitation to perform personalised treatment management and therefore to improve the patient journey. Oncology informatics has a goal to gather patient health records, radiology images, tissue pathology analysis and molecular pathology information to propose a precision cancer care that will improve patient outcomes, patient and staff experiences and decrease costs. To move in this direction, the obstacles are scattered data along the healthcare chain, availability of skilled personnel, regulation compliance and adoption by clinicians. Some initiatives exist, especially for the MRI-linac domain, to address these issues.

**In summary of this Data exploitation round table, the crucial challenges are:**

- Access to all relevant data to take a treatment decision (fragmentation, unstructured data, multi-disciplinarity)
- Addressing the patient privacy concerns
- Cyber security protection of ICT infrastructures
- Quality and completeness of data
- Ease of use and effectiveness of data management systems
- AI method adaptation to healthcare (type of data, specific legal issues ethics)

# 3. Brainstorming and ideas

The second day of the workshop was dedicated to brainstorming sessions about potential solutions to solve the challenges that were presented during the round tables. Each group consisted of around 10 people with a mix of end-users and technology providers. The groups were focused on one of the five topics of the round tables (except for the digital pathology topic) and had the "mission" to highlight the main problems, to discuss potential solutions and to propose ideas that can become collaborative research projects to be submitted to an ITEA Call for projects.

## 3.1. Telehealth

During the discussions the group agreed that for the development of telehealth several **problems** need to be addressed:

1. *Make sure the data is secured*: the people have strong concerns about the privacy of their health data, and it is mandatory to provide a trustworthy solution for the transmission, storage and access to the collected data.

2. *Put a lot of effort on seamless design / simplification / ease of use for both healthcare providers and patients*. The level of digital literacy of the users of telehealth solutions (on both sides) will not be equal. To allow a good diffusion and adoption, the ease of use must be a priority in the design of the solutions. This especially important because most of the targeted users will be elderly people who are the ones with less practice of smart phones or other digital devices.

3. *Interoperability (of solutions/apps) is a big problem, for both patients and healthcare providers*. The development of too many non-interoperable solutions is a threat that can endanger the potential benefit of telehealth. Closed solutions with small footprints will not allow a smooth development of a strong telehealth ecosystem. Each solution provider must understand this risk and offer interoperability with other solutions.

4. *Standardisation and quality problem*. Because of the need for interoperability, standardisation would be a big step forward. It is also mandatory to work towards a common methodology to assess the quality of telehealth solutions. Standardisation and a common quality framework will help the telehealth sector to grow.

5. *The existing solutions are not good enough for telehealth diagnosis*. Not everything can be used for a diagnosis/medical purpose; there is a difference between a medical device and lifestyle/consumer device. The telehealth is not suited/ready from a device point of view. Some existing solutions are not good enough for diagnosis.

6. *Healthcare is still thinking in silos.* A more patient-centric approach must be developed at the hospital in monitoring patient at home. Diseases are correlated to many factors and telehealth must be an opportunity to have a more global vision of the patient health condition.

7. *Access to healthcare through technology needs to be improved to lower the need for contact moments (addressing geographical and lack of healthcare provider issues).* In low density population areas or in location where the health offering is reduced, the access to telehealth is

more important but usually these areas also lack network access or other technology resources.

8. ***Patients have low self-efficacy***. Usually at home, the patients prefer to try to forget her/his health problem or is not convinced (s)he can act to improve it. This human behaviour needs to be recognised and mitigated.

The group proposed several **solutions** that can contribute to solve these problems:

1. Framework outside hospital
   The development of a framework that will be common for several hospitals can be a good solution to overcome some of the problems. With a broader scope, you will see less interoperability problems, you can invest more in all the data problem (safety, privacy, GDPR compliance) and you can standardise the connection with the hospitals. This outsourcing of the framework can lower the entrance barrier for hospitals and provide a more robust solution.

2. Management side
   To put in place telehealth solutions, you can adopt innovative solutions to coach both the healthcare staff and the patients. Both sides need some training and technology such as Virtual/Augmented reality and machine learning can be used to improve the coaching. At the management level, you can also implement seamless data flows that will break the silos between the hospital services.

3. Monitoring side
   The monitoring activity of a telehealth solution has some use case dependant dimensions (specific to the disease) that need ad-hoc solutions. In addition, you also have to deal with some general problems such as the self-efficacy of the patients.

During the group discussion three ideas of collaborative research project has emerged.

**Project idea 1: Framework for Community care / out-patient**
As seen above, the development of a framework has several advantages compared to an hospital initiative. It can propose a standardised approach with more investments and so a more robust solution to handle the security and privacy of data. Several stakeholders can join skills and efforts to develop such a framework that can provide an outsource solution for telehealth to healthcare providers.

**Project idea 2: Self-efficacy of patients (monitoring, management and coaching)**
The second project idea targets the development of new approaches to handle the issue of self-efficacy of patient. The focus is on new solutions for the monitoring, the management and coaching of the patients that can improve the efficiency of current telehealth systems.

**Project idea 3: Monitoring / Wearables for biochemistry**
The third project idea plans to develop solutions including the use of biochemistry sensors. As stated above, the quality and the diversity of sensors are still to be improved as well as the software that will

transform the sensor data into valuable health information. The addition of biochemistry data analysis can provide new insights to improve diagnosis capability.

## 3.2.  Hospital optimisation

This group on hospital optimisation identified several types of **problems**:

1.  ***Staff related problems***
    There is a lack of medical staff especially of nurses in most of the European countries. In addition, the continuous training of the medical staff is an important issue with the development of new technologies, therapies or protocols. There are also some concerns to keep a highly motivated staff that can provide the quality of service expected in hospitals. The evolution of the healthcare sector (such as the development of telehealth) creates new types of jobs that need to be filled with retrained staff or new education cursus.

2.  ***Patient centricity/feedback in the hospital processes***
    The hospital organisation has to evolve towards a more patient-centric approach. The current processes are mostly designed around the medical staff constraints and a more balanced approach with more weight of the patient's experience needs to be developed. It will also be good to integrate the feedback of the patient in the evaluation of therapies, protocols and hospital journey.

3.  ***Data exploitation***
    Data exploitation can be improved for different purposes. First for selecting the therapies and the protocols. Second for the management and to move toward value-based healthcare. Some data related to patient's safety and satisfaction are not enough taken into account. All the hospital processes also need to embed the relevant data. Exchange of data between the hospital and the other healthcare players (general practitioner, other caregivers) also needs to be further developed. There are also barriers to exchange data between hospitals at an international level that can slow down medical research. Data exploitation for economic analysis is to be developed.

In terms of **solutions**, the group considers that the staff efficiency can be improved if we work towards:

1.  Reduction of the administrative burden with automatisation of paperwork and optimisation of workflow
2.  New methods with a better balance between optimisation of the workflow (hospital perspective) and optimisation of the care pathway (patient perspective)

A more advanced knowledge of both the patients and the nurses' profiles can help to develop these new solutions. Today, the human dimension is not enough considered, and some more personalised processes can be proposed.

The group has proposed six ideas of research projects:

**Project idea 1: Optimised alarm response**
More advanced alarm management can be developed that will reduce the workload and fatigue of the medical staff:

- Priority of alarms (fallen from bed, or wanting glass of water)
- Replace manual measurements (temperature) with automated measurements
- Prevent alarm fatigue; personalised alarms, central dashboarding
- Location & activity tracking (real emergency closest nurse, if someone busy do not disturb, …)

**Project idea 2: Process optimisation through movement tracking of staff and patients (and equipment)**
The tracking of people and equipment within the hospital can provide several benefits:

- Reduced administrative burden
- Associated analytics
- Dashboarding
- Therapy focus
- Edge processing

**Project idea 3: Patient engagement analysis**
Knowing the level of engagement of the patient can be useful to adapt the therapies or to optimise the allocation of resources. The project focus is on patient profiling (engagement monitoring taking into account specific patient character traits)

**Project idea 4: Reduction of administrative burden**
The project will address several topics:

- AI to analyse hospital processes ($\rightarrow$ might be more generic to other application domains)
- Remove duplications
- Identify best practices (between departments, between hospitals)
- More structured approach to ad hoc verbal communication
  Speech recognition with domain knowledge

**Project idea 5: Patient-centralised data collection and dashboarding**
The goal of this project is to develop a data management system that will be compliant to emerging legislation on data exchange within Europe. Such an international data sharing system can benefit medical research across Europe.

**Project idea 6: Automated and prioritised, application-dependent data collection, management and analysis**
The purpose of the project is to help with the selection of what data to keep and with the management, the storage and future access to the stored data.

## 3.3.  Towards prevention

During its discussions the group has identified several **problems**:

1. *The reimbursement of preventive activities* is an issue that slows down the development of prevention. Everyone agrees that more emphasis should be put in prevention, but the business models are still to be put in place to sustain the growth of most of the initiatives.

2. However, the market is developing mainly thanks to personal investment of people willing to move towards a healthier lifestyle. Unfortunately, most of the wearable devices that are used are vendor specific and *the interoperability is not yet there*. This is another slow-down factor and vendor interoperability should be encouraged to foster an open the market.

   Due to the lack of interoperability the data are in silos and the interpretation of the data is still at a very early stage. Some progress is needed in the way the sensor data are transformed into information about the health status.

3. *The coverage of the data coming from wearables is not complete and some health dimensions are missing.* This is the case for mental health which can impact a lot of other health dimensions. The measurement of stress and pain are examples of this lack of coverage. Another area that can be developed is the biomarkers that can give quick feedback on the impact of some actions (i.e. impact of eating a banana compared to eating a donut).

4. *The group has also noticed the multiplication of so called "health" applications.* It is a kind of 'jungle' and people can have difficulties to select the most relevant for them. A framework to certify the apps would be welcome to build trust and develop the usage of good quality solutions. Such a framework can also be useful to progress towards standardisation.

As potential **solutions,** the group has discussed several directions.

1. The analysis of communication can deliver important information that will be useful for the success of prevention. First it can help to assess some factors as stress that have impact on the health. Second it can provide information about the motivation of the people and how to adapt the coaching to this motivation.

2. The development of new types of sensors is another important direction. The quality of existing sensors can be improved and new domains like biomarkers can be covered by these new generations of sensors.

3. It is also very important to develop solutions that give quick feedback to the users. A short feedback loop helps to change the bad habits into good ones and to get the interest of potential users.

4. The development of holistic analysis combining data coming from different sources is a potential game changer for prevention. It will significantly increase the quality of the assessment of the health status and helps in defining the relevant recommendations.

5. One of the low hanging fruits in the prevention domain is the development of solutions at work that will help to better manage the stress and the health condition of the workers.

The group came up with three project ideas:

**Project idea 1: Lifestyle intervention within healthcare**
The project focuses on several dimensions of health (sleep, stress, eating habits, movement and social environment) and wants to integrate them to provide better recommendations and to adapt coaching to this more complete view of the health status of the user.

**Project idea 2: Early diagnostics of cancer**
This project plans to develop new ways to test the people at home with the objective to get an early detection of cancer.

**Project idea 3: Spin off project Lifestyle idea related to specific areas like health check or obesity**
The idea is analogue to the first project idea but with a different objective in terms of output. If the focus is for example obesity prevention, the project can use the same approach but with different sensors, analysis modules and recommendation modules.

## 3.4. Data exploitation
The group got a consensus on a list of important **problems**:

1. *The sharing of data is still difficult*. Amongst the issues are the fear to have unauthorised access to data by either economic players (insurances, banks) or government. The privacy of the data is a big concern for the patients and there is even the fear that anonymisation will not be enough to avoid disclosure of individual data.

2. *Another type of problem is related to the difficulties to connect different types of data which are still very much stored in silos.* The data owners, even if they do not plan to exploit the data, fear that releasing the data will enable other players to make profits out of them without getting a fair retribution. There are also vendors that have a lock-in strategy preventing a better usage of the data.

3. To foster the data exploitation, it would be great to have a well-connected ecosystem involving hospitals, industry and start-ups. Unfortunately, usually *it is difficult to find the right business models* to develop those links and to put in place right incentives to build win-win relationships. The financing of start-ups is also still a concern.

4. *The health data are still not enough standardised to allow a smooth exploitation*. Even if image data are now standardised, this is not the case for a lot of other data types. The data quality is also an issue.

5. *The efficiency of data exploitation is another concern*. Several limitations are currently present that reduce the efficiency. We see administrative procedures and strict protocols that

can be obstacles to an efficient use of data. The lack of domain knowledge of data managers can be another issue. As a result, converting data into insight is difficult.

The group has highlighted several **solutions** to progress in data exploitation.

1. One way to progress is to add to data some meta-data that will help to correctly exploit the data. Knowing where data is coming from, how it has been collected, how it was managed and when it was handled is also very important when exploiting data (e.g. especially when connecting data from a controlled environment – hospital – with data from a non-controlled environment – home).

2. Another idea is to develop 'federated' data exploitation. Several approaches could be developed to foster the use of data coming from several owners. To reduce concerns about sharing data, only some selection of the data could be exchanged with some filtering mechanisms to reduce the sensitivity of the shared data. The development of federated learning can also be a path to exchange at the level of data models instead of sharing the data. This idea can be pushed a step further with the exchange of insights rather than data models. A different direction would be to develop business models that allow data sharing with a fair retribution to the data owners.

3. Data harmonisation will help to progress towards efficient data exploitation. There are several levels for which harmonisation could be valuable. First at the data level itself, it is important to continue the current harmonisation effort. The process to follow-up the results of therapies or protocols could be another level of harmonisation. The workflow of data within the hospitals could also be harmonised. The way outcomes of treatments are reported is another domain in which harmonisation could be beneficial. The harmonisation at these different levels will enable the consolidation of data across hospitals, some comparisons, and will also significantly increase the scope of potential usage of any new data exploitation solution.

The group has proposed two project ideas aligned with the solutions that have been highlighted.

**Project idea 1:  Sharing data: Federated learning**
The goal of this project is to develop new approaches that will facilitate data sharing. The federated learning methods are one of the directions of the project. Business models with sharing incentives and a fair retribution to the data owners are another one.

**Project idea 2: Data harmonisation**
The project plans to address the different levels where harmonisation is valuable for data exploitation. As explained, the project will consider the patient data themselves, but also other meta-data related to the treatments and hospitals workflows.

## You are invited to submit your customer-oriented project idea!

Once again, this international customer workshop reconciliated the customers concerns and the interest of technology providers (large industry, research institutes as well as innovative SMEs). It

occurred in a very open manner, thanks to all participants. It has been very fruitful with many challenges shared and 14 project ideas to build.

You are invited to use this valuable input and to create or join a customer-oriented idea for a project proposal in ITEA Call 2022. We look forward to discovering your unique solutions!