# SOCIAL HEALTH BOTS

## Mastering mental health issues through smart personalised automatic assistance

### 1. Relevance relative to the call for proposals

The primary objective of SOCIAL HEALTH BOTS, as illustrated in Figure 2, is to establish the knowledge needed to provide better and more efficient mental health services for young people (age 16-26 years) through smart use of chatting robots or online chatbots, that is, digital "machine conversation system which interacts with human users via natural conversational language" (Shawar & Atwell, 2005, p. 489) in an online environment. The recent developments within artificial intelligence and deep learning, coupled with the broad popular uptake of online digital devices and the emergence of huge data sets (big data) make chatbots a promising supplement to more labour-intensive interventions within health and welfare services. SOCIAL HEALTH BOTS will increase our understanding of the future potential of this type of technology, and the possible challenges of automatic robot services in the context of mental health to support young people.

The project will contribute to reach the goals of HELSEVEL. In particular:

- Increased quality, competency, and efficiency in the health and welfare services, through the establishment and dissemination of relevant and needed knowledge.
- Strong user involvement throughout the chain of research and innovation, including The Norwegian Directorate for Children, Youth and Family Affairs (www.ung.no), the health care services at schools in Oslo (Skolehelsetjenesten), and Save the Children, will enhance the relevance and uptake of the project result.
- The project will facilitate a new arena of collaboration, through the project user involvement and cross-sector academic cooperation, involving researchers from SINTEF (human-centred design in the health sector), Oslo University Hospital (clinical mental patient research), University of Oslo (youth and mental health), and University of Agder (intelligent systems and eHealth).
- Key service areas will be addressed. Given the cross-level relevance of mental health services for young people, the project addresses several key service areas: The municipal health and welfare services, in particular health care services at schools, the specialist health services, represented by the Oslo University Hospital and the Division of Mental Health and Addiction and the Division of Medicine, the specialists in healthcare prevention among young people are represented by The University of Oslo and the Institute of Health and Society. Finally, the child and adolescents welfare services, represented by Norwegian Directorate for Children, Youth and Family Affairs and www.ung.no.
- Important thematic areas, according to HELSEVEL will be addressed. Smart use of chatbots in mental health services concerns both *service innovation and implementation* as well as *technology and digitalization*, addressing the *ethical, legal and societal aspects* of health services based on chatbots.
- The project results will have substantial societal and economical value. Smart use of chatbots in mental health services will strengthen the accelerated need for service offering for young people in need of preventive health care and early interventions pertaining to anxiety, depression, and suicidal thoughts.
- The project results will have significant value for other services than mental health services for young people. Smart use of chatbots is relevant also for other health and welfare services, such as information and follow-up services for elderly with multiple and chronic illness and personalized automated support in rehabilitation programs.

## 2. Aspects relating to the research project

### 2.1 Background and status of knowledge

The increase in mental health issues (Whiteford et al., 2013) and suicidal behaviour combined with limited number of qualified health care staff is a major challenge to the health care system and to the society at large, both at the international (Chisholm, 2016) and the national (Norheim, Grimholt & Ekeberg, 2013) level. International studies suggest that, in particular, young people increasingly suffer from mental health issues such as social isolation, anxiety, eating disorders, sexual problems, depression, self-harm and suicidal thoughts (Glavin & Helseth 2005, WHO, 2015). Seventy-five percent of major mental disorders have their onset prior to the age of 25 (Kim-Cohen et al., 2003). For these, the consequences of insufficient information, preventive efforts, and early interventions can be detrimental (WHO, 2015). Seventy-five percent of major mental disorders have their onset prior to the age of 25 (Kim-Cohen et al., 2003) and suicide is one of the most frequent causes of death among young people (Norheim, Grimholt & Ekeberg, 2013). In Norway, a resembling increase in mental health issues is seen among young people (Nova, 2014). The usage of anti-depressive drugs among young girls in Norway have been rising with nearly sixty percent from 2004 to 2014 (Hartz et al., 2016).

The World Health Organization (WHO, 2015) concludes that if young people with mental problems receive the help they should have at the right time, it can prevent suffering and death. Preventive programs (Fisak et al., 2011) and early interventions (Calear & Christensen, 2010) has found to provide promising results. However, the reluctance of young people to discuss mental health issues with others (Melville, 1989), suggests a need for services aiming at prevention and early-phase interventions that are exceptionally accessible and low threshold. Technology-based self-management services and computerized programs for early intervention (Richardson et al., 2010) have shown to be potentially efficacious. Active assistance technology (Kennedy et al., 2015), and computer-based dialogue systems for health behaviour change (Bickmore et al., 2011) show promising results in areas such as exercise, diet, and adherence to medical regimes[1].

Chatbots, as humanlike representations of organisation or service, are increasingly applied within popular online social platforms such as Facebook Messenger and WhatsApp (Brandtzaeg et al, 2015a). Chatbots are also currently emerging in commercial contexts to interact, often unnoticed, with people in social media ecosystems or as customer service agents in bigger companies such as IKEA, Apple, and Scandinavian Chatbots can be added to friend lists in several messenger services like Facebook Messenger as well. These allow users to type questions (i.e., queries) and, in return, generating meaningful answers to those questions. The chatbot parses the content of the user input (questions such as, “Why do I have anxiety?”) and links this to a message database with possible responses (“Look for more information on anxiety at www.ung.no/anxiety and visit your school health care service“).

The specific application of chatbots as online social agents is still understudied in the health domain, but some examples in *Figure. 1* exists[2]. Potential benefits of chatbots in the health domain includes (1) personalized access to information and advice anytime (not just during clinic hours); (2) the opportunity to ask questions too embarrassing to ask a health professional;(3) the opportunity for users to deal with complicated decisions at their own pace; (4) electronically seek sources of support to help them deal with their emotional responses to health problems; and (5) examine how others have survived similar problems.

Due to an accelerated need for services that can provide help to young people with mental health issues, but also the increased automation of services and the society in general, it is important

[1] An interesting example; in February 2015, Facebook partnered with several mental health organizations including Forefront, Now Matters Now, the National Suicide Prevention Lifeline, and Save.org to offer its users more tools to help (see http://mobihealthnews.com)

[2] There is one interesting example so far (Launched April 22, 2016): HealthTap App Chat Bot (http://m.me/healthtapp) a health chatbots was launched on the Facebook Messenger Platform. "HealthTap allows users to type a question into Messenger and receive free responses from doctors within their network of more than 100,000 doctors that span 141 specialties. It's like having a doctor on call at any time of the day to answer any health questions": http://www.messengerchatbots.com/Reviews/healthtap-app-chat-bot-walkthrough_review.aspx

to conduct this research at this time. ***In SOCIAL HEALTH BOTS we target three core research challenges as particularly important to young people with mental health issues,*** and which new automatic health service assistance online can support and connect to (as outlined in *Figure 2.*); 'social contact and participation', 'information support', and 'Public healthcare service innovation'.


*Figure 1*. **Examples of health chatbots**
(Source: https://www.chatbots.org)

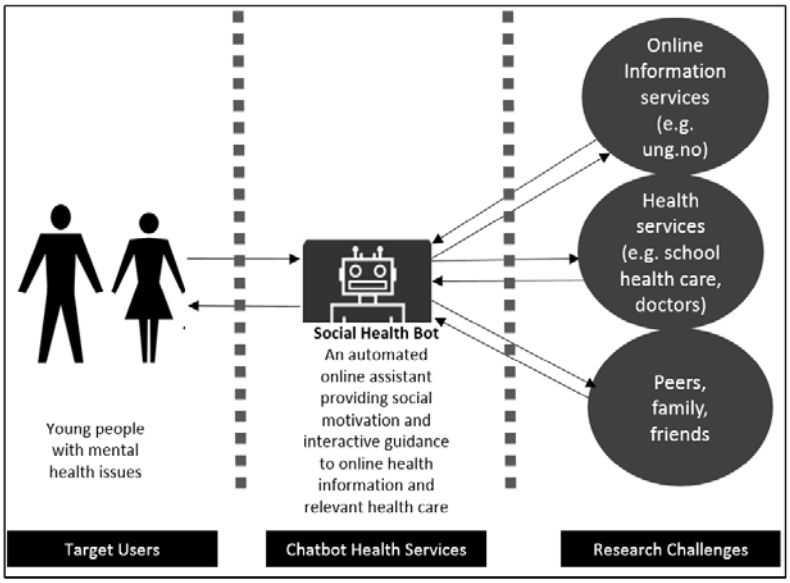


*Figure 2*. **The underlining idea in Social Health Bots**

***First challenge: Social contact and participation***: The significant influence that social relationships have on health has gathered great interest among both researchers and health care personnel (Heaney & Israel, 2008). Numerous studies have confirmed that family, peers, school, and community is crucial (Cauce et al., 2002), while loneliness is associated with depression and anxiety (Wetterlin et al., 2014). With the Internet, thousands of online support groups are addressing mental health issues, enabling individuals to connect with others in similar situations (Deetjen & Powell, 2016). Yet, some young people also spend too much time in front of digital screens, which can lead to isolation and psychosocial problems (Heim et al., 2007; Brandtzaeg, 2012). *SOCIAL HEALTH BOTS seeks to advance state-of-the-art in social contact and social participation,* by examine how chatbots services can facilitate both online, as well as offline sociability among young people.

***Second challenge: Information support:*** The consumption pattern and experiences of health information has changed dramatically with diffusion of the internet, social media and smartphones (Wetterlin et al., 2014), which is in particular true among young people (Brandtzaeg et al., 2015a). Online information and interaction can have unique benefits for people suffering from mental illnesses (Eysenbach et al., 2004; Wetterlin et al., 2014). However, internet and social media are increasingly prone to misinformation (Brandtzaeg et al., 2015b). Misconceptions about health issues are often shared online (Del Vicario et al, 2016), which can leads to distribution of harms. In addition, the impact of chatbots will grow, so does the capacity of misuse (Woolley, 2016). *SOCIAL HEALTH BOTS seeks to advance state-of-the-art in health information services*, by investigating how smart use of chatbots services may mitigate the negative effects of health misinformation online, and serve as a smart guide to young people searching for help online. In the future, we expect that people not will search for information online but they will talk to a chatbot as this technology will develop. Artificial intelligence will improve and learn responses to cope with people's unique questions and comments.

***Third challenge: Public health care service innovation challenges:*** Higher-order challenges such as the need for information support and social participation cannot be met or provided by local health care alone. We need to find ways in how young people with mental health issues and their

social network can work in partnership with voluntary sector, private entities and local care, but it is far from clear how such collaboration should be pursued. Hence, the public health care sector is in the middle of a service innovation process where innovations take place in the service concept, the touch-points between service provider and users, the service delivery system and/or technological options driving innovations (Agerwal & Selen, 2011; Gallouj et al., 2009). Providing a careful composition of new resources, activities and re-thought practices are components of social innovations that can delay onset of reported mental problems. *SOCIAL HEALTH BOTS seeks to advance state-of-the-art in health care services;* investigating how integrative services, supported by chatbots, can facilitate new connections and models of co-operation.

### 2.2. Approaches, research questions and choice of method

To achieve a deeper understanding of how young people can interact with chatbots in the context of mental health services, SOCIAL HEALTH BOTS will address the following research questions derived from existing knowledge, and our theoretical basis in human-centred design (Maguire, 2001) and theory on *human-machine networks* (Tsvetkova et al., 2015). This theoretical position understand human behaviour in the networks of the humans and machinery of which it takes place, and supports analysis of antecedents such as trust (Engen et al., 2016), motivation, problem solving, and collaboration (Lüders, 2016).

The research questions have been developed in close cooperation and involvement with target users. The main area of interest is the use of chatbots as part of preventive health care and early-phase intervention for young people with a broad range of mental issues.

***RQ1 – social contact and participation:*** *How can services deployed by chatbots help young people with mental health issues to enable social contact and participation?*

***RQ2 – information support:*** *What are the current information needs and information gathering strategies of young people with mental health issues, and how can such information gathering be supported and guided by chatbots?*

***RQ3 – public healthcare service innovation****: How can chatbots strengthen coordination and collaboration between health care services at schools, health care specialists (e.g. doctors) and online information providers (e.g. ung.no)?*

**RQ1 Social contact and participation**

*a) How do young people with mental health issues benefit from social contacts and participation, with peers, friends, and families?*
*b) How can chatbots strengthen beneficial social contacts and participation patterns, to support prevention of mental health disorders?*
*c) How can chatbots be designed and implemented to strengthen such beneficial social contact and participation?*

**RQ2 Information support**

*a) What are the informational needs and typical information gathering patterns of young people with mental health issues?*
*b) How can chatbots support individual and personalised needs for verified information health support?*
*c) How should chatbots services be designed to serve as a useful and trusted in communication with young people with mental health issues, and, if necessary, guide these young people towards to targeted information support and other preventive and early-phase interventions?*

**RQ3 Public healthcare service innovation**

*a) What are the challenges to establish collaborative partnerships between people working with young people, such as the school health care, health care, private and voluntary online services and information sites,*

*b) How can chatbots, and young peoples' usage patterns of these, improve on current coordination and collaboration with actors targeting young people with information support related to health issues?*

*c) How can chatbots serve as integrated platforms for collaboration, learning and knowledge sharing between the involved partners?*

The research questions point towards both the need for new knowledge and the need to exploration and trials of technological solutions in cases. For this reason, our choice of method is a mixed-method approach, based in the theoretical paradigm of human-centred design (HCD) (Maguire, 2001) which integrates user involvement, design, engineering, and knowledge development (Giancomi, 2014). Following HCD principles, key user groups are involved both in the needed knowledge generation as well as in the development and trial of prototype solutions to gain insight into practical implementations as well as refine the knowledge base (Sanders & Stappers, 2008). *Figure 3.* provides an overview over the main research activities.

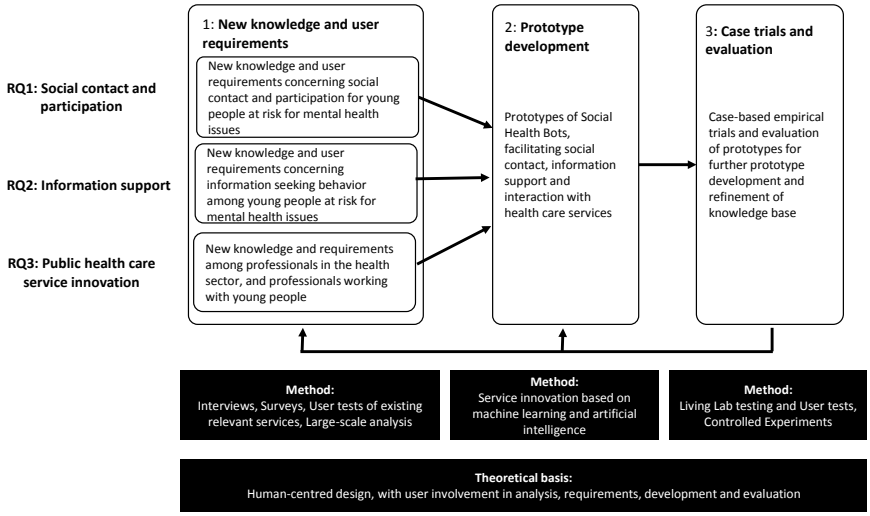


*Figure 3.* **Overview of research activities and methods in Social Health Bots**

First, qualitative and quantitative data collection and analysis are applied to gain in-depth knowledge. Then, the design and development of chatbots are explored in case trials to investigate how opportunities concerning information support and social participation may be realized through smart use of chatbots. This exploration will in turn allow us to revisit the knowledge base, for validation and refinement as well as demonstration purposes.

***1) New knowledge and user requirements*** will be gathered on the basis of a mixed method approach involving a broad range of sources. To gain new insight into the online information seeking behaviour of young people, *the project will utilize a unique dataset of 150.000 questions from young people posted at the Norwegian online information service ung.no, and associated comments.* A significant proportion of these also concern mental health issues. Analysis of this large-scale qualitative data source will be enabled through the integrated application of artificial intelligence and text-mining on the one hand, and manual, hands-on analysis on the other. The insight from the large-scale qualitative analysis will be complemented with interviews of (a) young people as potential health service chatbots, (b) healthcare personnel from the school health service

and specialist services, and (c) personnel from volunteer services such as Save the Children and information services such as ung.no, as well as user testing of relevant existing services with young people. The interviews and user testing will be set up so as to inform RQ1-RQ3.

***2) Developing prototypes*** of chatbots services will be done based on open scripts and programs (e.g. open chatbots APIs in Facebook Messenger, WeChat and WhatsApp), and technologies developments at University of Agder (e.g. Yazidi et al., 2013). This will be combined with the output from machine learning processes and the findings from the user involvement research above. The development of the prototypes will be a co-creative and iterative process involving the young people, health care employees, information services (e.g. Ung.no) and NGOs such as Save the Children, and take place in natural user-context such as Ung.no and the School Health Service. The prototypes will have natural language ability, so that the target group of young users can chat with it directly to simulate real-time conversations (harnessed by artificial intelligence) and ask it questions. The prototypes will also reference information from useful third-party services. Particular efforts will be directed, through service innovation, to understand how chatbots can enable coordination and collaboration between young people and relevant professional actors, such as information workers, local health care personnel at schools, and specialist health care personnel.

***3) Case trials and evaluation*** of any programme, service or intervention is vital to determine whether it works, to help refine the service delivery, and to provide evidence for continuing support of the service. Evaluation of the prototypes developed will not only provide feedback on the effectiveness of the chatbots but will also help to determine whether the social health chatbots is appropriate for the target population, whether there are any problems with its implementation and support, and whether there are any ongoing concerns that need to be resolved in the future concerning usefulness, motivation, usability, and trust, as well as privacy and ethical issues. Evaluations will be conducted as randomized experiments with use of chatbots as experimental condition. The experiments will be complemented with exploratory case trials studies in online Living lab facilities (Følstad, 2008; Følstad et al., 2015), to gain insight into young people's preferences with regard to the prototype chatbots. This will give unique real world experiences into their perceptions of usefulness and trust and usability.

## 3. The project plan, project management, organisation and cooperation

SOCIAL HEALTH BOTS will run for 3,5 years (2017-2020). The project plan is organised in six work packages as illustrated in *Figure. 4.* Milestones are listed in the electronic application form.

SOCIAL HEALTH BOTS will collaborate with partners from research organisations (SINTEF and University of Oslo, Oslo University Hospital, University of Agder), public health care sector (School Health Services in Grorud, Nordre Aker and Bjerke), voluntary organizations (Redd Barna/Save the Children), and the public information service (ung.no, BUFDIR). SINTEF, is the coordinator and reporting partner. The consortium partners have been selected based on their domain expertise and expertise on user needs, methods and tools to ensure that objectives are met.

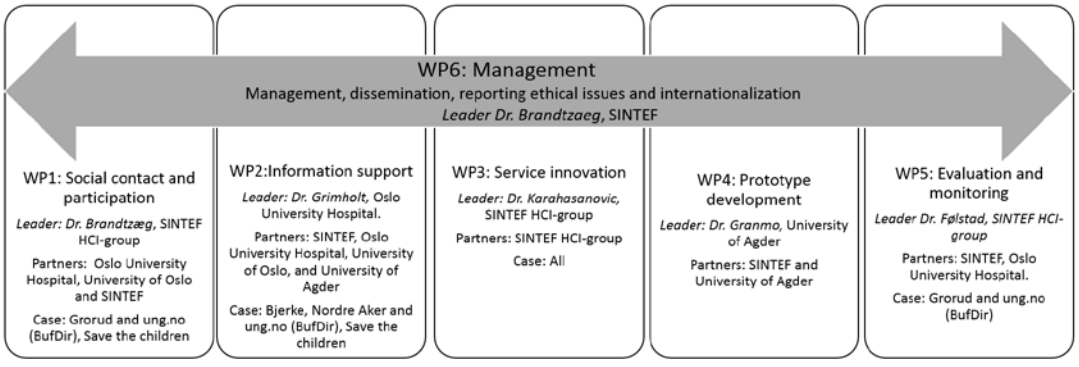


**Figure 4**. *Work packages structure in SOCIAL HEALTH BOTS*

A Steering Committee (SC) will be established including user partners with young people, health sector representatives, and from each partner in the project, chaired by the coordinator. The project also include an Advisory Board, with international visiting researchers per annual meeting. We will in addition invite representatives from the *National Directorate for eHealth Affairs* (eHelsedirektoratet) (Norway) and *Helsenorge.no* (Health Norway) that already have shown interest to participate in the Advisory Board of SOCIAL HEALTH BOTS. This board will provide the project with a faster understanding of emerging policy changes, emerging trends in patient concerns and aspirations, technological developments and access to good practice.

Table 1. show all the R&D partners and user partners confirmed for SOCIAL HEALTH BOTS.

| Partner | Role, contribution and significance for SOCIAL HEALTH BOTS |
|---|---|
| SINTEF | **Project Coordinator and R&D partner** with expertise in research on social contact, verification of information online, use of communication technologies among young people, human-centred design, and service innovation. Responsible for case-study on Social contact and participation (WP1), Service Innovation (WP3) and Evaluation and Monitoring (WP5). |
| Oslo University Hospital | **R&D partner** with expertise in research into mental health, clinical studies and intervention studies. Responsible for one Postdoc student and for WP1 on information support. |
| UNIVERSITY OF AGDER | **R&D partner** with expertise in Machin learning, deep learning, artificial intelligence and eHealth. Responsible for Postdoc student and for prototyping of chatbots, WP4. |
| UiO : University of Oslo | **R&D partner** with expertise in research in young people and mental health and prevention programmes. Co-responsible with Oslo University Hospital for one Post.doc student and the information support case. |
| School Health Service at Grorud city district | **User partner with domain competence on local health care among young people.** Specifically involved in the case study on Information support, by identifying informants, participating in requirements gathering, evaluation and testing pilots with minority youth. |
| School Health Service at Nordre Aker city district | **User partner with domain competence on local health care among young people.** Specifically involved in the case study on Social contact and participation, by identifying informants, participating in concept development, evaluating concepts and testing pilots. |
| School Health Service at Bjerke city district | **User partner with domain competence on local health care among young people.** Specifically involved in the case study on Information support, by identifying informants, participating in development, evaluating prototypes and testing pilots. |
| UNG.NO | **User partner and public information service provider.** Involved in both case studies, data gathering participating in concept development, evaluating concepts and testing pilots. Hosting a large data set with over 150 000 questions from youth that will be analysed in the project. |
| Save the Children Norway | **User partner with domain competence in young people.** Involved in both case studies, data gathering participating, evaluating concepts and testing pilots. |

*Table 1.* **An overview over the users and R&D partners in SOCIAL HEALTH BOTS**

### 3.1. International partners

Adjacent, related projects: SOCIAL HEALTH BOTS will collaborate with and build on work done in the European HORIZON 2020 project, **HUMANE** (lead by SINTEF), investigating human-machine networks concerning chatbots in the context of health. Our research efforts are also closely related to research in the FP7-project **REVEAL,** where SINTEF have a central role on verification of information in social media (i.e. information support case).

SOCIAL HEALTH BOTS will collaborate with two international visiting researchers in the project, which also will be part of the *advisory board* in the project. First, *Dr. Astrid Weiss* is selected

as one of the "25 women you need to know in robotics", working at **Vision4Robotics group** (ACIN – Automation and Control Institute) at the Vienna University of Technology. Second is *Dr. Katherine Boydell,* a Professor of **Mental Health at The Black Dog Institute, University of New South Wales.** Her research focuses on understanding the complex pathways to care for young people experiencing mental issues and the use of new technologies in youth mental health.

## 4. Key perspectives and compliance with strategic documents

SOCIAL HEALTH BOTS aligns with European strategies (e.g. WHO, 2005, WHO, 2014, NOU, 2015) and national strategic documents, targeting young people and the importance of strengthen the work concerning mental health issues (Folkehelsemeldinga, 2015; NOU, 2015). According to European strategy, outlined by WHO (2005) for child and adolescent health and development good health in younger age is a resource for social and economic development, while the burden of ill health and impaired development in children has a multitude of effects. Health is a fundamental human right for all young people in Norway and the Region. Two of the seven priority areas of WHO's (2005) areas for action in the European contexts, is (1) to provide youth friendly health services and (2) focus on psychosocial development and mental health among young people. In the Norwegian ICT-strategy (Nasjonal IKT, 2016-2019) the improvement of digital health services to the public is a clear goal.

**SINTEF** is coordinating and reporting R&D partner. SINTEF is Scandinavia's largest research institute, and the overall vision of SINTEF is "Technology for a better society". SOCIAL HEALTH BOTS capitalizes on SINTEF's multi-disciplinary efforts in the field of young people, social media and health and welfare technology, as well as service innovation. SINTEFs HCI-group also holds leading competence in the interaction between human and machines.

**Oslo University Hospital, Department of Research and Development, Division of Mental Health and Addiction** is collaborating R&D partners and among the leading research environments on clinical treatments of mental issues and suicidal behaviour. SOCIAL HEALTH BOTS will add to and further develop research efforts in the field of mental issues among young people, and early intervention support through innovative services.

**University of Oslo, Institute of Health and Society and Dept. of Behavioural Science,** are collaborating R&D partners and leading research partners on health and well-being among young people, in particular how society and the health care services can prevent mental disorders. SOCIAL HEALTH BOTS will align and strengthen this research by exploring how chatbots can integrate important puzzles in young people's lives to prevent mental disorders

**University of Agder and The Centre for Integrated Emergency Management (CIEM, ciem.uia.no) and eHealth Centre:** CIEM conducts research projects related to artificial intelligence, human-agent collectives, resilience, and collaborative decision-making, while eHealth Centre do user-centered research close to care practises to develop more effective solutions that can provide safety, social contact, care and quality in the everyday life, which aligns with the research objectives in SOCIAL HEALTH BOTS.

**School Health Service at Grorud city district.** Grorud, is a low-income multiethnic district in Oslo, and are in the focus of political strategies. SOCIAL HEALTH BOTS will be linked to these strategies and ongoing activities in the municipality with a focus on the mental health support among young people with a diverse background with the aim to reduce inequality in such services and support.

**School Health Service at Nordre Aker city district** is increasingly focusing on identification and, if appropriate, referral for mental health issues. SOCIAL HEALTH BOTS will fully complies with the strategy and help the young people in the district with easier and faster access to help and information.

**School Health Service at Bjerke city district** have approximately 2500 young people over the age of 16 years. The work and main objective in SOCIAL HEALTH BOTS is in line with their current strategy in approaching and assist young users to verified and quality assured health information support.

**The Norwegian Directorate for Children, Youth and Family Affairs (BUFFDIR) and ung.no** is a website with public information. Ung.no has extensive experiences in targeting young people with information, and is planning a larger focus on young people and their mental health. Ung.no are also testing light chatbots (online calculators). SOCIAL HEALTH BOTS will be linked to this information service and their ongoing activities.

**Save the Children, Norway** is working to protect young users online and to guide them towards verified online information sources. They also want to empower minority youth, linked to the research objectives in SOCIAL HEALTH BOTS.

**4.2. Relevance and benefit to society:** SOCIAL HEALTH BOTS addresses and increasing mismatch between health-related social trends and economic resources. Please see the introduction and the mandatory attachment on user involvement and project benefits.

**4.3. Environmental impact**. No significant impacts on environmental issues.

**4.4. Ethical perspectives**

SOCIAL HEALTH BOTS will include research on chatbots services and their artificial intelligence. Artificial intelligence are said to be representatives of future humanity and thus have an ethical obligation to be transparent in their efforts and to discuss and explore the ethical implications. This will be done throughout our human-centred research efforts, focusing on the trust and privacy issues. We will invite The Norwegian Directorate of eHealth in our advisory board to advice and guidance on strategies and measures according to both national and international policy rules and ethical aspects. As the user involvement in SOCIAL HEALTH BOTS includes young people (over the age of 16 years) and professionals working with mental health issues the we will report to our project to NSD, Data Protection Official for Research. Data and material from the study will be kept in line with the requirements of the Oslo University Hospital Personal Protection Agency. The ethical principles highlighted in the Declaration of Helsinki (2009) will be followed. All participation should be voluntary and required written informed consent, free to withdraw from the project at any time. The school nurses will be informed about the study and will also be prepared to support young people at any health risk.

**4.5. Gender issues (Recruitment of women, gender balance and gender perspectives)**

SOCIAL HEALTH BOTS focus on gender difference, and why young girls more often report mental issues as described in the introduction. The project will gain relevant knowledge into gender difference and what girls are requesting and how they can be motivated to be supported by chatbots. Many of the principal researchers working on the R&D and our two international guest scientists are women. All involved partners will actively promote gender balance in the project. The project manager is member of the Norwegian Research Council competence group concerning gender balance in science. Efforts will be made to recruit female researchers in to the two post doc positions.

**5. Dissemination and communication of results (see grant appl.)**

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