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D2.5 - REPORT ON END-USER INTERFACE DESIGN AND USABILITY-RELATED REQUIREMENTS

Due date	M18	**Delivery date**	M18
Work package	2		
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Version	2.1		

DISSEMINATION LEVEL

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VERSION AND AMENDMENTS HISTORY

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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List of Abbreviations

XX	XX
NCDs	Non- transmissible Chronic Diseases
CVD	Cardio-vascular diseases
COPD	Chronic Obstructive Pulmonary Disease
DM	Diabetes Melitus
T1/T2 DM	Type 1/Type 2 Diabetes Mellitus
CM	Cutaneous Melanoma
WHO	World Health Organization
CCs	Chronic Conditions
MI	Myocardial infarction
IARC	International Agency for Research on Cancer
OECD	The Organization for Economic Cooperation and Development
RCTs	Randomized Controlled Trials
NO	Norway
SP	Spain
RO	Romania
CGM	Continuous glucose monitoring
GDPR	General Data Protection Regulation GDPR 679/2016
EMR	Electronic medical record
PA	Physical activity

1 INTRODUCTION

The current deliverable results from the corresponding *Task 2.5. Define the user-related requirements for the preventive app design,* supported by the collaboration of experts within tasks T.7.1 and T.3.2

Deliverable D.2.5. builds on the extensive information gathered already in the deliverable D.7.2. REVIEW OF THE LITERATURE ON APP USE AND USABILITY (M6), collects the expert opinion from the Consortium Members with expertise in clinical and preventive medicine, social and behavioral sciences, software development and computer sciences, as well as patients' advocacy representatives' perspective.

Initially planned to build on information from the deliverables *D.8.1. Stakeholders preferences*, and *D.2.2 End-users opinions and expectations*, it does so in limited manner, as those deliverables are still in progress, because they were delayed due to the significant obstacles and deferrals in the in-field analysis of stakeholders and end-users needs and preferences caused by the Covid-pandemic-related restrictions across the Consortium Countries, for most part of the project duration so far.

Therefore, the information in this deliverable represents the stepping stone for the development of the WARIFA app interface, and will be supplemented and refined in the next phases of the project by new data provided by stakeholders and end-users analysis, as well as by the iterative users' feedback and input during the co-creation and personalization process within the project.

Objective of D.2.5 is to provide succinctly the main principles and a priori requirements that WARIFA interface will have to fulfil, in order to respond to the end-users' needs for disease prevention and

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health maintenance, as well as to assure an optimal users' uptake, data collection, engagement and long-term adherence.

This deliverable benefits in first place to the work in WP3, and sets the foundation for the work of co-creation and personalization of the WARIFA app in WP7.

These a priori requirements will be revised, refined and reformulated along the process of building of the WARIFA app, during the co-creation and personalization process, while harmonizing also with the technical feasibility limits of the WARIFA prototype development during the project. The final version of the requirements will be presented in the Deliverable D.2.7 (planned for M36).

2 BACKGROUND

GENERAL CONDITIONS RELATED TO USABILITY, USER-REQUIREMENTS, QUALITY ASSESSMENT FOR WARIFA

The development of the functionalities and user interface for the WARIFA app has to evolve within the frame of the EU and WHO recommendations for M-Health.

While these have been reviewed extensively in D.7.2, the main principles are illustrated in Table 1.

Table 1 Principles for Digital Development

(From Principles for Digital Development Available online: https://digitalprinciples.org/)

1)	Design with the User.
2)	Understand the Existing Ecosystem.
3)	Design for Scale.
4)	Build for sustainability.
5)	Be Data Driven.
6)	Use Open Standards, Open Data, Open Source and Open Innovation.
7)	Reuse and Improve.
8)	Address Privacy & Security.
9)	Be collaborative.

In terms of quality assessment and quality-assurance criteria that WARIFA will have to comply with, the general domains evaluated by the different assessment frameworks valid in the European context include **privacy, transparency, safety, reliability, validity, interoperability, technical stability, effectiveness, accessibility, scalability, (technical) security and usability/user experience**

On top of that, the regulation and certification procedures dedicated specifically to quality control of medical applications and medical devices available online will be also relevant for WARIFA tool. This is because WARIFA solution will be developed as a complex system with a broad spectrum of functionalities including general public self-estimation of disease risk, medically-validated recommendations for preventive behavior change, disease management for Diabetes patients.

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The most recent regulation on medical devices in Europe, Regulation EU 2017/745, took effect on the 26th May 2021. The guide *Manual on borderline and Classification in the Community Regulatory Framework for Medical Device* [1] develops the regulation on Software and Mobile Applications.

Due to its complex functionalities' ecosystem, WARIFA is difficult to classify in a certain category of risk and pathway of regulatory procedure for Medical Software and Mobile Applications. WARIFA would generally fit into class IIa or IIb of risk, with the functionality for patients with type 1 diabetes recommendations to adjust lifestyle and insulin treatment possibly falling under the class III risk, whereas the functionality for healthy individual assessing their long-term risk of cardiovascular diseases and how to lessen it, would fit most likely in the class I or IIa risk. Compliance with the appropriate pathways of regulation, certification and quality assurance as medical software would in the same time benefit WARIFA from the point of view of acceptance by the users, trust in its reliability, which are important factors for usability.

USABILITY

According to the ISO (International Organization for Standardization), usability is defined as: "*the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*" [2]. In this context, effectiveness is defined as "*accuracy and completeness with which users achieve specified goals*", efficiency, as "*resources used in relation to the results achieved*" and satisfaction "*includes the extent to which the users experience that results from actual use meets the user's needs and expectations*".

Another, extensively accepted definition of usability is that established by Nielsen[3], which includes 5 dimensions, namely: learnability, efficiency, memorability, error management and satisfaction (definitions in Table 2).

Table 2 Definition of the five dimensions of usability

(extracted from [4])

Learnability	Ease of learning the functionality and the behaviour of the system.
Efficiency	Level of attainable productivity of the user after he has learned the system.
Memorability	Ease of remembering the system functionality, so that the casual user can return to the system after a period of non-use, without needing to learn again how to use it.
Few errors	Capability of the system to support users in making less errors during the use of the system, and in case they make errors, to let them easily recover.
Satisfaction	Measure of how pleasant the design is to use.

In agreement with these two definitions of usability, the present document will address the main elements related to:

- Effectiveness – in terms of describing the main functionalities of WARIFA that will serve the users' achievement of their goals related to disease prevention, healthy lifestyle and disease management, adapted to each target group of users.
- Efficacy – in terms of handling the user-related variables that need to be collected by the app. Principles of optimizing the collection of user data and the input of user-related variables will be addressed, aiming to reduce the resources of time, know-how, procedures, technical infrastructure that the users need to invest in order to using the app, and in the same time to assure accurate data collection for correct output.

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- User experience- related to general interface design considerations.

3 TARGET GROUPS AND MAIN FUNCTIONALITIES FOR WARIFA APP

WARIFA app will have two main categories of functionalities:

I. Primary prevention of major chronic diseases (NCDs): Diabetes, Cardiovascular diseases, COPD, skin cancer and maintenance of a healthy lifestyle
II. Disease management support for Type I Diabetes patients

TARGET GROUPS

WARIFA will have to meet the challenge of being used in 3 different national settings, representing different regions, and illustrating the different demographic, socio-economic, cultural, epidemiological and governance configurations within the European landscape: Norway (Northern Europe); Spain (Southern Europe), Romania (Eastern Europe)

Most of these differences, relevant for WARIFA are detailed in the Deliverable D.2.3.

Additionally, parameters highly relevant for WARIFA like the levels of digital health literacy, internet use, internet use for health-related purposes in the population show a sharp gradient North West-South East, with Romania and Easter Europe countries at the lower end, Nordic countries at the top end, with Spain and Southern Europe in intermediary domain[5].

CATEGORY I. Primary prevention of NCDs and maintenance of a healthy lifestyle

Target group: any adult (over 18 years old) interested in preventing any of the NCDs and/or maintaining a healthy lifestyle

Within this general population target, special attention will be paid to making WARIFA app accessible, usable and appealing for the sub- groups with highest burden of the 4 diseases, most exposed to the risk of the NCDs studied in WARIFA, and most prone to risky behaviors: older age, low education, low socio-economic level, comorbidities

* Persons who have Diabetes type 1 are a special sub-category in this target group. They can use this category of functionalities, but with particularities in some areas:
    - The app will use special risk calculators for CVD adapted for T1DM patients
    - Recommendations for prevention behavior like optimal weight, diet, physical activity etc., will be adapted to their condition and in connection with the Disease management Category of Functionalities

CATEGORY II. Disease management support for Type I Diabetes patients

Target group: Diabetes type 1 Patients.

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FUNCTIONALITIES

Here below we list the main functionalities that could be included into the WARIFA tool, in order to fulfil its role in supporting citizens to prevent major chronic diseases, adopt a healthy lifestyle, change behavior on long-term in order to reduce risk of major NCDs, morbidity and mortality, and to manage diseases such as Diabetes type 1.

Not all the functionalities in this a priori list will be possibly developed and implemented to their full into the WARIFA prototype during the limited timeframe of the Project, but their list is informative for the development of the proof of concept that is the aim of WARIFA. Among these functionalities, prioritization of their development during the project will be made, according to medical relevance for and needs of the studied populations, the target end-users' preferences and feedback during co-creation and personalization process, as well as the technical feasibility within the Project framework.

CATEGORY I. Primary prevention of NCDs and maintenance of a healthy lifestyle

Functionalities:

I.1 **Risk estimation.** Based on input from the user, WARIFA app will calculate a combined risk score for the 4 diseases personalized for the user.

For risk calculation, the app will use the values most recently input by the user. This means at the beginning of using the app the initial input; afterwards, the app will prompt the user to update some information, depending on the time elapsed from the last variables input. (See below section ***Dynamics of collection***). If a user decides to use the functionality of monitoring (see I.3.2. below), the last input values will be used, so an updated risk score can be provided at any time the user wants, but the user will have also the possibility to visualize his/her history of risk scores.

I.2 **Risk factors assessment**: Based on input from the user, WARIFA app will present the user the list of risk factors for the studied NCDs that he/she is exposed to (e.g.: based on weight/height input will signal obesity, based on input about physical activity will highlight sedentarism, based on questions about meals will signal unhealthy diet etc.)

This information will be stored, so the user has access to his/her history of risk factors exposure.

I.2.1. Risk ***behaviors assessment.*** In the above I.2. list, the risk factors that are modifiable (the lifestyle factors) will be highlighted (against comparative normal/optimal values)- and the app will offer to provide support to change the respective behaviors (the user will decide if he/she uses the support offered). See next section I.3.

I.3 **Support for modifying risky lifestyle**:

I.3.1 ***Preventive recommendations.*** The app will provide personalized recommendations how to change behavior, based on input from users (opt-in functionality, the user will have to provide additional information for this function. The user will be explained the more info he/she provides the more accurate and personalized the feedback will be).

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This function would be available as:

a. initial set of recommendations, and
b. as serial follow-up, if the user choses to use also function I.4.2 (*below*). The set of recommendations will change in dynamics, according to the changes in behavior/risk factors registered in I.4.2(b*elow*).

The recommendations will include advices for behavior change but also may include the recommendation for the user to consult a doctor, in case his/her risk level/score for at least one disease is significantly elevated.

I.3.2 ***Monitoring.*** The app will prompt repeated input for selected variables related to lifestyle, to monitor the progress in improving behaviors and reducing risk factors. (Opt-in functionality, the user will choose which risk factors he/she wants to monitor, if any).

The timing of the repeated prompting for variables will vary according to the type of variable and the reasonably expected time of changing (e.g., physical activity, smoking - weekly, weight - weekly, sun protection habits - in connection with the UV index, when UV index is high); also, users could have a choice on the rhythmicity of being prompted to input dynamic values). Exact timings for recurrent data input should be proposed initially by clinicians/behavioral experts, then should be tested by pilot test-users and also agreed on the feasibility with the interface builders.

I.3.3 ***Feedback from monitoring***
The app will display the progression in risk factors/behavior change (see *also feedback for user*).
To include:

- "gratifications" for good progress on healthy behavior changes (to *be decided from users' feedback and interface designers' advice. See D.7.2. Usability Review and section below: Feedback for User*)
- alarm signs if risk factors exposure increases, or if recommended doctor appointments were not fulfilled.

The app will also provide updated prevention recommendations (I.3.1. above), according to the changes in risk level/factors.

1.3.4. ***Doctor appointment tracking functionality***. If at some point the user receives the recommendation "go see your doctor", like for high risk of melanoma or stroke, then a schedule function would become available, where the user can input the appointments made, confirm the appointments fulfilled, and then the app can signal when the appointment is approaching, or alarm when an appointment has been missed

I.4. **Health Information.** For the user regarding healthy lifestyle, risk factors, risk factors reduction. General and medically correct information. Possibly with library of links to further useful websites/organizations/apps which can provide correct info.

I.5. **Community building**/chat/ forum function of communicating with other users.

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This functionality is optional, as not related directly to the preventive functionalities. However, community building and sharing has been shown to be an important factor of increasing user's engagement and long-term adherence to the health apps (see D.7.2 Review on Usability requirements).

CATEGORY II. Disease management support for Type I Diabetes patients

Target group: Diabetes 1 Patients.

Functionalities:

II. 1. Prevention of Hypoglycemia and Hyperglycemia

II. 2. Monitoring of parameters

II.2.1. ***Integration and easy visualization of data from different data sources*** (glucose, insulin, physical activity, heart rate, sleep monitoring, etc.)

II.2.2. ***Calculators*****:** Insulin-bolus calculator and carbohydrate counting tool

II.2.3. ***CGM display*** and Tool to teach users how to read CGM data

II. 3. **Health-information and tutorials**: Tutorials on insulin concept, how to use it, conservation etc. and the same for blood monitoring tests (capillary blood glucose).

II. 4 Feedback:

- Recommendations for sick days
- Dietary and physical activity recommendations and registry tool

II.5. Dedicated forum/community building

II. 6 Access to all the functionalities in Category I (Prevention of NCDs) with the adjustment in risk calculator and recommendations needed for the particular condition of Diabetes type 1 patients.

4 VARIABLES COLLECTION- CATEGORIES, DYNAMICS OF COLLECTION

VARIABLES CATEGORIES

Input variables for WARIFA are detailed in Deliverable D.2.4.

An overview of the main selection of input variables, mandatory for the main functions of WARIFA app, together with indications about the methods of their collection is reproduced in Appendix I (Table S1).

In summary, input variables fall in the following functional categories (n.b. overlapping exists, some variables are used in more than one category/function)

1. Demographics

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2. Variables needed to estimate risk for the four NCDs included in WARIFA (included in existing risk calculators)
3. Variables related to risk, beyond existing risk calculators
4. Variables needed to assess behavior and the lifestyle factors
5. Variables needed to tailor preventive recommendations
6. Variables needed to tailor interface for increasing usability
7. New, emerging variables possibly related to risk (for WARIFA research)
8. Variables regarding Diabetes 1 patients for disease management (biological parameters, treatment schedules and dosages, diet and other behavioral features etc.)

These categories include variables at individual level (biological measurements or behavioral) and variables at community/environment level.

To note that not all these variables would be feasible to be collected in all 3 country settings, and for all users. The research within WARIFA will clarify which of these variables can be collected in which setting and for which category of users.

COLLECTION

For the collection of these variables several channels may be taken into consideration:

1. Questions asked to user via WARIFA app interface
2. Connection to wearable sensors (e.g., fitness bands, biologic parameters measuring device (sleep monitors, heart rate, etc.), smartwatches, portable UV sensors, glycemia sensors, monitoring medical devices (e.g., Blood pressure)
3. Connection via location services/individual input on location to public data sources about environment (UV index, air pollution)
4. Connection/linking, where available, to community risk profiles/public databases on relevant population characteristics
5. Linking, if accepted by user, to personal social media accounts (Facebook, Instagram, etc.)

The feasibility of using these channels for data collection for WARIFA in different national/ populational settings depends on the risk assessment, GDPR regulation compliance, and other data access considerations like cost or agreement of third parties to get access to data.

Automated collection, via connection/linking to existing databases or sensors (channels 2-6) is made upon user's choice on *opt-in* method. The user should be asked at the beginning, in establishing user's profile, for which information from the above list he/she is willing to grant access to WARIFA.

> The user should have the option at each moment to withdraw consent for access to those personally-relevant databases.
>
> A main strength of WARIFA would be the integration of electronic resources and records, ubiquitous data databases, and personal sensors/wearables-derived data, in order to reduce as much as possibly the amount of data the user needs to input manually, and to rely as much as possible on automatic collection, without user action.

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Questionnaire-based collection will be used for all the variables where automatic collection is not possible (e.g., personal history of sun exposure) or not available (the user does not use certain sensors, linking with medical databases is not possible etc.)

The questionnaire-based collection of information will follow the principle of hierarchy:

- Ask the user first which functionality he/she wants to use,
- Ask the minimum number of questions needed for that functionality,
- Then propose to user to input more information, for more accurate feedback.
- More information will be asked stepwise, according to the choice of the user regarding the feedback he/she expects from WARIFA app.

DYNAMICS OF COLLECTION

For automatic collection:

- Ask for permission of access at the beginning, at the set-up of the profile.
- Set-up a synchronization schedule (user's choice) (continuous feed of data vs. periodic sync)

For questionnaire-based collection of data

- Some unchangeable variables are asked only once at the beginning when establishing user's profile:

E.g., birthdate, phenotype (height, natural color of skin/eyes/hair, phototype, number of nevi); ethnicity

- Historic variables, asked once and stored, but a prompt for "has anything changed for you?" every time the user wants to access the risk estimation functionality (I.1, I.2); this is for the long-term use of WARIFA app. The user should be prompted to add to the previous info recorded for him/her, not to input all over again, for the variables:
  - personal medical diagnoses, medical history, medication history
  - personal biological/physiological status changes
  - personal history of exposure to UV, carcinogens
  - family medical history
  - education
  - socio-economic level related variables
  - past residence

For these variables if changes are made during the WARIFA app use, the old inputs should still be stored, so the history and chronology of these changes during WARIFA app use can be analyzed. For example, if the user suffers a new CVD event, diagnosed while using the app, it is relevant for the validation of new potential risk variables, for the assessment of the efficiency of the prevention recommendations etc. If additional education is acquired, it is interesting to see how this changes the preventive behavior etc.

Past residences are relevant, especially for long-term users of the app, since most community-level risk factors need a certain time of residence in that community to take effect on the user.

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If the user allows location tracking during the app use, past residences can be automatic updated after 6-12 months in the same location. If not, repeated input should be prompted from the user.

- Dynamic variables - Store all previous values, but ask user for update for current situation of the following type of variables:

Biological parameters (cholesterol, blood hypertension, weight etc.), current behavior (diet, current physical activity, sleep patterns), current exposure behavior (alcohol, smoking, UV); current location, etc.

The ask for update should come up every time the user accesses the risk estimation functionality (I.1, I.2 *vide supra*), at intervals of time longer than 1-3 months, i.e., an interval when most of dynamic variables can be reasonably expected to change. Alternatively, this request for update will appear automatically, at regular intervals set at the beginning, if the functionality monitoring (I.4.2 *vide supra*) is chosen by the user.

5 ONBOARDING, SIGN-IN

User on-boarding and sign-in process should be designed with balance of security vs. user-friendliness. Security of data is important since the user's input are sensitive medical and health information. More detailed information on the level of security and data protection needed, according also to the EU recommendations/regulations are to be found in Deliverable D.7.2, "Review of the Literature on App Use and Usability".

Different options are available. For the WARIFA app, in principle, a 2-step sign-in process is envisaged, with a first authentication step, through username and password, followed by a user verification step, performed through biometric support of the mobile device (fingerprint, face recognition etc.) if available, or alternatively through setup of numerical PIN/code.

This initial proposed solution will be tested further in focus groups of users during the co-creation and personalization protocol to identify the preferred and safe solution for users in different settings

LANDING PAGE

This will provide the user the opportunities to perform:

Profile establishment: name, photo, username/alias, access permissions (for location, personal sensors/wearables, personal social media accounts)

Appearance settings and personalization (user has choice of themes, colors, text size, accessibility features, sounds etc.)

Dashboard with the functionalities available from the list:

- Diabetes 1 management;
- Risk assessment for major NCDs studied in WARIFA;

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- Lifestyle assessment;
- Risk reduction/lifestyle improvement;
- information/education for health;
- Community forum/sharing
- Help/customer service and information; terms of use; etc.

The user has the choice which block of functionalities to access (from the above) at any moment. The user will be asked to input/update his/her data only in regard with the functionality chosen.

6 TYPES OF FEEDBACK FOR THE USER

The WARIFA app may provide the user several types of feedback, according to the functionality chosen. The final configuration of feedback output to the user will be decided in subsequent phases of prototype development, according to users' expressed preferences and needs after iterative testing of the prototype.

Category I Primary prevention of NCDs/healthy lifestyle

1. **Estimation of risk level (risk score)** combined across the NCDs included in WARIFA (WARIFA innovation)
   With visual help of the type of « color scale » like in the WARIFA logo, from « low risk » to « very high » risk

   WARIFA may present to user one global risk score (Innovation in WARIFA), and possibly also, additionally separate risk scores for each of the four diseases. The configuration of the risk scores presentation for the user will be finally decided after user feedback and testing of various options.

2. **Color scale for the level of exposure to each of the main risk factors** for the diseases: weight, blood hypertension, cholesterol levels, unhealthy diet, physical activity, alcohol, smoking, UV exposure (e.g., *UV risk scale should contain a combination of UV index, phototype and declared sun protection measures*)

3. **Time evolution** of the values of the main risk variables

   3.1. Time evolution (history) for the « new risk variables » included in WARIFA (see. D.2.4)

   For these new variables, their correlation to a risk score cannot be yet provided, as this is still under research and needs medical validation, but WARIFA app can be used to track these variables, and their evolution in time, to base future research.

4. **Progression bar for the changes in the modifiable variables**, towards optimal values, with gratifications for positive change and alarm signs for negative change (e.g., in weight, diet, physical activity, smoking, alcohol, excessive sun exposure, lab values like blood pressure, glycemia, cholesterol etc.).

5. **Updated set of personalized recommendations** for behavior change, according to updated values of the variables input by the user.

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6. **Schedule of medical appointments** (related to the prevention of the NCDs), with reminder function for upcoming appointments, prompting for making appointments recommended by the prevention functionality of the app, and alarm signal for missed appointments.
7. **Progression bar for the completeness of information provided** by the user. For each functionality, as the user is invited to provide stepwise more information, the color scale progression bar indicates where the minimum necessary info has been provided, and how much is left until the optimal level for complete functioning of the app.
8. **Personalized « daily report »** or **« highlights report** », user should be able to customize which elements of feedback she/he wants to see in a summary/highlights when opening the app, or pinned to the homepage.

CATEGORY II Diabetes 1 disease management

1. **Level of risk for hypo / hyperglycemia** and alarm signaling
2. **Output of insulin-bolus calculator and carbohydrate counting tools**
3. **CGM display and glucose tendency arrows**
4. **Other types of feedback as for Category I,** already stated above

7 EXAMPLES OF QUESTIONNAIRES FOR DATA COLLECTION

For the questionnaire-based input of variables, where automatic collection through sensors/links is not possible or available, the questionnaires already in use in the clinical practice should be used for WARIFA app, as initial solution. These questionnaires will be subsequently tested in pilot focus-groups during the co-creation and personalization processes, in the 3 countries of the study.

Here below we provide as orientation a few examples of questionnaires/ visual help for user input online used in clinical or research practice.

EXAMPLES OF QUESTIONNAIRES/VISUAL HELP FOR USER INPUT FOR MELANOMA RISK-RELATED VARIABLES

Table 3. Examples of questions for demographics, skin phenotype and sun exposure – relevant for skin cancer/melanoma risk

(adapted from [6])

II.	**DEMOGRAPHIC (completed by user)**		
6.	**Sex**	M/F (defined at birth)	
7.	**Date and place of birth**	DD/MMM/YYYY, or 15/MMM/YYYY (if day is not known), or 15/JUN/YYYY (if day and month are not known), or UNK if data is completely unknown Place: city, province, country	UNK stands for "unknown date of birth"

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8.	**Weight and height**	Weight (Kg): Height (cm):	Last time checked within 12 months
9.	**Ethnicity**	1. White a. Europe b. North Africa c. Middle East d. Jewish ancestry 2. Black or African American 3. Asian 4. Hispanic or Latino (i.e., from South or Central America) 5. Other (please specify)	Other: including Gipsy/Roma, American Indian, Alaska Native, Native Hawaiian or another Pacific Islander, etc.).
10.	**Residency**	Record all places where the case/control has resided for >6 months Specify exact location (country, city/town) and time (from YYYY to YYYY)	Geocoding is advisable
11.	**Education**	Three categories: a. Up to junior high school (up to 14-16 yrs.) b. High school (up to 18-19 yrs.) c. University	
12.	**Current occupational status**	Five categories: a. Employed b. Working at home c. Unemployed d. Student e. Retired	
SECTION B			
I. PHENOTYPE (completed by user)			
1.	**Skin type**	Answer to the following 2 questions and classify skin type according to Suppl. Figure 1: 1. Which of the following sentences does better describe your skin response to sun exposure at noon for 30 minutes in the first days of the summer without sunscreen/clothing protection? a) Not burn b) Burns lightly c) Burns moderately d) Burns severely 2. Does your skin tan after a prolonged and repeated sun exposure (e.g., after several days as at the end of the summer) without protecting it with sunscreen or clothing? A. No tan B. Tans lightly C. Tans moderately D. Tans deeply	The table can be applied after receiving the answers from the participant Please refer also to tanning ability chart. Figure 1)
2.	**Eye color**	Three categories: a. Light (green, blue, gray) b. Medium (light brown, hazel) c. Dark (dark brown, black)	Eye color chart (Suppl. Figure 2.1)
3.	**Hair color (at age of 18 yrs.)**	Five categories: a. Red b. Blonde c. Light brown d. Dark brown e. Black	Hair color chart (Suppl. Figure 2)

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<table>
<tr><td>4.</td><td>Freckles
Definition: Light brown small macules since childhood, on the face, during summer time (disappear in winter)</td><td>None/Few/Some/Many</td><td>Freckle density chart (Suppl. Figure 3) from Reference 25</td></tr>
<tr><td>5.</td><td>Nevi in adolescence-youth (i.e., age of 18-21 yrs.)</td><td>None/Few/Some/Many</td><td>Nevus density chart (Suppl. Figure 4)</td></tr>
<tr><td colspan="4">II. HISTORY OF ULTRAVIOLET EXPOSURE (completed by user)</td></tr>
<tr><td>6.</td><td>Occupational sun exposure (i.e., outdoor occupation with at least 4 hours/day spent outdoor in the sun)</td><td>YES/NO

If YES, specify the occupation:
_____
How many hours/day? ___
How many days/month? ___
How many months/year? ___
How many years? ___</td><td>Optional list. for examples of occupations with continuous sun exposure</td></tr>
<tr><td>7.</td><td>Recreational sun exposure (i.e., outdoor hobbies or physical activities–other than sunbathing–with at least 4 hours/day spent outdoor in the sun)</td><td>YES/NO

If YES, specify which activity:
_____
How many hours/day? ___
How many days/month? __
How many months/year? __
How many years? ___</td><td>Optional list. for examples of outdoor recreational activities</td></tr>
<tr><td>8.</td><td>Intermittent sun exposure (i.e., sun exposure in spring and summer time, including vacation, during peak hours–11AM-4PM)</td><td><table><tr><td>Age period</td><td colspan="2">Exposure time</td></tr><tr><td></td><td>Weeks of vacation</td><td>Hours spent between 11AM and 4PM</td></tr><tr><td>Childhood (up to age 10 yrs.)</td><td rowspan="4"></td><td rowspan="4"></td></tr><tr><td>Adolescence (11-18 yrs.)</td></tr><tr><td>Adulthood (≥18 yrs.)</td></tr><tr><td>10 years before melanoma diagnosis (for cases) or last 10 years (for controls)</td></tr></table></td><td></td></tr>
<tr><td>9.</td><td>Most recent intense intermittent sun exposure</td><td>Provide date or month of last time of intense intermittent sun exposure before the diagnosis of melanoma (for cases) or before this interview (for controls)</td><td></td></tr>
<tr><td>10.</td><td>Severe sunburns (Grade 2), lifetime before diagnosis.
Definition: sunburns with erythema and pain for more than 2 days or</td><td>At age <18 yrs: YES/NO/Not known
If YES, number:

At age ≥18 yrs: YES/NO/Not known
If YES, number:

At site of melanoma? YES/NO/Not known</td><td></td></tr>
</table>

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<table>
<tr><td></td><td>with blisters (no matter for how long)</td><td>In the last 5 yrs: YES/NO/Not known
If YES, number:</td><td></td></tr>
<tr><td>11.</td><td>Sunscreen use
(Summer time)</td><td>
<table>
<tr><th>Age period</th><th colspan="2">Sunscreen use</th></tr>
<tr><td></td><td>Did you use sunscreens during the summertime?</td><td>Type sunsc use</td></tr>
<tr><td>Childhood (up to age 10 yrs)</td><td rowspan="4">- Never
- <50% of time exposure
- >50% of time exposure
- Always
- Not known</td><td rowspan="4">- SPF≤20
- SPF>20
- Not kno</td></tr>
<tr><td>Adolescence (11-18 yrs)</td></tr>
<tr><td>Adulthood (≥18 yrs)</td></tr>
<tr><td>10 years before melanoma diagnosis (for cases) or last 10 yrs (for controls)</td></tr>
</table>
</td><td>Answers to the questions related to the sunscreen use should be provided for each of the specified time periods'</td></tr>
<tr><td>12.</td><td>Sun protection other than sunscreen use
(summertime over the last 10 yrs)
(Optional)</td><td>Did you use a hat?
- Never
- <50% of time exposure
- >50% of time exposure
- Always
- Not known
Did you use protective clothing?
- Never
- <50% of time exposure
- >50% of time exposure
- Always
- Not known

Did you seek the shade or stay indoors during peak UVR hours?
- Rarely
- Sometimes
- Always
- Not known</td><td></td></tr>
<tr><td>13.</td><td>Sunlamps/sunbeds</td><td>YES/NO
If YES:
- Lifetime number of sessions:
- Age at first exposure:
- Age at last exposure:</td><td></td></tr>
<tr><td>14.</td><td>Phototherapy (UVB-PUVA)
(Optional)</td><td>Ever/Never</td><td></td></tr>
<tr><td colspan="4">III. LIFESTYLE HABITS (completed by individual responder)</td></tr>
<tr><td>15.</td><td>Smoking</td><td>a. Never
b. Former smoker (quit one year before diagnosis or earlier)
c. Current smoker

If b. or c.:
- age when you started smoking: ___
- how long have you been smoking (years)?
- how much did/do you typically smoke:
one pack/day or more___
up to half pack/day___
only occasionally___</td><td></td></tr>
</table>

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<table>
<tr><td>16.</td><td>Have you received vitamin pills during the last year?
(Optional)</td><td>YES/NO
If YES:
- Never
- 1-3 days/month
- 1-3 days/week
- 4-6 days/week
- Everyday</td><td></td></tr>
<tr><td>17.</td><td>What type of vitamins did you receive and how often?
(Optional)</td><td colspan="2"><table>
<tr><th>β-carotene</th><th>Vitamin A</th><th>Vitamin C</th><th>Vitamin E</th><th>Vitamin D</th><th>Multivitamins</th></tr>
<tr><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td><td>-Never
-1-3 days/month
-1-3 days/week
-4-6 days/week
-Everyday</td></tr>
</table></td></tr>
</table>

Examples of pictures for the table on melanoma questionnaire (reproduced from [6] and https://publications.qimrberghofer.edu.au/Custom/QSkinMelanomaRisk) We present these pictures as examples only

Figure 1. Picture for question on ability to tan (phototype)

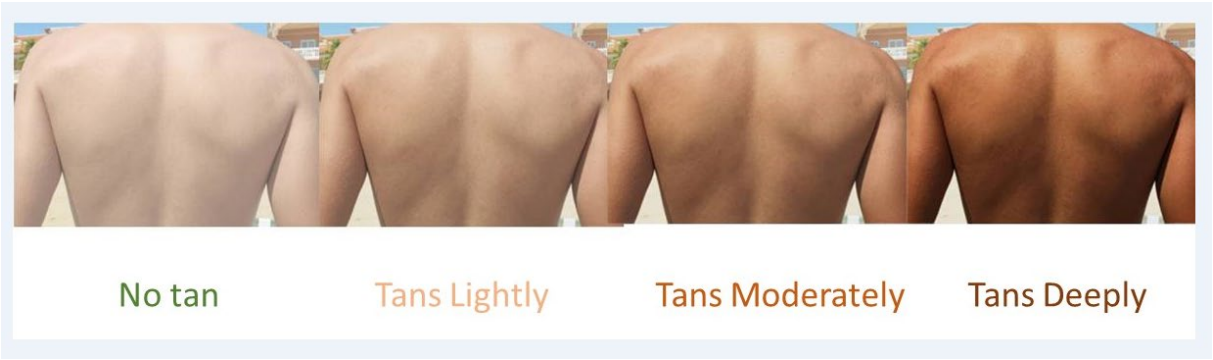

Figure 2 Picture for user help – natural hair color in youth (phenotype)

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Figure 2.1. Picture for user help – eye color (phenotype)

Figure 3 Example of picture for user help – self estimate intensity of freckling

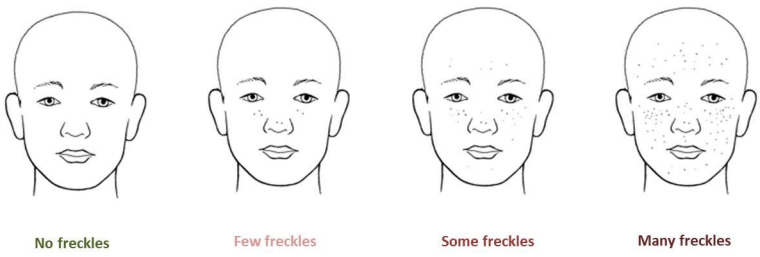

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Figure 4. Example of Picture for user help – self estimate number of nevi on body

EXAMPLES OF QUESTIONNAIRES AND VISUAL HELP FOR USER INPUT FOR DIABETES/CVD/LIFESTYLE FACTORS- RELATED VARIABLES

Example visual help for input of alcohol intake (from https://alcoholchange.org.uk/alcohol-facts/interactive-tools/unit-calculator) (Figure 5)

Example of user interface for online risk calculator for CVD risk in DM patients (UKPDS Risk Engine 2.0, accessible from https://www.dtu.ox.ac.uk/riskengine) (Figure 6)

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Figure 5. Example visual help online calculator of alcohol intake

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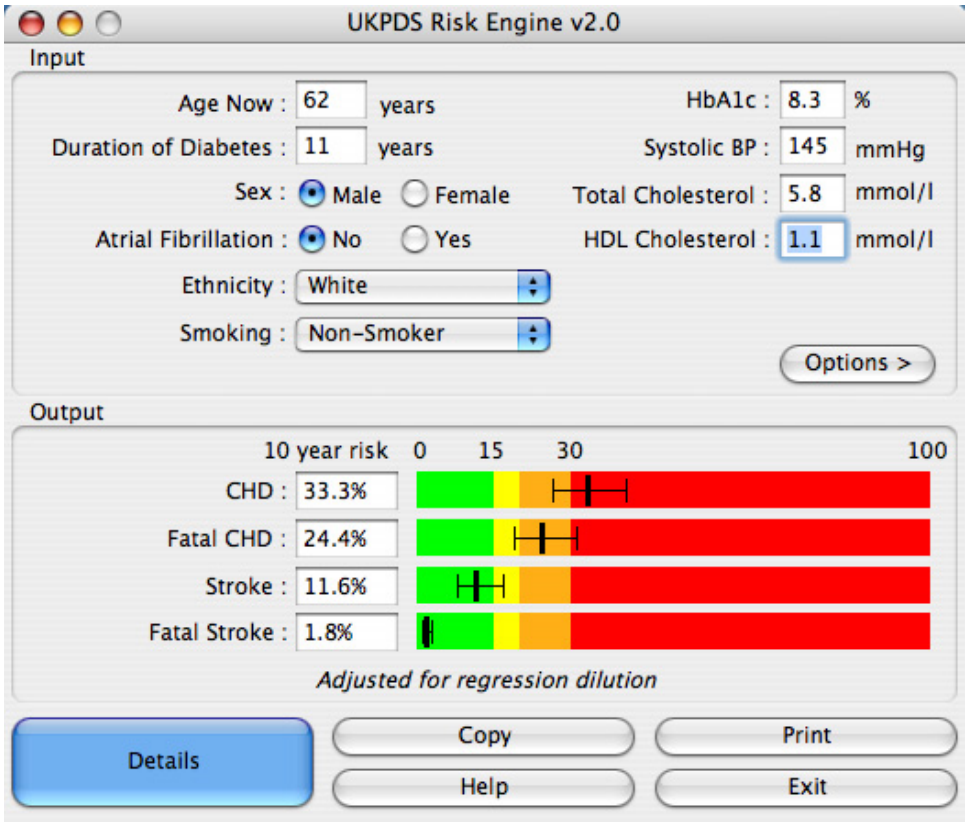

Figure 6. Example of user interface for online risk calculator for CVD risk in DM patients

8 INTERFACE DESIGN

The principles of designing the WARIFA app interface in order to facilitate the use and long-term adherence to the app for the users are grounded in the particularities of the target group and in the ample information available so far from the global research on usability.

The target group is the European general adult population, but WARIFA should be paid particular attention to be accessible and usable to the groups at particular high risk for the NCDs studied. These groups exhibit (See D.2.3) higher prevalence of lower education, lower social-economic levels, older age, but also differ significantly across countries in their differences regarding digital literacy and digital health literacy and ability, health-education, co-morbidities related physical and cognitive impairment, all of which impact the usability of health-apps. Additionally, special focus group are Diabetes 1 patients, with specific accessibility and usability requirements.

In depth analysis of usability-associated features for app design have been extensively reviewed in *Deliverable D.7.2*.

In summary the preferred features for health apps include: use of photos, and visual help for data input and feedback, intuitive, icon-based interface, low-maintenance app, i.e., the app to be low- or no cost, consume little energy and device storage capacity, be available despite internet unavailability and require as little manual data entry as possible, while relying on automatic data collection form sensors/wearables etc.

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The interface should be intuitive, but also flexible, customizable, adaptable to the (changing) needs of the end user. And even if the app is easy to use, support should be available to the user, and it should be quick and simple.
To be engaging, an app must be satisfactory, rewarding and entertaining. Behavior change techniques (e.g., goal-setting, feedback, personalisation), gamification and social interaction, increasing engagement (see Table 5).

There is less evidence available on the features that lead to actual behaviour change and improved health outcomes, in contrast to mere pleasant or prolonged app use; but they seem to be based on the same principles as for engagement, emphasizing appropriate behaviour change techniques.

Finally, including personalisation to participants' needs (digital and health literacy, accessibility) and preferences (data input and output, interface features), and addressing their privacy and data protection, as well as credibility concerns appear crucial.

These principles and considerations **serve as the foundation of developing the WARIFA app interface.** The optimal modality to implement them into the final WARIFA prototype will be decided following the intensive and iterative query of users' input, perspectives and feedback during the next phases of co-creation and personalization process that will take place in the Project.

Table 5 Recommendations for Health App development for optimal usability and engagement (Adapted from D.7.2)

User-centredness	App development should involve end-users at early stages of the design process.
Beliefs	Negative beliefs about the behaviour to be changed should be addressed from the beginning.
Human support	Even if the app is easy to use, human support from health providers, caregivers or family is valuable.
Customised simplicity	Comfortable and intuitive screen layouts and menus, minimizing manual data entry, avoiding long multi-step tasks, assistance in proportion to the learning-curve stage of the user and making useful educational content being available to the user at any time.
User characteristics	Considering age, gender, baseline health, culture, desire of empowerment, disease stage, health literacy, digital literacy and other user-related factors that can influence engagement.
Accessibility issues	Enhancing education, awareness, ease of payment and support structures for users and providers. Personalisation to different degrees of physical and cognitive capabilities.
Privacy	Transparency and choice of data use/sharing.
Credibility	Prescription by health care professionals and support by scientific organisations improve user confidence. Validation methods should be described.
Technical issues	If possible, avoiding need for internet connection, high usage of battery or storage capacity, conflicting operating systems, slow running apps and costs associated with app use. When external hardware is needed for app functions, it should be minimized and kept as simple and comfortable as possible.
Gamification	A wide range of features have been proposed, especially those that enhance mechanisms based on behaviour change theories. This includes: challenges, leader-boards, level-up systems, reward mechanics, avatars…
Social interaction	Facilitating social interaction. It can be implemented in different ways ranging from allowing in-app interaction with family and friends to full integration with existing social media platforms or health care professionals.
Tailoring model and behaviour change theory	Increasing evidence suggests using feedback, goal-setting, user targeting, adaptation, user education, context awareness, self-learning, incentives, predictive analytics and/or personalisation. The tailoring model of the app should be based upon behaviour change theories, which also are diverse and not fully explored. Most apps use a small array of behaviour change techniques to increase engagement, and probably different users will interact better with different behaviour change techniques.

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9 USABILITY AND SOCIAL DETERMINANTS OF HEALTH

Usability, plainly put, is one's ability to use something. Someone's ability, or capacity, is heavily impacted by "the conditions in which people are born, grow, live, work and age", i.e. social determinants of health [7]. Most usability scales focus on the interaction between an individual and, in the case of WARIFA, an AI-risk prediction app. However, there are additional layers of interaction that are not addressed; what impacts a person's interaction with their health app? What is the root cause of their ability/motivation or inability/lack of motivation to use a health app? Based upon the concept of personalization, an individual's access to resources and capacity to engage in personal health technologies may require additional services, help or infrastructure than others. This is an important concept for policy makers to address when designing resources and services to facilitate the initial and continued use of AI-related health technologies, i.e. "principally those shaping the 'outer setting' of the health system overall" [8]. This is also important for developers and researchers to consider when setting realistic expectations and calibrating output recommendations for the AI-app itself, e.g. when interpreting data that is either present or missing when "teaching" the algorithm how to perform[9].

Social determinants of health are aspects of a person's life and surroundings that affect their ability to engage in their health including "economic policies and systems, development agendas, social norms, social policies and political systems"[7]. As stated by the WHO, "social determinants can be more important than health care or lifestyle choices in influencing health" [7].

As technology has developed and become a greater part of our healthcare and wellness systems - from electronic health records and personal health technologies to online appointment scheduling - digital inclusion has become a social determinant of health[10]. COVID-19 demonstrated the consequences of increasing society's dependence on digital health technologies without addressing the underlying social determinants of health, namely, the increase in health inequities[8].

Deliverable 7.2 performed earlier in the project took in discussion certain aspects of digital inclusion[10] such as broadband connection and internet access based on income, social inclusion through functionalities such as gamification and competition and quality technical support, as well as individuals' immediate cognitive ability to use an app, the barriers or facilitators of sustained use of health apps, which is necessary for the development, accuracy and usefulness of a predictive algorithm. In this section of the current deliverable D.2.5. we present aspects outside of those already addressed in previous deliverables and expand upon concepts related to intention to use and sustained use of health apps.

While health technologies promise many benefits to a diversity of individuals, e.g. greater access, cheaper cost etc., adoption is predicated on much more basic concepts of one's ability to use a technology than a device interface or how often it queries the user for information. Maslow's hierarchy of needs states that one must first have food, safety, stability etc., before they can engage in additional activities, including the use of health technologies[11]. These concepts are included and will be further explored in WARIFA within the population surveys described in Deliverable 2.2 regarding the population's acceptance and beliefs of AI.

If we would consider factors related to the direct interaction between a user and the technology to be primary factors, e.g. user interface and frequency of reminders, and factors that affect that interaction as secondary factors, i.e. broadband connection and digital literacy, we will consider and

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refer to factors, or “conditions”, in which “people are born, grow, work, live and age” [7] as tertiary factors (Figure 7).

Figure 7. Layers of factors directly and indirectly affecting a person’s ability and willingness to use personal health technologies.

The WHO lists the following as, what we will consider as, secondary and tertiary social determinants of health:

- Income and social protection
- Education
- Unemployment and job insecurity
- Working life conditions
- Food insecurity
- Housing, basic amenities and the environment
- Early childhood development
- Social inclusion and non-discrimination
- Structural conflict
- Access to affordable health services of decent quality [7].

A person’s culture, social norms of their immediate and surrounding social circles, and other tertiary factors can mean the difference between ability and inability to engage in one’s health let alone use a predictive AI-driven app.

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The research that is ongoing in WARIFA includes studying more in depth the characteristics of and the mechanisms conducting to the constitution of subgroups of population who are considered “hard-to-reach” by the current prevention programs and strategies, or un-engaged in their health and/or health technology use, and the reasons behind this status. While it is not the scope of WARIFA to develop the AI-app to address all existing barriers to use or for the algorithm to incorporate all social determinants of health in its predictive capacity, the factors identified in that research will supplement the material presented in the current deliverable and will further contribute to informing policy makers of barriers or facilitators for engaging a diversity of individuals and addressing social inequalities of health.

We presented here just a few examples of concepts in addition to those covered in usability assessments presented in Deliverable 7.2 that are important for WARIFA to take into account, as well as for policy makers to consider when developing the means and support for wide-spread implementation of any digital health solution.

10 QUESTIONS FOR FURTHER DEVELOPMENT- FOR CO-CREATION AND PERSONALISATION PROCESS

The development of the interface design and usability features of the WARIFA app will build on the principles presented so far and will be further modulated and steered by the input and feedback that will be obtained from end-users during successive testing and surveying. This will occur within the co-creation and personalization process. In the same time, input from the ongoing stakeholders analysis, general population samples and patients surveys during the next steps of WARIFA project, will be also used to inform this process.

Several of the main questions to be answered through this process are:

1. **How extensive the sign-in process should be designed (security vs. user-friendliness)**
2. **How much information are the users willing/able to fill in at once?**
3. **How can queries be divided into more elements to make it manageable and user-friendly?**
4. **The optimal timing to query the users for new/updated input for each functionality?**
5. **Particularities of interface look and design, including e.g. elements like: colors, font size, menus, use of graphic vs. text**
6. **Special accessibility features needed**
7. **Which sensors can we expect users to relate to, from a usability perspective?**
8. **Which data and to which extent are users willing to share – especially form social media accounts like Instagram/Facebook/etc?**
9. **What kind of feedback will be expected from the users?**

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11 APPENDIX I

Table S1. List of main variables regarding the user to be collected within WARIFA

VARIABLE TYPE	Risk variable	Measurable Parameter for the risk factor	type of variable	Input value/ Question	Source	How to collect
					Q=questionnaire; A=Online Account; S=Sensor system	
Demographics						
	Age	Years of age	number	birth date yyyy/mmm/dd	Q/A	Q/A
	Sex	Male/ female/	category	sex at birth (Male/female)	Q/A	Q/A
	Ethnicity	ethnic category	category	Categories as in European Standard Classification of Cultural and Ethnic Groups/ OTHER)	Q	Q
	Education level	Highest level of education attained	ordinal	Categories: (No/Primary/secondary/tertiary/doctoral)	Q	Q
	socio-economical status	Annual income	ordinal 3 tiers	Top/ middle/lower tier questions about annual household income, annual personal income, employment status		
	Location	Current residence		Country, county, municipality (city) of residence OR GPS/location if allowed by user	Q/A	Mobile device/IP address/ Google Map data, Wearable device
		Past residences		optional. All places of residences more than 6 months, with start/end dates	Q	
PHENO-TYPICAL MARKERS						
	Skin Photo-type (skin reaction to sun exposure	6 Fitzpatrick phototypes (I-VI) based on self-reported skin reaction to sun	category	Questions: How does your skin react to the sun exposure: a) I always burn, never tan b) I usually burn, poorly tan, c) I initially burn, but afterwards tan well, d) I rarely burn, usually tan e) I have brown skin, tan very well, very rarely burn f) I have dark brown/black skin, I never burn Alternative questions with picture (see picture 1)	Q (or online pictures)	Q (or AI algorithm)
	Natural Hair color	Color categories	category	Choose category: Black, dark brown; light brown; blonde; red (with picture chart)(see figure 2)	Q (or online pictures)	Q (or AI algorithm)
	Presence of freckling	4 intensity categories (no, little, medium, a lot)	ordinal	No, Little, Medium, A lot (with picture chart see figure 3)	Q (or online pictures)	Q (or AI algorithm)

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	Total Number of nevi on body	Self-reported estimate on naevi count	number or ordinal	Number of nevi >3mm on arm OR Choose most likely picture from 4 picture variants representing your skin when you were 21 years old (see figure 4)	Q (or online pictures)	
	Presence of atypical nevi (optional)	Self-estimated number range of atypical nevi on whole body	category	Categories: 0/ 1-2/ 3-5/ >5 with pictures help for the patient to identify atypical nevi *difficult to self-estimate,	Q (or online pictures)	
MEDICAL SITUATION						
Personal medical history						
	Diabetes	Yes/no Type 1/Type 2/ other types? Year of first diagnosis		Answer questions: • Did any doctor tell you have diabetes"? If yes, • which type? (1/2/other/I do not know) • Do you use more than 3 injections/day or an insulin pump for lowering blood sugar? Yes/no • Which year did you get the first diabetes diagnosis? (year)	Q/A/link to EMR	
	CVD	Yes/no for a list of diseases (stroke, MI, CHD, HT)	binary	Answer questions: •Did any doctor tell you you have/had any of these diseases: (Yes/no): stroke, hypertension, coronary heart disease (angina), heart attack,	Q/ link to EMR	Q
	Hypertension (HTA)	yes/no medication Yes/no		•Did any doctor tell you you have high blood pressure? •Do you take any medication to lower your blood pressure? Yes/no	Q/ link to EMR	Q
	COPD	Yes/no		Did any doctor tell you you have COPD?	Q/link to EMR	Q
	Cancer	Yes/no Type (organ)	category	Have you been diagnosed with cancer? If yes, what type? (choose from drop down list, including melanoma)(multiple choices must be possible)	Q/link to EMR	Q
	Immuno-suppressive treatment	Yes/no	yes/no+ category of treatment from list	Do you take any of the medicines (from list)?	Q/link to EMR	Q/link EMR
Family History				Answer question: Has any of your 1st degree relatives been diagnosed with:	Q/Link EMR	Q/link EMR
	of skin cancer	Yes/no/	binary	Yes/no/don't know	Q	Q
	of cancer	Yes/no AND which cancer	category	Yes/no/don't know If yes which organ?	Q	Q
	of CVD (coronary heart disease, MI, stroke, hypertension)	Yes/no/	binary	Yes/no/don't know	Q	Q

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	of Diabetes T1/T2	Yes/no	binary	Yes/no/don't know	Q	Q
Current Laboratory parameters						
	blood pressure	values in mm	numerical	input most recent value	Q/link to EMR/	
	serum cholesterol total	Mg/dl OR mmol/l		Input most recent value	Q/link to EMR	
	Serum cholesterol LDL HDL	Mg/dl OR mmol/l	numerical	Input most recent value	Q/link to EMR	
	Fasting plasma glucose	mg/dl (LOINC 1558-6) or mmol/l (LOINC 14771-0)	numerical	Input most recent value	Q/S/link EMR	
Laboratory parameters for Diabetes 1 patients only						
	HbA1c *	value	numerical	Input most recent value		
	Quick (rapid)-acting insulin*	category		Regular/LisPro/Glulysine/Asp/FiAsp	Q/A/S	Q/Sensotrend app/Other account
	Long-acting insulin*	category		NPH/detemir/glargine/degludec	Q/A/S	Q/Sensotrend app/Other account
	Quick-acting insulin*	Dose		Units at a given time	Q/A/S	Q/Sensotrend app/Other account
	Long-acting insulin*	Dose		Units at a given time		Sensotrend app
	Carb/Insulin ratio (will be calculated/found in settings)*				Q/A/S	Q/A
	Kidney function (creatinine, estimated glomerular filtration rate, proteinuria) *	values		Input most recent value known		
	Previous hypoglycemia (from sensor automatically)*	Yes/no		Answer question/automated from continuous monitor	S/A	Sensotrend app/ Other account/ Sensor
	Time in range (70-180mg/dl glucose) *	Value (%)		Automated from continuous monitor, or calculated from BGM	S/A	Sensotrend app/ Other account/ Sensor

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	Hypo-glycemia unawareness *	Yes/no		Clarke's questionnaire		
	Average glucose concentration*				S/A	Calculate CGM data
	Time below glucose 70mg/dl*				S/A	Calculate CGM data
	Coefficient of variation in glucose (%)*				S/A	Calculate CGM data
CURRENT BEHAVIOR/ Lifestyle						
	BMI/adipose status	BMI calculated from height+weight	number		Q/A	Q/A
		Height in cm	number	Input value height in cm	Q/A	Google Fit / Apple Health
		Weight in kg	number	Input value weight in cm	Q/A	Google Fit / Apple Health
	DIET					
	1.-Diet low in fruits	No. of servings daily		(<1, 1, 2, 3, 4, >5) with definition of serving	Q/ visual help	
	2.-Diet Low in vegetables	No. of servings daily		(<1, 1, 2, 3, 4, >5) with definition of serving	Q/ visual help	
	3.-Diet high in red meat	No. of times eaten/week		Answer options: Not eating meat; less than1/week, 1, 2, 3, 4, >5/week	Q/ visual help	
	4.-Diet high in processed meat	No. of times eaten/week		(not at all, <1, 1, 2, 3, 4, >5) with definition of processed meat	Q/ visual help	
	5.-Diet high in sugar-sweetened beverages			(0,1,2,3,4,5,6, ≥7), with definition of sugar-beverages	Q/ visual help	
	6.Diet high in sodium			Answer question: How often do you add salt to the food before eating? (never, occasionally, often, always)	Q/ visual help	
	Diet- other patterns Optional questions for other risky diet patterns, for which there is not yet a consensus on measurement.				Q	
	Carbohydrate (g in a meal)					Sensotrend app (for diabetes,

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						estimated, per meal)
	PHYSICAL ACTIVITY	Duration of moderate/ vigurous activity/ week		Steps/day	PA tracker	Google Fit / Apple Health - calculated
				Duration, and Intensity	PA tracker	
				Heart rate x duration	PA tracker	Oura/Fitbit/ Garmin/ Polar/ Suunto
				Resting During exercise After exercise	PA tracker	
				Self-evaluated level of activity OR Self estimated number of minutes/day, 7days of week, of each type of activity (moderate/vigorous) with definitions and examples of each category of PA https://www.wcrf-uk.org/uk/cancer-health-check	Q	
	ALCOHOL consumption	Self estimated average quantity/type/ week		Average units/week of each type of alcohol (visual scale as in UK calculator) https://www.wcrf-uk.org/uk/cancer-health-check OR Multiple choice questions: • How often do you drink? ≤1 time/month, 2-4 times/month, 2-3 times/week, ≥4 times/week, • How many units do you usually consume 1-2,3-4,5-6,7-9, ≥10), • How frequently do you drink ≥6 units of alcohol? Never, less than monthly, monthly, weekly, daily/almost daily	Q	Wellmo (tracking period) Dottli
	Tobacco exposure	Smoking frequency Smoking (duration)		Self reported categories: **Cigarettes**: never, former smoker occasionally, former smoker daily, current smoker occasionally, current smoker daily **e-cigarettes**: never, former smoker occasionally, former smoker daily, current smoker occasionally, current smoker daily **snus**: never, former smoker occasionally, former smoker daily, current smoker occasionally, current smoker daily	Q	Wellmo (tracking period) Dottli
		Exposure to 2nd hand smoking		(never/occasionally/ daily)	Q	
	Drug abuse in any form and type	Duration		Yes/No	Q	

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	Current Sun exposure (ref to past 12 months)	Number of sunburns/year		Number of sunburns last year (situation where your skin became red/hot, and painful, or blistering from too much sun)	Q	
		Sunbathing holidays		Number of weeks/year (sunbathing-vacations) last 12 months: (none, <1 w; 1w; 2W; 3w; 4w or more)	Q	
		Frequency of wearing protective clothing		Question: How often do you wear protective clothing when outdoors on sunny days? - never, rarely, sometimes, usually, always (explain "protecting clothing")	Q	
		Sunscreen use when outside in sunny days		How often do you normally use sunscreen when outside in sunny days a) in homeland b)in sunny holidays: - (never, sometimes, usually, always) -Which SPF do you use (15/30/50+) (for each SPF: never/sometimes/usually/always)	Q	
		Tanning bed use		no of sunbed use sessions/week/month)	Q	
		Photosensitizing medication yes/no		Do you take any of these medicines: Antibiotics; Retinoids; Diuretics; Amiodarone (yes/no)	Q	
		UV index in user location		UV-profile for the area of residence.	Q/ location sensor/personal sensor	
		UV sensors (individual) – by sensor if possible			Personal sensor	
	Sleep patterns	Sleep hours/day		Input value for the average typical week/month	Q/S	Oura / Beddit Wellmo / Apple Health / Google Fit
		Bedtime (times/week with bedtime>22h)		Input usual bedtime OR Frequency of bedtime>22h/week	Q/S	Oura / Beddit Wellmo / Apple Health / Google Fit
	Air pollution exposure	Deductible from location		e.g. https://airindex.eea.europa.eu/Map/AQI/Viewer/	automatic from location	
EXPOSURE HISTORY	**UV Exposure history**				Q	
	History of Sun exposure (one time questionnaire)	• Outdoor profession (yes/no) • Total Time lived in sunny countries? (years) • Weeks of sunny holidays/year		For questions formulation examples see also table 3	Q	

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		before age 20 years • Average Weeks/year of sunny holidays in the past after 20y? • Outdoors hobbies (average weeks/year)				
	Sunburn history	Self Estimated no. of sunburns in the past after 18 years		Estimated no of sunburns < 18 years of age Self Estimated average no. of sunburns/ year in lifetime For questions formulation examples see also table 3	Q	
	History of Indoor tanning sessions	Estimated No. of tanning sessions in lifetime Estimated No. of tanning sessions before age 30		For questions formulation examples see also table 3	Q	
	Past Exposure to carcinogens	Yes/no		Check from list	Q	

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