The Signature Domain and Geographic Coordinates: A Standardized Approach for Uniquely Identifying a Health Facility

Health Facility Assessment Technical Working Group

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Introduction

A list of standardized indicators for health facility surveys is being proposed by the Health Facility Assessment Technical Working Group, composed of members from several organizations and led by the U.S. Agency for International Development's MEASURE Evaluation project (see Appendix II for a list of members and their affiliations). The adoption and use of these standard indicators would make cross-survey comparisons possible and promote the increased use of the information collected for health facility surveys.

With any facility survey, the ability to identify a facility uniquely is vital to being able to use and analyze the data properly. This is especially true when making comparisons across surveys or years. This document proposes the creation of a "signature domain" to ensure each facility can be uniquely identified. Because a facility's geographic location can be a vital item of information, the geographic coordinate of the facility is a key element of the signature domain. Typically, the geographic coordinate is obtained through the use of global positioning system (GPS) receivers. This document presents a core set of best practices to ensure that GPS coordinates collected for health facility surveys are collected in a standardized way. Using a standardized approach will also facilitate cross-survey comparisons.

This document does not provide a complete technical guidance for GPS point collection and does not offer specific recommendations on hardware or software or mandate a specific data collection protocol to be used. There are multiple ways the best practices presented can be adopted for an individual survey's use, and Appendix I includes some examples of how these protocols can be adapted. Likewise, the elements of the signature domain are a minimum list. Additional elements, to suit the user's needs, can be added.

In short, the purpose of this document is to provide an overview of the elements of the signature domain so those elements can be included on health facility survey instruments and, therefore, permit comparisons across surveys or years.

Background

Increasingly, GPS receivers are being used in health facility surveys to obtain the locations of facilities being surveyed. In addition to the obvious ability to map these locations, the value of adding a geographic coordinate permits more advanced analysis, such as modeling of accessibility, tracking health events and interventions geographically, linking with health management information system (HMIS) data, and assisting with revisiting the facility for subsequent surveys.

The growing use of geographic coordinates in facility surveys has presented an unexpected problem. Projects collect data using different methods and protocols. Unless there is standardization among these protocols, it is difficult to do comparisons on health facilities across surveys and years. In August 2006, the Health Facility Assessment Technical Working Group met in Geneva to develop a set of core indicators for health facility surveys, to make cross-survey comparisons easier. In addition to the core indicators, the group identified the need to standardize the collection protocols for geographic data (such as GPS collection) and how to integrate that GPS data with the existing survey data.

The need for standardization

Each health facility survey provides a snapshot of a moment in time. To understand the snapshot most effectively, it is important that the survey data can be integrated with other datasets. The key to being able to accomplish this is by standardizing the data included about each facility and ensuring the protocols used to collect the data are similar.

Simply knowing a facility's geographic coordinates might uniquely identify that facility. However, random variability in the GPS signal can result in slightly different coordinates for the same location, which can make it difficult to use coordinates as the only means of assuring that two locations are actually the same facility. Having additional identification elements, beyond latitude and longitude, will improve the identification of unique facilities, and allow better cross-survey comparisons.

These uniquely identifying elements are vital to being able to perform cross-survey comparisons, and if they can be standardized along with the core indicators, cross-survey comparisons will be much easier. This document proposes the inclusion of these elements in a new domain, called the "signature domain."

The signature domain

The working group identified eight domains for the core indicators for health facility surveys. The group recommends adding the signature domain as a ninth.

Much like a signature is used to insure the identity of a person, the elements of the signature domain would insure the identity of a facility. This domain contains all the information necessary to identify a facility uniquely and should be explicitly included in all health facility surveys. The following is a list of proposed elements in the signature domain:

- date of the survey
- health facility country registry code
- health facility survey identification (ID)
- health facility name
- health facility contact information
    - postal address (street number, city, postal code, other; in some circumstances, a facility may have some but not all of the postal address elements and in these cases the elements that are present should be recorded; if the facility has no postal address at all, this element would be omitted)
    - main telephone number
    - main fax number
    - main e-mail address
    - name of the director
    - director's telephone phone number
- facility's geographic administrative unit (at least first and second level)
- GPS coordinates (latitude, longitude waypoint ID)

While each element in the signature domain may or may not uniquely identify a facility (and indeed some elements may not exist), the collection of as many elements as do exist will permit a preponderance of identical values to make matching facilities across surveys correctly more reliable.

Recommended protocols for collection of signature domain elements

The following sections present protocols to be used for the elements of the signature domain.

Date of the survey

The importance of the survey date is often underestimated. The time stamp can be very valuable when trying to combine data coming from different surveys as it might explain why some of the information has changed (e.g., name of the director, administrative structure, etc.) between two surveys for a same health facility.

Different formats exist for the collection of the date. No specific recommendation needs to be made but it is important to make sure that the format used is properly documented and that a same date does apply to all the information collected during the survey.

Health facility country registry code and survey ID

At the most elemental level, each facility should be identified by a unique ID to which all collected data are associated. However, many different IDs may exist for the same facility, and this proliferation of IDs make it very difficult to know for sure which facility is which when trying to combine information coming from different surveys.

This is not an easy issue to manage, as health facilities are dynamic and evolve through time (e.g., the ID of one facility might be assigned to another facility after the facility has closed). This point emphasizes the importance to develop and maintain health facility registries in countries as part of an HMIS.

If a unique ID already exists, especially if it is one assigned by a country's ministry of health, this registry code should be included in the survey. Even if this is the case, some facility survey managers may still wish to assign their own ID to the facility. In this case, a lookup table should be included that provides a link between the country registry code and the survey ID. If no registry exists, the survey should make sure that a unique code is attributed to all the facilities.

Health facility name

Like the ID code, the facility name should come from the country health facility registry. If no registry exists, then special care should be given in order to report the full name of the facility, avoiding any abbreviations. Use of capital letters and punctuation should follow standard grammatical rules. For example a facility named "Main Hospital" should be recorded as such, and not "main hospital" or "MAIN HOSPITAL."

Health facility contact information

While it may seem obvious how to collect contact information for a facility, often only limited attention is paid by the interviewers when collecting this information. The result can be poor quality information that can lead to problems when performing longitudinal surveys.

The following guidelines should therefore be employed when collecting the postal address information:[1]

- contact information should be a mailing address
- the information has to be entered in the correct field (the field should remain empty in case the information is non-existent, e.g. no street name)
- the spelling should be verified (if possible, a gazetteer with standardized place-names should be used as a reference; preference should be given to a gazetteer provided by a recognized government authority; the full title of the gazetteer and the source should be included in the metadata accompanying the dataset; the

[1] Extracted from WHO's Study on Global Aging and Adult Health (SAGE) Household Survey GPS Data Collection Documentation, found in Appendix I.

standardized place name should be used, and preferably selected through a list if electronic forms are being used for data collection)

- any useful additional information not corresponding to the street or city can be reported in a field “other” (this can be, for example, useful landmarks)

Additional contact information such as main telephone number, main fax number, main e-mail address, name of the director, and the director’s telephone phone number also represent important information, not only for being able to contact the facility in question if needed, but as additional points of reference for linking surveys together.

Facility’s geographic administrative unit

Knowing the parish, district, or other administrative unit where a facility is located can be very useful for differentiating facilities with similar or identical names. This element can also be useful for aggregating the surveyed data according to the administrative level of the country. It is therefore recommended that surveys include this information during the survey.

Because the administrative structure of a given country can change over time and the possibility of spelling variations, the following recommendations are made:

- Obtain the complete list of administrative units at the lowest level possible, on which the survey will be based prior to the survey itself.
- Use a coding scheme that integrates the different administrative levels and can evolve through time depending on the changes that are observed. One example of such scheme is the one developed in the context of the Second Administrative Level Boundaries (SALB) data set project, an activity of the United Nations Geographic Information Working Group, available at: http://www3.who.int/whosis/gis/salb/salb_home.htm.

GPS coordinates

Using GPS can be deceptively simple. It may seem that GPS data collection is simply a matter of pressing a few buttons. However, if proper protocols are not followed, the data collected may be unusable. The following are the recommended protocols for collecting GPS coordinates for inclusion in the signature domain of the core indicators.

Coordinate system and format

There are many coordinate systems that exist for representing GPS coordinates. For instance, consider the following values, all for the same place — Mumbia, India.

Latitude-Longitude (Decimal Degrees)	Indian National Coordinate System	Universal Transverse Mercator (UTM)
N 72.84897	2621290	0273596
E 19.02557	0141664 Zone IIA	2105043 Zone 43

The left-most coordinate in the example is latitude, longitude recorded in decimal degrees; the middle coordinate is in a national Indian coordinate system, and the right-most coordinate is a Universal Transverse Mercator (UTM) coordinate, a projected coordinate.

Latitude and longitude can be expressed in multiple ways: degrees, minutes, seconds, decimal minutes, or decimal degrees are the most common. The table below, for example, illustrates the multiple ways that the latitude/longitude coordinate for Johannesburg, South Africa can be recorded.

Latitude and Longitude Formats for Johannesburg, South Africa

-26° 11' 56.9" S	-26° 11.948' S	-26.19913 S
28° 3' 23.1" E	28° 3.385' E	028.05642 E
Latitude/Longitude values expressed in Degrees, Minutes, Seconds	Latitude/Longitude values expressed as decimal minutes	Latitude/Longitude values expressed as decimal degrees.

Latitude/longitude, decimal degrees is the preferred choice for recording facility locations for the following reasons:

- It is easier to store data as decimal values instead of degrees, minutes, and seconds.
- It is a global geodetic coordinate system that provides great precision for any place on the planet, and while local coordinate systems can provide greater accuracy, latitude/longitude will facilitate data integration and avoid the need to convert across multiple local coordinate systems.
- Working with decimal degrees for latitude and longitude values will make it easier to import the results into a GIS or other mapping application, since many commonly used GIS programs such as ArcGIS, HealthMapper, and SIGEpi require latitude/longitude values to be in decimal degrees.
- It clearly delineates the various hemispheres – locations north of the equator will have a positive latitude value, while locations south of the equator will be negative. Likewise, points east of the prime meridian will have positive values while points west of the prime meridian will have negative values. Other coordinate systems can have reference lines that vary depending on where they are used, which can lead to confusion when the data are subsequently mapped.

The last item to consider is the datum used by the GPS receiver. Datums refer to the model of the earth used by the GPS and how that model relates to the "true" shape of the earth. Like coordinate systems, there are a variety of different datums available for use. It is a complicated topic, and one beyond the scope of this document, however

over time, the WGS84 datum has become a standard datum for GPS coordinates, and it is recommended as the datum for facility surveys.

To summarize, the following recommendation are to be used as default when setting up the GPS devices used for a survey:

- coordinate system: latitude/longitude
- coordinate format: decimal degrees
- datum: WGS84

This may require modification of the unit's settings, since it is not necessarily the default for all receivers.

It should be mentioned that there are local coordinate systems and datums that may be more common than latitude/longitude, WGS84. These local datums and coordinate systems can be included as data elements in the signature domain in order to facilitate the inclusion of the survey data with existing spatial data infrastructure; however for cross-survey comparisons and standardization across health facility surveys, the latitude/longitude, WGS84 coordinate should still be included.

As illustrated in Appendix I, there are many different ways that GPS data can be collected. However, there are several steps that are common and should be followed in any data collection effort.

GPS data collection protocol

The following common data collection protocol should be used:

1. Once you have arrived at the health facility to be surveyed, find an open space and turn on the GPS device.
2. If it has not been done before, set the device to display and record the coordinate in latitude longitude, decimal degrees, using WGS84 datum (refer to the receiver's manual for instructions on how to do this.)
3. Move to the main entrance of the building, if possible. If there is no easily identifiable main entrance, select one door. Stand within 30 meters of the main entrance or door, where the entrance is in plain view with a clear view to the sky (not obstructed by buildings or trees, etc.) and begin trying to acquire satellite signals. Note: the personnel collecting the coordinate should avoid blocking any entrances or otherwise impeding entrance to the building, or place themselves in harm's way by standing in a road or other dangerous location.
4. Once the receiver has locked on to enough satellites to get a coordinate within the accuracy thresholds, begin the process of obtaining the coordinate (refer to the GPS's manual for instructions). Make sure the ID assigned to the point by the GPS receiver matches the facility ID. If your receiver can perform point averaging, it is recommended that point averaging be used during this step to improve accuracy. A three-minute period of point averaging should be sufficient.

5. Enter the coordinates in the survey form or log. If applicable, record any comments (e.g. "could not take any reading") in a comment field, if one is available, in either the log or the survey instrument.
6. Turn the GPS device off. At the next health facility, start again from step 1.

The above are steps that should be applied in any health facility survey. Different health facility surveys have taken these basic steps and modified them to take into account the requirements of the receivers used, the interviewer skill set, and other factors, and have customized their data collection protocols accordingly. Appendix I provides protocols from three different facility surveys to illustrate different variations of the six steps above.

After data collection

Once the coordinates have been obtained, they will need to be entered into a database along with the other data collected during the survey. The specifics of how and when this happens will vary, depending on the survey. However, there are steps that should be taken to ensure the coordinates in the database are as close to the facility's true location as possible.

Data management and quality control

In order for the facility locations to be useful, it is vital that the coordinates be able to be linked to other data, whether this is the current survey or past or future data sets. There are several steps that can be taken to ensure that this linking can take place. First, as soon as the data collection phase is complete, the raw coordinates from the GPS units should be downloaded and archived. These can be referred to, if necessary, in order to resolve any issues that may arise due to incorrect recording of the coordinate on the form or data entry errors.

During the data entry phase, range checks can be used to make sure that latitude/longitude values are not out of range. Acceptable data ranges can be determined by using an atlas or gazetteer to determine the minimum and maximum latitude/longitude values for the country or region being surveyed. These data ranges should be considered only as a rough first defense against errors, because they will not completely identify all incorrect coordinates. Therefore, soon after the data entry phase, the coordinates should be mapped to make sure that the facilities do not show up in bodies of water or outside the country or region. If there are errors, they can be tracked down by referring to the original raw files downloaded from the GPS unit or, if necessary, recaptured.

Another key to ensuring maximum utility of the coordinates is the inclusion of metadata. Appropriate metadata will provide potential users of the data key information about how the data were collected, who collected them, any gazetteers relied upon, any error correction used, and basic information about the collection protocol. The International Standards Organization (ISO) has developed a spatial data metadata standard (ISO 19115). Adherence to this standard will ensure maximum utility.

Background on GPS receivers

There are many different types of GPS receivers available, from expensive mapping-grade receivers to inexpensive recreational receivers. Typically for facility surveys, a recreational grade receiver will be sufficient. These usually can be found for U.S. $100 to U.S. $150. Very basic, low-end receivers (U.S. $100), while passable, may not be the best choice for facility surveys since their features and interface may be minimal, making it more difficult for survey teams to operate. There are also GPS receivers that plug into a port on a PDA or laptop. These can work well if the surveys are administered using a laptop or PDA. The advantage to these receivers is that the coordinates can be automatically stored digitally, along with the survey data. The disadvantage is that the interface for the GPS may not be sophisticated or easy to use, and power requirements for the equipment may make them unsuitable for remote areas.

Regardless of whether the GPS receiver is a hand-held receiver or connected to a laptop or PDA, there are certain features that are important. In order of priority, a receive should be able to store waypoints. Secondly, it should provide the capability to assign user-specified IDs to the stored waypoint, to ensure that the survey team can assign the facility's ID to the waypoint, minimizing the chance that coordinates are assigned incorrectly to the wrong facility. Thirdly, the GPS receiver should provide a sky map showing the location of the satellites it is receiving; and lastly, the ability to do point averaging is a desirable feature.

Examples of GPS Receivers

Basic recreational receiver (U.S. $100)

USB GPS setup for laptop (the GPS antenna is the round puck in front of the laptop)

Higher grade recreational receiver (U.S. $150)

GPS error and accuracy

There are several different possible sources of error that may be present in the GPS signal. Among other factors, atmospheric conditions, rounding errors, or clustering of satellites in one quadrant of the sky can all affect the accuracy of the coordinates. It is, of course, vitally important that coordinates collected during a facility survey be as accurate as possible. Steps should be taken during a facility survey to maximize accuracy. This will not only insure accurate placement of the facility, but will also facilitate the identification of the facility during cross-survey analysis.

There are different methods and techniques that have been developed to maximize accuracy. It is recommended that each facility survey employ at least one approach.

Point averaging — Point averaging is an error correction method that mitigates some of the random and systematic errors that can be present in a GPS signal. GPS data collected without point averaging typically has an accuracy of within 10 to 15 meters under ideal conditions. With point averaging, accuracy is typically within five to seven meters. While that may seem like a negligible difference, it is important to remember that is an average error under ideal conditions. The presence of random as well as systematic errors mean that there will be outliers, or points with errors much greater than the average. While there are no reliable data on errors associated with outliers, if the GPS receiver has not adequately locked onto enough satellites or if there is random noise or other error, a coordinate can be off by many kilometers, resulting in facilities showing up in lakes, oceans, or even in other countries.

In point averaging, the GPS receiver calculates a coordinate once a second for a pre-determined period of time, and then calculates a mathematical average of all the coordinates. This has the consequence of minimizing the effect of the random errors. A three-minute point averaging process is sufficient to produce a very accurate coordinate. Not all GPS receivers provide point averaging capabilities, but if it is available, it is recommended.

User monitoring of accuracy — If the receiver does not have point averaging capabilities, a greater burden to monitor such factors as satellite reception and estimated accuracy falls upon the user. Some receivers provide an estimate of the accuracy of the signal. It is important to note that this estimate is simply that, an estimate, and is not a guarantee of the accuracy of the coordinate. However, it does provide helpful context to the user, which can be used to determine if it is possible to collect a point and still conform to the project's accuracy standards. A minimum accuracy of 30 meters (about 100 feet) should be applied when locating health facilities.

In the event the receiver does not provide estimates of error, nearly all GPS receivers will provide a sky map showing the satellites the unit is receiving and their spread in the sky. The user can use this sky map to make sure that at least four satellites have been found by the receiver and locked on to. Additionally the user should make sure they are not clustered in one area or quadrant of the sky. While rare when there is a full view of the sky, this situation can occur if buildings or trees block portions of the sky. The result of this distribution of satellites can be highly inaccurate coordinates. It is recommended that users refer to their GPS manuals for information on how to read the satellite sky map.

Training prior to fieldwork

The key to a successful data collection effort is making sure the survey teams are adequately trained in the use of the GPS receiver and the protocols being employed for the survey. Therefore it is recommended that time be set aside during the interviewer training to focus on the GPS data collection effort. Ideally, GPS training should be completed in half a day.

During the GPS portion of the training, survey teams should be given a rudimentary familiarity with GPS and how it works. This will keep the receivers from being black boxes and improve ussers' troubleshooting ability. The survey teams should also be given an overview of the collection protocols for the survey and given a chance to practice collecting several points during the training. When possible, directly showing the result of their readings in a GIS does reinforce proper collection protocols and permits the early detection of potential problems with the receivers. The goal is to make sure the teams are as familiar as possible with the receivers and the protocols so that chance for mistakes are minimized.

Conclusion

The capability to identify a health facility uniquely is a key element for insuring the proper integration of data coming from different sources or longitudinal surveys. By systematically including the elements of the signature domain in any facility survey, the likelihood of being able to accomplish this objective is increased. While the proposed signature domain is intended to be a standard, it does not preclude the addition of other elements in a health facility survey, nor mean that specific needs of a survey or special circumstances can not be accommodated. These special circumstances can be included in the health facility survey in addition to the signature domain. This will permit the signature domain to remain whole, which will provide the ability to uniquely identify a facility and allow for cross-survey comparisons.

The elements of the signature domain are designed to identify a facility uniquely with minimal effort. Including geographic coordinates in the signature domain represents a minimal additional investment in time and equipment, with a considerable amount of value added to the survey data.

Proper data collection protocols are essential, especially for the collection of the GPS coordinates. The systematic application of these protocols will not only improve the quality of the collected data but also lead to a reduction of the cost for future surveys as GPS coordinates only needs to be correctly collected once to be used by anybody afterwards.

Appendix I. Examples of health facility survey collection protocols

The following pages provide examples of the collection protocols used by different surveys: Service Availability Mapping (SAM) and Study on Global Aging and Adult Health (SAGE) from WHO; and MEASURE Evaluation surveys, including health facility censuses. They illustrate how it is possible to adapt the core GPS data collection protocols presented above to accommodate a survey's specific needs.

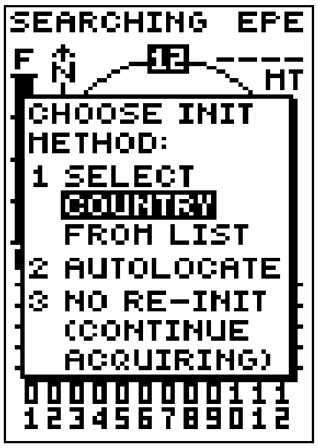
MEASURE Evaluation GPS Documentation

Data Collection Using GARMIN 12

Once the instructions in the *GPS Preparation* document has been followed, the user is ready to capture points using the GPS receiver. This document provides instruction for collecting data.

Initialization (*Optional)*

Sometimes when the receiver is turned on after being off for a long time or is activated in a location that is far away from where it was last activated it may be necessary to reinitialize the receiver.

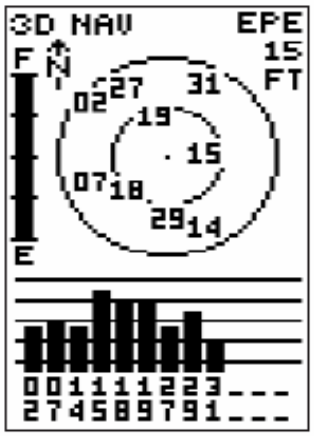


Initialization Screen

If the receiver displays the "CHOOSE INIT METHOD" screen, it is necessary to initialize the unit. Otherwise, no initialization is necessary.

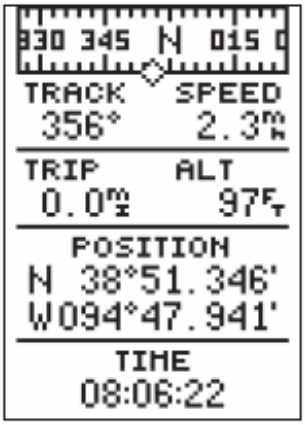
Initialization Process

1) When receiver presents "Choose INIT Method" select option 1 ***Select Country From List***
2) When a list of countries is presented, choose the appropriate country
3) The receiver should then properly initialize



Satellite Screen

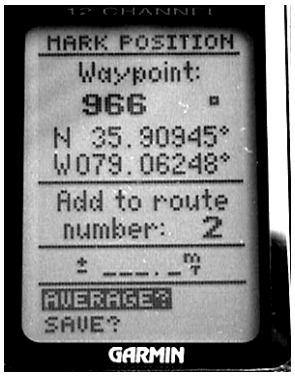
1) When first turned on, the receiver will display the **Satellite Screen**. This displays the location of the satellites in the sky

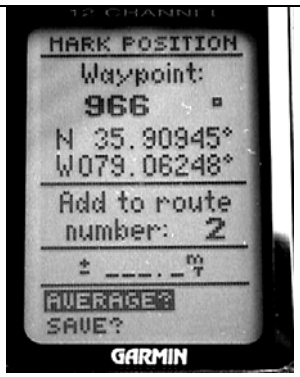


Position Page

2) Once a sufficient number of satellites have been found by the receiver, it will automatically switch to the **Position Page**

3) Press the ***MARK*** button on the receiver, the **MARK POSITION** screen will appear

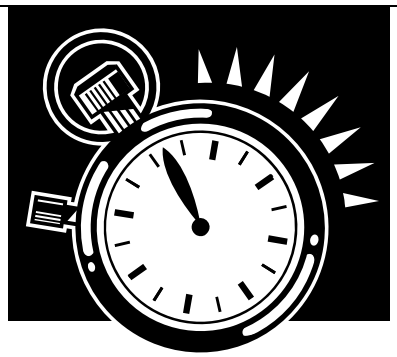




Mark Position Page

4) Highlight the Waypoint number and press the *ENTER* key, then enter the appropriate ID number.

Next, highlight the word **AVERAGE** and press *ENTER*.



Wait 3 minutes. During this period, the GPS unit will collect points and determine an average location.

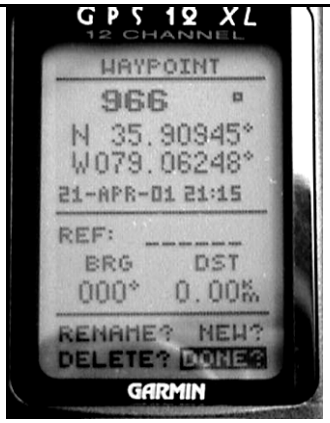
Note: Do not move from location during these 3 minutes.

5) After **3 minutes**, highlight the word **SAVE** and press the *ENTER* key.

Warning!: Do not record the latitude/longitude value visible on the screen. It does not represent the averaged position.

Main Menu

6) Switch to the **Main Menu** screen, by pressing the *PAGE* button. From **Main Menu** highlight **WAYPOINT LIST** and press *ENTER*. Select the waypoint that you just captured from the waypoint list.



Waypoint Screen

7) Record the coordinates in the waypoint screen.

For instance, for this waypoint, the following values would be recorded:

35.90945 for the latitude
79.06248 for the longitude

Once the coordinates have been recorded, the unit can be turned off.

MEASURE Evaluation
Carolina Population Center
University of North Carolina, Chapel Hill
Chapel Hill, North Carolina USA

WHO SAGE Household Survey GPS Data Collection Documentation

Data Collection Using GARMIN eTrex devices

The steps presented here are followed in order to enter the information in the questionnaire. This is done once the training has been given to the person in charge of collecting the GPS coordinates.

Section 0100 Sampling Information

Introduction This section covers all the sampling unit information

Responsibility Sampling Information is to be completed by **the Supervisor before the start of the interview**.

Q0101a - Q0104 The table below provides a guide to the supervisors for completing questions Q0101a to Q0104.

Question No.	Question	Guide for completion
Q0101a	Primary sampling unit (PSU) name	Write the name of the primary sampling unit taken from the sampling key correspondence table that was generated prior to the survey. *For example* if the PSU corresponds to 'county' and the respondent's household is in 'Riordan' county, write 'Riordan' for question Q0101a.
Q0101b	PSU Code	Write the code for the primary sampling unit, which corresponds with the PSU name reported in field Q0101a, and which is also coming from the Sampling Key correspondence table .
Q0102a	Secondary sampling unit (SSU) name	Write the name of the secondary sampling unit for the household/dwelling, taken from the sampling key correspondence table that was generated prior to the survey (this is likely to be the geographical area name that is the next smallest to the PSU).
Q0102b	SSU code	Write the code for the secondary sampling unit, that corresponds with the SSU name reported in field Q0102a, and which is also coming from the Sampling Key correspondence table.
Q0103a	Tertiary sampling unit (TSU) name	Write the name of the tertiary sampling unit for the household/dwelling (This is likely to be the geographical area name that is the next smallest to the SSU).

Question No.	Question	Guide for completion
Q0103b	TSU code	Write the code for the tertiary sampling unit, that corresponds with the SSU name reported in field Q0103a, and which is also coming from the Sampling Key correspondence table.
Q0104	Setting	Write the name of the setting taken from the sampling key correspondence table that was generated prior to the survey. The setting may be: 1. Urban; 2. Rural **Note:** If definitions for urban or rural are different from the definitions provided, you must define these categories and provide the definitions to WHO to allow for comparison of data between countries.

Q0105a-Q0106b

Use the list of administrative units' names and their corresponding codes (Appendix A0100) to complete the first and second administrative levels unit name and codes in questions Q0105a to Q0106b.

If the name of a unit is not on the administrative list, write the name in but do not enter any code.

Example

The example below illustrates how to enter the administrative names and codes.

- The household surveyed is part of the region "Greater Accra" which corresponds to the First Administrative Level Unit Name in Ghana
- The code for this region is GHA005.
- In this Region, the household is situated in the Accra District (Second Administrative Level Unit Name)
- The code for this district is GHA005001.

ADMINISTRATIVE DIVISION INFORMATION
Refer to Appendix A0100 for administrative names and codes

Q0105a. First Administrative Level Unit **Name:**	**Q0105b**. First Administrative Level Unit **Code:**
Greater Accra	G H A 0 0 5 *99 Not applicable if the unit is not in the annex list*
Other name for the first administrative level unit if not in the Appendix list:	

Q0106a. Second Administrative Level Unit **Name:**	**Q0106b**. Second Administrative Level Unit **Code:**
Accra	G H A 0 0 5 0 0 1 *99 Not applicable if the unit is not in the annex list*
Other name for the second administrative level unit if not in the Appendix list:	

Section 0200 Geocoding/ GPS Information

Introduction

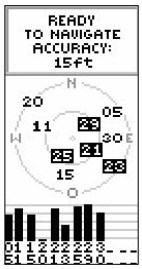
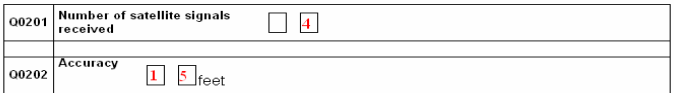
The Global Positioning System (GPS) allows you to precisely identify locations on the earth's surface.

Responsibility

Geocoding information is to be completed by the Supervisor.

To use the GPS device

Follow the steps below to use the GPS device in the field. Please refer to the GPS Field guide and Garmin eTrex user manual for more information about the GPS system and the functionalities of the Garmin eTrex device.

Step	Action
1	Once you have arrived at the cluster area to be surveyed, find an open space and turn on the GPS device.
2	Wait for the GPS to indicate it is ready to navigate.
3	Go to the 'Units' setup page and set the device to default as follows: • Use the 'Up' or 'Down' button to highlight the 'Defaults' field. • Press the 'Enter' button. • Once complete, all the settings apart from 'Variance' should appear as indicated in the Figure. 
4	Move to the first household**.**
5	Go back to the 'Satellite' (advanced Skyview) page (see Figure) and wait for the accuracy to become better than 65ft with at least 3 satellite signals received. In the example, the accuracy is15ft and with 4 satellite signals (out of 9) received. 
6	Once the accuracy value is below 65 ft with 3 satellite signals write this information in the field Q0201 and Q0202 as shown in the example below. 

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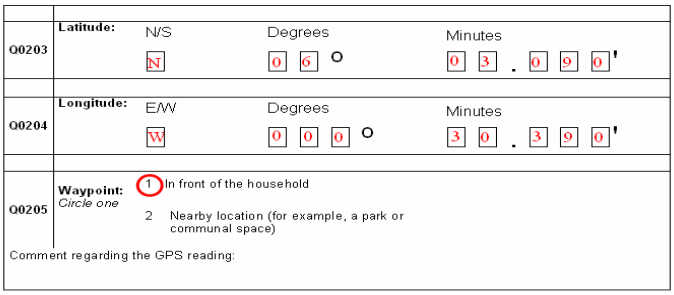
Step	Action
7	Press and hold the 'Enter' button to access the ‘Mark’ page and read the coordinates.
8	Verify that the coordinates are within the range of the administrative division in which you are located referring to Appendix A0200. *In the example, the coordinates are within the Greater Accra Region range.* 
9	If this is the case, enter the coordinates as shown in the Figure with the indication of the location where you were when you took the reading (waypoint). Write any comments (e.g. "could not take any reading") in the boxes for Q0205. 
10	Move to the next household and repeat steps 5 to 9 until you have measured the GPS coordinates of each household within the cluster.
11	After, turn the GPS device off, move to the next cluster and start from step 1.

Q0201 - Q0206 The table below provides a guide to completing questions Q0201 to Q0206.

Question No.	Question	Guide for completion
Q0201	Number of satellite signals received	Specify the number of satellite signals received. The 'Satellite' page on the GPS device indicates the number of signals received with black boxes behind the satellite number (see Figure in step 5 above).
Q0202	Accuracy	Make sure that the accuracy value in the 'Satellite' page on the GPS device is less than 65 feet (ft) and enter that number.

Q0203 - Q0204	Latitude Longitude	Verify that the coordinates are within the range of the administrative division in which you are located and write them in the specific fields.
Q0205	Waypoint	The waypoint is the point on the ground where the Latitude/Longitude measurement was taken. The waypoint may be: • In front of the household • A nearby location (e.g., a park or communal space)

Note: Add any additional comments about the GPS reading or problems encountered in the "comment regarding the GPS reading space".

Section 0300 Re-contact Information

Introduction

Re-contact information is important for re-test cases and also for follow-up as part of the SAGE study.

Requirement

Collect as much information as possible, with as many specifics as you feel are needed to be able to go back to the household if needed. Write clearly and be consistent in how you record the information across the different households you interview.

Q0301 - Q0306a

The table below provides a guide to completing questions Q0301 to Q0306a.

Question No.	Question	Guide for completion
Q0301	What is the respondent's <u>full name</u>? Last Name: First Name:	• Print in CAPITALS. • Verify spelling of the name and write clearly. • Enter first (given) name and, then last (surname) name.
Q0302	What is the respondent's address? Street Number and Name: City: Postal Code: Other:	• This would be a mailing address - or detailed directions for how to return to this dwelling. • Print in CAPITALS. • Make sure that the information is entered in the correct field. The field should remain empty in case the information is not existing (e.g. street name). • Verify spelling and write clearly. • Provide street number and name, city and/or

		township, postal code and any other information that would be necessary to identify the location. • Include any useful additional information not corresponding to the street or city in the field 'Other'. This can include useful landmarks.
Q0303	Does this informant/household have a telephone?	• Can be fixed (land) line or mobile (cellular) phone. • Circle 'Yes' or 'No'. • If 'No', skip to Q0306.
Q0304	What is the telephone number?	• Print numbers clearly in the boxes provided. • Include the number with area code. • Do not include the country phone code.
Q0305	Is this telephone number listed in the telephone directory?	• Indicate if the telephone number is listed in a public directory. • Circle 'Yes' or 'No'.
Q0306	If we cannot contact you for whatever reason, is there someone else we could contact who would know how to reach you?	• Indicate a person or persons - who would know how to contact you in the event that the person or persons in this dwelling move to another location at any time in the future. • Circle 'Yes' or 'No'.
Q0306a	What is this person's name, relationship to you and her or his address?	• Print in CAPITALS. • Verify spelling and write clearly. • Provide first (given) name and last (surname) name, street number and name, city, postal code and any other information needed to locate this person or persons, in the case that we need to locate the informant. This could include important landmarks, telephone numbers or work/home addresses.

4 | Using GPS (handheld devices)

When using the GPS device for the first time, it will take up to five minutes to find your location. After the first use, only 15 to 45 seconds will be needed to find your location, depending on the strength of the signals received.

One the aspect of the SAM relates to the services offered in health facilities. If health centers are visited during the survey, it is necessary to collect the geographical co-ordinates of these centers with a GPS receiver in order to be able to represent them on a map.

In order to standardized data collection for health facilities the following protocol should be respected as much as the context allows it. It is important to remember that GPS devices should be used outside, in a large, open area that has a clear view of the sky.

For the selected districts of the SAM survey, each health facility of a village, town or city should be visited. By convention only health facilities which are "hard" build should be reported to ensure reliability of data over time.

Configuration of the GPS device

- Before starting data collection the GPS devices setting should be configured properly.
- Make sure that if the device had been previously used to collect data, the data collected be on a PC, the device empty and ready to be use.
- To ensure optimal compatibility with other layers of geographical information within a GIS, it is advisable to take the coordinates of a point in **decimal degrees**. The GPS device should be set-up as follows:

NAV Units	Km/Kmph
Map datum	WGS 84
Co-ord system	Lat/Lon (hd.mmmmm)
North reference	Magnetic

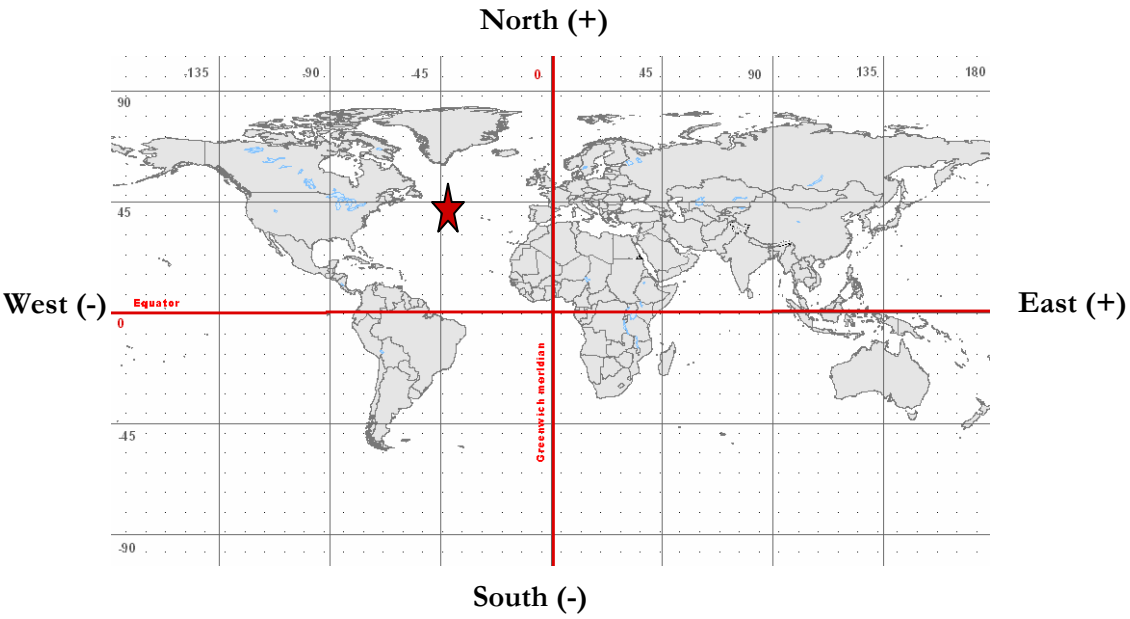
Collecting geographic coordinates

Once you have set-up the units on the GPS device you can use it to record the geographic co-ordinates of a point. GPS receiver can record in memory a certain number of points but it is recommended to report important information like the latitude and longitude or the name of the point on paper and/or on the PDA. To record the geographical co-ordinates of a point:

- It is necessary to be placed at the **health facility entrance** in a open area that has a clear view of the sky and hold the GPS receiver parallel to the ground.
- Make sure you get the message "Ready to navigate" on the GPS and the accuracy is lower than **10 meters**. In case you do not get the message "Ready to navigate", wait at the same place during 5 minutes.
- When the signal is sufficient (it is recommended to establish connection with four satellites) and the accuracy is good enough, you can record the point. You can report the co-ordinates latitude and longitude on the paper form and/or in the PDA.
- Switch off the GPS receiver once the point is recorded.

Latitude and longitude

Latitude is measured from the equator, with positive values going north and negative values going south. Longitude is measured from the Greenwich Meridian, with positive values going east and negative values going west.



So, for example, 45 degrees north latitude, 45 degrees west longitude, is +45 degrees latitude, -45 degrees longitude.

Note that the GPS device will display the letters N (north) or S (south) in front of the latitude, and W (west) or E (east) in front of the longitude indicate the position in relation to the Equator and to the Greenwich Meridian. Thus, based on location of the health facility positive (+) or negative (-) co-ordinates should be properly reported. On the example below, the coordinates will be displayed as follow on your device:

N 45.00000

W 45.00000

Note that the elevation will be displayed on the same screen and might be a useful information to note down as well

Check-list

- Check battery level and verify that devices are properly working.
- Check the setting of your GPS receiver (Hddd.dddd, WGS 84, …).
- Have questionnaire for data collection ready to be used (paper form, PDA form, Excel from).
- Make sure to be properly placed for reliability of data collection

Report coordinates taking into account location to the Equator and Greenwich meridian.

- Make sure that all information relative to the collected point has been reported (names, coordinates, etc…)

Appendix II. Health Facility Technical Working Group membership

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