**Outline of specific tasks.**

1. Download app
   1. What is the first thing to happen when opening the app?
   2. App information – 3 sentence summary of what this app does and what will happen next.
   3. How to activate based on specific location or study? Should the user input a study code, so that it is configured accordingly?
   4. Eligibility questionnaire
      1. Age, gender, Ethnicity
      2. Anthropometric data – height, weight, Waist circumference (give options for metric or American units)
      3. Health status (Smoker, pregnant, any chronic disease – diabetes, eating disorder, depression, on other medication, etc.)
      4. Work schedule (shift work or regular work) – Working days and off days, college students)
2. The answers to eligibility questions are screened to say if the person qualifies to be in the study – this is done locally on the phone.
   1. Email address or phone number where the person can be reached.
   2. If the person qualifies, then s/he and is ready to come to the office for orientation to the study and sign an informed consent, the
      1. Informed consent (legal stuff)
      2. Location service on – consent
      3. OPTIONAL - Phone usage on – consent (To collect daily log of when the phone is being used – this will be a surrogate measure of sleep or rest time)
      4. How to communicate with the study coordinator (text or email or phone number? This should be tied to the study). This links to back-end work on how to activate a location specific study? Should we also need an IRB number to activate the study?
      5. Should this sign on tab be left on with device or participant id and a link to FAQ or how to use the app?
      6. The first time the app is launched, it creates and stores a 20 character alphanumeric identifier for the device, e.g. Bw2iAm67juEglgN1qK8t. This identifier is unique and permanent for the duration of the study, stored on the device as well as the server and serves the purpose of uniquely but anonymously keeping track of multiple users.
3. First Office visit (there may be more than one subsequent visits and at each visit all or some of the following may be recorded). These data inputs are from a clinical investigator using a web-based data input portal
   * 1. Date of visit
     2. Weight
     3. Height
     4. Temperature
     5. Waist
     6. Hip
     7. Waist to hip
     8. Blood pressure
     9. Heart rate
     10. Any text input
4. Calendar and timer options: these options might be useful to set office, lab visits and for follow up. These calendar events may be set in the user’s phone and synchronized with the server, so that the study coordinator can schedule his/her appointments with the users.
   1. To set which days are working days and off days for the individual – this will be used in calculating weekdays (work days) and weekend (off day) eating pattern
   2. Set office visits
   3. Set timer for recording weights
   4. Set timers for recording blood sugar or any other parameter the participant is supposed to measure at regular interval.
   5. Set timer for taking medications etc.
5. Push notifications: Push notifications are used to set reminders, to measure false positive and false negative rates, improve compliance, send encouraging notes, or to send health tips (for users in a control arm – don’t bother about it now).
   1. Did you eat in the last 30min?
      1. For each user – during the first 7-10 days the server will send one or two push notifications to the device asking whether the person eat in the last 15min? The time to send these notifications will be typically after between 9am – 8pm local time where the user had last reported event. “Did you eat or drink in the last 15min?” there are only “Yes” or “No” answer.
      2. The *time when the user answers the message is* “time stamped” and sent back to the server.
      3. Server runs a query only against the user’s last event to see if that event was within 15min. If there was an event and the person answered “Yes” – Zero. If there was no event and the person answered “no”- zero. If there was no event and the user ansered “Yes” – scored “False positive”. If there was an event and the person answered “NO” – scored “False negative”.
      4. There will be only 10 push notifications per user. The number of false positives and negatives will be stored to assess reliability factor.
   2. Automatically send encouraging notes for completing – day 1, day 2, day 3, 7 days, 2 weeks. etc.
   3. If a user has too few or no events for a day
   4. If a user has no events for 2 days
   5. Scheduling clinic visit, or lab visit
   6. Prompting to measure body weight
   7. Prompting to take a questionnaire
6. After the first office/lab visit, in a typical clinical study the user will be prompted to start recording food pictures from Wednesday morning onwards for 10-21 days. As soon as the app is activated (user clicks on the app icon and the app opens on the phone), it will seek the instantaneous geolocation (longitude-latitude). The individual can take a picture of the food, can choose to use the picture or retake and makes sure there is no personally identifiable item in the picture (ID card, another person’s face at a conference table, etc). Once s/he is satisfied with the quality of the picture, the individual will have the option of adding a short annotation for the item. Such optional text entry will describe the food, (item name, decaf or sugar free, portion size, whether the picture represents leftover from the previous meal etc.). Every textual entry will populate an individualized database of foods or beverages consumed. Thus, the app will learn the subject’s entries, so that over time, it can auto-suggest these annotations. The user will use three different options – food picture tab, food text tab, preselected food or barcode scanner.
   1. TAB1 FOOD PICTURE TAB: This should be the default tab after the app is activated.
      1. As soon as the app is opened, the camera should be active and ready to take picture. OR – should we leave it to the participant to tap on a button to activate the camera (like we have now)
      2. Snap your food –
      3. Should there be a button for taking picture or tapping on the picture will take the picture?
      4. “Flash off” should be the default option.
      5. Annotate option – annotate the food with names (is there a way to autocorrect spelling or to suggest names based on popular food names or based on prior food naming from the user?)
      6. Slide the image to food, beverages, supplements/medicines, water tabs. After the picture/barcode/text is entered (see next sections), the user will “slide” the picture to one of three different edges of the screen – water (sorting tag: w), medication/supplement (sorting tag: m), or food/beverage (sorting tag: f). This simple act will sort the items into three major classes and greatly simplify downstream annotation. At the beginning of the study, the participants will be encouraged to annotate at least once any medication or supplements they are taking in the text field of a picture.
   2. TAB Text option: This feature will be mostly used for situations where taking a picture of the food is not socially acceptable or if the subject forgets an event. As soon as the individual fills out the text field, a time wheel will automatically pop-up asking whether the event is current or happened in the past.
      1. From the camera window there should be a way to switch to a text option where a person can type the food s/he ate and time (XYZ minutes ago).
      2. After completing text and time, is there a way to slide that to food/beverage/water/medication or it goes to food category by default?
   3. TAB Common food options (this should auto-populate with common food in a specific region or with the person).
      1. This tab will have a set of pre- defined or user defined food options with a time-stamp option as in text option. This is similar to the existing app.
      2. Alternatively or in addition, one can populate these tabs with self-selected food or medication. For example one can add a medication and a scheduled time to take the medication and the app will remind. Once the person comfirms taking medication (by pressing the tab) the tab will change color till midnight.
   4. TAB (OPTIONAL) Barcode reader option (but this may be different in different countries). To scan barcode of food/beverage items. Scanning the code simplifies downstream data annotation. Food manufacturers are required to label or offer detailed nutritional information. The app’s barcode scanner is used to retrieve the manufacturer’s data during the subsequent annotation step.
7. Sending the info to a server
   1. What is the send trigger?
      1. [IN IMAGE TAB] - When the image is slid to bins,
      2. [IN TEXT TAB], pressing the SEND button
      3. [IN COMMON FOOD TAB] pressing the SEND button

After the send trigger is activated ; As the user slides the information to the correct box, the app will name the picture or text file with a unique identifier. The identifier will begin with the user ID followed by the timestamp. Network congestion can sometimes slowdown the data transmission, cause frustration and reduce compliance. Therefore, the picture/text along with the time stamp and geo-location be stored in a temporary on phone cache while the network functionality is getting restored, and once the app is able to connect to the internet, it can transmit the data to the server. All picture files are reduced in size by a factor of 10 or 15 to make the final image file size <300kb. At this size the pictures have enough resolution for identifying food items, while minimizing the data transmission time to one-tenth. Each outgoing food data package from the smartphone will have three pieces of information; (1) a picture or textual entry <subject identifier>\_<sorting tag>\_<date>\_<time> e.g. Bw2iAm67juEglgN1qK8t\_f\_2011-11-11\_18-12-58.jpg (2) annotation text e.g. Bw2iAm67juEglgN1qK8t\_2011-11-11\_18-12-58.dsc and (3) Location tag e.g. Bw2iAm67juEglgN1qK8t\_2011-11-11\_18-12-58.loc. In the current prototype, there is <5 sec differences in timestamp for the geo-tag, picture file and the text annotation as they are created and sent sequentially from the device. However, it does not cause any confusion on the data analysis part, as the subject identifier distinguishes the data package from other subjects and data packages sent within 15 second bins can be considered as descriptor of one event. Nevertheless, in the new prototype this aspect will be replaced by first creating all three files with temporary names, then obtaining the instantaneous time, renaming all files corresponding to this time-stamp and then (sequentially) transmit all the files.

* + 1. The image or information is sent to a buffer and the app becomes fully active for recording the next event
    2. In buffer the image is reduced in size by a factor of 10. Image is named/tagged with the user id, time and paired with location, associated error and annotation of location (if possible) and sent to the server.
    3. If the information cannot be sent immediately, it should stay in buffer until it can be. The buffer should accommodate upto 20 events or one day of data.
    4. [during intervention or 2 weeks after activation] all events may be stored for up to a month in local buffer. This will use ~80-100Mb of storage space. See its use in the intervention display tab.

1. Inactivity – reminder, drop out and pause
   1. If there was no water data sent from the user (Since most people drink water several times a day, if the user faithfully sends data, there should be some “water” data)
      * 1. If there was no water data – send a reminder the following day to remember to drink enough water as a push notification.
        2. If there was no water data for 3 or more times in the last 10 days, then stop sending water push notification.
   2. If there was no food data – remind as above
      1. If there was less than 3 events a day – send a reminder the following day.
      2. If no data was reported from a user over the past 24 h (prior to 4am),
         1. mark the user as inactive and send the following text “ XYZ”
         2. Highlight the user in the daily report to the study coordinator
      3. If no data was reported from a user for 2 consecutive day – send a final reminder and then inactivate the user log in server until further action.
2. Other inputs through the phone OR web-based input
   1. From phone: OPTIONAL
      1. Anthropometric data (self input) weight, waist circumference.
      2. Biomarker data (Blood glucose, cholesterol, blood pressure, LDL, HDL, VLDL, blood pressure etc. if the user self tests, these data can be sent to the server or saved on the local machine)
      3. Input from fitbit or other devices [IF API EXISTS]
      4. Phonse usage log (just when the phone was used throughout the 24 h) (set an option in the beginning)
   2. Through Web. Figure out a way to input data through the web. The user may use his/her unique ID, select a login or be assigned a login
      1. Sleep questionnaire or SFPQ : weekly
      2. Chronotype questionnaire: once
      3. Wellness questionnaire: at the end of baseline period
      4. Food questionnaire : at the beginning of the baseline period
3. What will happen to the food data in the server
   1. Storage structure [DEVELOPER WILL FIGURE OUT]
   2. Analyses For food – Time stamp and locations are most critical
      1. Each time and location stamp is used to find the ***local sunrise sunset*** (and twilight times? All reports will use the users’ local time.
      2. For each day as the data comes in, time stamp is plotted against 24 h day:night cycle
      3. Each food type (food, beverage, water and medication) is color coded on the time line. A hash mark or a star represents an eating or drinking event.
      4. Plotting the data from multiple days where each day is represented in one line generates a “Feedogram”
      5. A feedogram is appended as the time progresses.
      6. By default the area between 6am and 6pm local time is shaded in light blue (or another color) to represent “day”. The rest is shaded dark grey (or some other color).
      7. OPTIONAL: There should be an option to shade the area between local sunrise and sunset or twilight (- 60 of sun below the horizon) time to represent day.
      8. “Daily report” At 4am of user’s last local time a “daily report” is generated for each user. It is not sent to the user during the baseline period, but is presented in daily update to the research coordinator. *During intervention, it may be sent to the user.* It will have
         1. Time of first non-water intake,
         2. Time of last non-water intake,
         3. Number of total events,
         4. Number of food events,
         5. Number of water events
         6. N*umber of meals*,
         7. Eating duration (i.e. time of last caloric intake minus the time of first caloric intake)
         8. Change in first caloric intake time since the previous day (i.e. time of first caloric intake on t-1 day and today)
         9. Change in last caloric intake time since the previous day (i.e. time of first caloric intake on t-1 day and today)
         10. Average breakfast time (average of item #1 over the past multiple days for which data is collected)
         11. Average last caloric intake (Average of item #2…)
         12. Every morning ~5am of Study Coordinator’s time, an automated script on the server will summarize the data and email a summary report to the study coordinator on the number of active participants, total numbers of pictures, texts, sleep responses and responses to push notification. Any inactive subject will be flagged for potential follow up. Participants can also securely communicate with the study coordinator from within the app. These communications will not use the subject’s email; rather they will be routed to the study coordinator who can respond appropriately via push notifications. One day prior to the end of the study, the server will remind the subject about the end of the study and will prompt him/her to schedule the second lab visit.
      9. “Weekly report”
         1. DEFAULT: Every Monday morning for the user’s local time (4am Monday) calculate the change in breakfast time during the weekend
         2. Calculate the change in dinner (last caloric intake) during the weekend
4. Feedback to the phone: The major feedback to the phone is the “Feedogram” and related parameters. Since the “Feedogram” is supposed to trigger change in eating behavior, it is not shown to the user during the baseline period. The simple option is the feedogram is continuously generated and sent to the phone, but the “Feedogram” tab is not activated until X days after the study starts.
   1. Content of the display tab is present in the phone from the beginning, but the tab is not activated until X days after commencement of the study. *Question\_ should the fedogram be made on the phone as time progresses or it is made in the server and sent back to the phone?*
   2. At the end of the baseline period
      1. One day before the baseline period ends, the user will get a push notification or the app will have its own timer and alert to tell that the baseline period is ending in a day.
      2. The user is prompted to measure his/her body weight and enter in the body weight tab or email/text to the study coordinator.
      3. At the end of the baseline period, the user – for the first time - sees the baseline report. This can be displayed to the user at the office visit and/or can be activated on his/her phone remotely at the end of the baseline period. Irrespective of how this is presented to the user, the report must be visible to the user after the baseline period. This may also be visible to the user from his/her own account on the web. Content of the report are following:
         1. Feedogram for the baseline period – this is identical to the feedogram as described above.
         2. Average time of first caloric (non-water) intake and the standard deviation or confidence interval for the entire period
         3. Average time of last caloric intake and the standard deviation or confidence interval for the entire period
         4. Average times of first caloric (non-water) intake and the standard deviations or confidence intervals for the weekdays and weekends
         5. Average times of last caloric intake and the standard deviations or confidence intervals for the weekdays and weekends
         6. Eating duration for the entire baseline period
         7. Eating duration during weekdays
         8. Eating duration during weekends
         9. Social jet lag during weekends (average time of first caloric intake in weekdays minus average time of first caloric intake in weekend)
         10. OPTIONAL: Average caloric intake during the baseline period
   3. Intervention period
      * 1. Once the feedogram tab is activated, there should be an option to “Set my food zone”. Once the user taps on the “set my food zone” – it gives three options stringent (8-10 h), moderate (10-11 h), relaxed (11-12h). and the user can set the first sip/first bite time and the app calculates the last bite/last sip time. However the screen will show disclaimer to the effect that “one can drink water anytime and can occasionally eat outside the self-selected limit for medical or religious reasons.”
        2. How many days to show on the feedogram? Number of days – 10 days or 2 weeks (options- user can set a duration from 3 days to 1 month.
        3. Start at 00:00am till 11:59pm (Option- user can also set to 6am or 8am start)
        4. Shade the 6am-6pm period in light blue to denote day (option – user can choose to show local sunrise and sunset or twilight time instead)
        5. Scale – local time for all days (option – local time where food was consumed, for example if the person traveled across time zones or after daylight saving time)
        6. Show all intake as hash mark (option – show food as tiny circles, medicines as pills, water as water cup and beverages as tiny cans)
        7. Below the feedogram show the average eating duration from the last 7 days as bar and daily fasting time in hours (12/12 or 11/13 etc..).
        8. Show weekend social jetlag [ELABORATE]
        9. The paramaters that are described in the daily report section may be shown to the user on a daily basis or weekly basis. This to be discussed.
      1. OPTIONAL: When the user wants to see only 3 (or X) days, it will automatically show miniature images of the food pictures or text (if the user texted the food) OR- there will be options on top to select “Feedogram” “collage” or “Food map”
      2. OPTIONAL: When the user sees three days of feedogram with all the food pictures and taps on a food picture – it will show options “show on map” or “Name it”
      3. OPTIONAL “Food collage”: Will show all (max up to 20 or so that can fit in a screen) pictures of food from the last X number of days.
         1. If the user touches a specific food picture – it enlarges by 2X and gives options – “save to album”, “show on map”, “show on feedogram”, “Name it”
         2. If the user chooses “show on feedogram” it will show a miniature image of the food on 3 day feedogram
         3. If the user chooses “save to album”, it will save to the local album but will not delete from the feedogram cache.
         4. If the user chooses “name it” – it will open a text entry filed next to it where the user can enter food names and “save”. [POTENTIAL PROBLEM ; HOW IS THIS NEW INFORMATION APPENDED TO THE PREVIOUS FILE IN THE PHONE AND ON THE SERVER?]
      4. OPTIONAL “Food map” : will switch to map view of all food in the last X no. of days.
         1. If the user taps on a specific tag – it will ask for options “show on feedogram”, or “Show pictures”.
      5. OPTIONAL: Self annotation.
         1. “Name it” – the user names the food and the annotation overrides any prior annotation.
         2. “Rate the food” the user rates the food on a scale of 1-5
         3. Comment – if the user wants to add some comment (these three features may be more useful in future version)
      6. TAG CLOUD; how to generate
      7. Time since last non-water meal ; Should this be displayed on the feedogram, so that it serves as a prompt?
      8. Rewards for sticking to the interval (breakfast consistency during weekday, breakfast consistency during weekend (double points), dinner within self-selected interval (one point). Friday – Sunday night dinner at right time (double points), Self-annotate images of one day (2 points)
5. Reminders and other data input during the intervention period
   1. During the 16 weeks intervention period, the user will be prompted to take his/her body weight every 2 weeks
   2. At 8 weeks the user will be prompted for a lab/office visit. Again this should be flexible to accommodate the work schedule of the user/clinical coordinator/lab.
   3. Every 2-3 weeks the user may be prompted to take additional questionnaires or start/stop recording of activity/sleep.
   4. One week before the end of the intervention (week 15) the user will get a reminder to schedule lab/office visit.
6. At the end of the intervention period, the user will have an office/lab visit
   1. One set of vital sign measurements (height, weight, blood pressure, etc.)
   2. Lab tests will be done.
   3. The user will also answer a questionnaire about sleep, wellness, etc.
   4. The app will continue running on the user’s phone and remind to take body weight measurements every month.
   5. At 1 year anniversary, the app will again prompt for another office/lab visit.

FOLLOWING SECTIONS REFER TO HOW THE IMAGES ARE ANALYZED IN BACK-END TO FIND NUTRITION/CALORIC CONTENT AND NAME THE FOOD ITEMS

1. DEFAULT Backend image annotation (only user annotation – left to if the user names the food)
2. OPTION 1. Backend image annotation – in any clinical study – “Screening” to remove personal identifier.
   1. All images are copied to an annotation directory: *exif information is stripped,* but any user input annotation is retained.
   2. Images are presented to a clinical coordinator or “authorized examiner” who “clears” the image if there is no personal identifier.
   3. If personal identifier is present in a picture – the clinical coordinator flags it, names the food content in the picture and the picture is “REPLACED” with the “text entry” from the clinical coordinator. *But the picture remains in the user’s phone.*
   4. The screening result (list of images and replaced text – if any)
      1. returns to the main database or
      2. goes to a queue if additional annotation is to be done
      3. Goes to mTURK queue if mTURK annotation will be done
   5. When the images return to the main database –
      1. if the image is cleared – noting happens and the image is in the “Cleared list”
      2. if the image was replaces with text annotation, the image in the database is “REPLACED” with the text annotation.
3. OPTION 2. Backend image annotation with nutritionist or specific annotators
   1. All images are copied to an annotation directory: *exif information is stripped,* but any user input annotation is retained.
   2. Option 1- The images are queued up for the clinical coordinator to “screen” for personal information and THEN only the non-water and non-medication images are assigned to specific annotators.
   3. Option 2- The images are assigned to specific annotators – images from the same users are presented to the same annotator to improve annotation
   4. The annotator checks for personal information and then annotates the images
      1. What if the image is water
      2. What if the image is medication
      3. What if the image is beverage
      4. What if the image is food
4. OPTION 3. Backend image annotation in mTURK
   1. All images are copied to an annotation directory: *exif information is stripped,* but any user input annotation is retained.
   2. Images are presented to a clinical coordinator or “authorized examiner” who “clears” the image if there is no personal identifier.
   3. If personal identifier is present in a picture – the clinical coordinator flags it, names the food content in the picture and the picture is “REPLACED” with the “text entry” from the clinical coordinator. *But the picture remains in the user’s phone.*
   4. The screening result (list of images and replaced text – if any) are sorted according food, beverage, water, medication
   5. Only food and beverage images along with any user annotation are sent to mTURK
   6. OUTLINE mTURK annotation, quality control, return to database and integration in report

FOLLOWING SECTIONS REFER TO WHAT PARAMETERS WILL BE SHOWN TO THE STUDY COORDINATOR AND IN VARIOUS REPORTS. THIS IS PRELIMINARY AND I SSUBJECT TO REVISION – BUT WILL USE THE DATA COLLECTED IN THE PREVIOUS SECTIONS.

1. Dashboard for Study coordinator
   1. Number of participants and related numbers
      1. Number of sign ups
      2. Number who completed questionnaire
      3. Number who qualified
      4. Number who started the baseline study
      5. Number who qualified for the intervention
      6. Number who started intervention
      7. Number who have completed XY number of days
   2. Active participants are to be monitored more carefully
      1. Active participants are those who have started data input and
2. Dashboard for the system administrator
3. Reports to study coordinator
   1. Active participants
   2. and number of events in last 24 h
   3. Sort participants according to duration of eating (largest to smallest)
   4. Highlight participant with 2 or less images
   5. Drop outs – participants with no images in the last 3 days
   6. mTURK monitor – how many in
4. Reports to study participant
5. Meta reports