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National Health and Nutrition Examination Survey Biospecimen Program: NHANES III (1988–1994) and NHANES 1999–2014

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

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Data Evaluation and Methods Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

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Contents

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Abstract

Background

The National Health and Nutrition Examination Survey's (NHANES) biospecimen program was formed to manage the collection of biospecimens (including serum, plasma, urine, and DNA) from NHANES cycles, the storage of biospecimens in NHANES biorepositories, accessing of biospecimens by researchers, and the providing of resulting data to future researchers. Data from biospecimen research can be combined with existing NHANES data.

Objective

This report provides background on the development of NHANES biorepositories and describes the collection, processing, and storing of biospecimens; ethical considerations and informed consent; and the proposal process for accessing biospecimens and resulting data. The number and types of biospecimens collected in each survey cycle from NHANES III (1988–1994) through NHANES 1999–2014 are discussed so that researchers can understand what biospecimens are available if they are considering using NHANES biospecimens in their research.

Keywords: DNA • serum • plasma • urine

National Health and Nutrition Examination Survey Biospecimen Program: NHANES III (1988–1994) and NHANES 1999–2014

by Geraldine M. McQuillan, Ph.D., and Jody E. McLean, M.P.H., National Center for Health Statistics; Michele Chiappa, B.A., Harris Corporation; and Susan L. Lukacs, D.O., M.S.P.H., National Center for Health Statistics

Introduction

The National Health and Nutrition Examination Survey (NHANES) is one of a series of health-related surveys conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). NHANES collects data on the health, nutritional status, and health behaviors of the civilian noninstitutionalized resident population of the United States (1). The survey is unique in that it combines a personal interview with a standardized physical examination that includes a blood draw and urine collection for laboratory analysis.

This report describes the origins and characteristics of the NHANES biorepositories, which store biospecimens obtained during NHANES III (1988–1994) and NHANES 1999–2014, as well as the process for obtaining access to the biospecimens for testing and use in research. Blood and urine specimens will continue to be collected in NHANES 2015–2016. The NHANES website (http://www.cdc.gov/nchs/nhanes/genetics/stored_specimens.htm) will provide the most current information about the biospecimen program.

Appendix I contains supporting figures and tables, and Appendix II provides a glossary of key terms used in this report.

NHANES III (1988–1994) and NHANES 1999–2014

NHANES III was conducted from 1988 through 1994 and included persons aged 2 months and over. As with previous NHANES cycles, NHANES III focused on health and nutrition. Data were also collected on environmental exposures, to examine the effect of environment on overall health (2). NHANES III gathered data on 30,000 survey participants across the United States. It was conducted in two phases—Phase I (October 1988–October 1991) and Phase II (October 1991–October 1994)—each nationally representative of the U.S. population (2).

In 1999, NHANES became a continuous annual survey. Approximately 5,000 participants of all ages are examined each year, and data are released in 2-year cycles (3). The focus of NHANES 1999–2014 was to provide prevalence data on selected diseases and risk factors for the U.S. population; monitor trends in selected diseases, behaviors, and environmental exposures; explore emerging public health needs; and maintain a national probability sample of baseline information on health and nutritional status (3).

Development of Biorepositories

Biorepositories were created to store NHANES participants' blood (serum or plasma), urine, and DNA for future research. Resulting research data can be combined with existing NHANES data. One biorepository stores pristine serum, plasma, and urine that have not undergone freezing or thawing; a second stores surplus serum, plasma, and urine that have undergone freezing and thawing; and a third stores DNA specimens (see Table).

Establishing the Serum, Plasma, and Urine Biorepositories

During NHANES III, either 1 or 2 ml of serum from each participant, depending on age group, were aliquoted into four vials in the NHANES Mobile Examination Center (MEC) and sent to NHANES' serum biorepository in Lawrenceville, Ga. There, the biospecimens were re-aliquoted into 0.5-ml vials and stored as pristine sera, even though they had undergone one freeze-thaw cycle. This biorepository for pristine sera was established in 1988 at the start of the survey.

In 1989, the laboratories that were testing the serum specimens as part of NHANES informed NCHS' Division of Health and Nutrition Examination Surveys (DHANES) that they could no longer keep residual biospecimens in their laboratory freezers and that there was a sufficient volume of serum in each vial that could be made available for future testing. This was due to changes in laboratory methodology that required less specimen per individual laboratory test and because few tests needed to be repeated. At that point, DHANES contracted with a commercial biorepository and in 1989 began to store the surplus serum that was returned from the various laboratories.

In 1999, the biorepositories expanded to include both pristine and surplus serum, plasma, and urine. Pristine serum specimens were aliquoted in the MEC into 0.5-ml vials that have never undergone a freeze-thaw cycle.

Establishing a DNA Biorepository

In 1991, NHANES developed a biorepository to maintain DNA specimens for future studies. This would allow genetic information to be combined with other NHANES data to improve knowledge of human disease. Prior to establishing the DNA biorepository, blood specimens were collected from participants during NHANES III Phase I to validate a DNA processing and extraction method. A molecular genetic technique using crude cell lysates from cell lines was used to extract the DNA. Small samples of cells obtained from 8 ml of blood collected from participants aged 12 and over were sent to CDC's National Center for Environmental Health (NCEH) molecular biology laboratory for extraction. With the knowledge gained, blood was then collected from participants during NHANES III Phase II, DNA was extracted, and specimens were stored for future genetic research (4). Starting in 1999, blood specimens for isolating DNA from whole blood were collected from participants during NHANES 1999–2002, 2007–2008, 2009–2010, and 2011–2012.

Ethics, Privacy, and Confidentiality

The NCHS Ethics Review Board (ERB) protects the rights and welfare of NHANES participants. The NHANES protocol, and the protocol to make DNA available for research, comply with the U.S. Department of Health and Human Services' Policy for Protection of Human Research Subjects (45 CFR 46), available from: http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html (3). Additionally, three federal laws protect information collected from individuals:

- Privacy Act of 1974 (5 USC 552a)
- Section 308(d) of the Public Health Service Act (42 USC 242m)
- Confidential Information Protection and Statistical Efficiency Act (CIPSEA) (PL 107–347, enacted in 2002) (2).

The Public Health Service Act stipulates that "…no information may be used for any purpose other than the purpose for which it was supplied unless …[a] person consented to its use for such other purpose, and further that it cannot be released or published in a form that the particular …person supplying the information or described in it is identifiable unless such …person has consented…." These strict prohibitions, forbidding even unintentional unauthorized disclosures, guide the behavior of all NCHS staff and contractors (3).

In addition to scientific review, all research protocols proposing to use

Table. Overview of NHANES biospecimens, by survey cycle

	Specimen type						
	Pristine[1]			Surplus[2]			
NHANES cycle	Serum	Plasma	Urine	Serum	Plasma	Urine	DNA
III (1988–1994)	X	…	…	X	…	…	X
1999–2000	X	X	X	X	X	X	X
2001–2002	X	X	X	X	X	X	X
2003–2004	X	X	X	X	…	…	…
2005–2006	X	X	X	X	…	…	…
2007–2008	X	X	X	X	…	…	X
2009–2010	X	X	X	X	…	…	X
2011–2012	X	…	X	X	…	…	X
2013–2014	X	…	X	X	…	…	…

… Category not applicable.
[1]Biospecimens immediately frozen for storage, did not undergo laboratory testing.
[2]Biospecimens were surplus after laboratories had completed testing.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

NHANES biospecimens are reviewed by the NCHS Confidentiality Officer for disclosure risk and by the NCHS Human Subjects Contact and ERB for protection of the rights and welfare of NHANES participants, including vulnerable populations such as children, pregnant women, and older Americans (3).

Once a protocol is approved, it is reviewed annually by the ERB. After 5 years of annual continuations, if there is need for continued use of biospecimens to complete the study protocol, a new protocol is required. If at any time after approval a researcher wants to change the protocol, an amendment to the protocol is required and undergoes the same review process as the initial protocol.

Informed Consent

During NHANES III, participants aged 12 and over signed a form consenting to storage of a sample of their blood for future research (a parent or guardian also signed the consent form if the participant was under age 18); genetic research was not specifically mentioned. Beginning with NHANES 1999, participants aged 7 and over signed a form consenting to have blood and urine specimens stored for use in future studies (a parent or guardian also signed the consent form if the participant was under age 18). On the same form, participants aged 20 and over could consent to have blood stored for future genetic studies (3).

Beginning in 2007, these consents were separated into two forms and participants signed one consent form for storing blood and urine for future nongenetic studies and a different form for storing blood for use in future genetic studies. The consent form for nongenetic studies highlights the need for research using stored biospecimens to help find new ways to prevent, treat, and cure many diseases. The genetics consent form informs participants that their DNA will be used for genetic research to help understand genetic links to medical conditions. On all consent forms from 1999 through 2014, participants were informed that there was no plan to contact them with the results of future tests.

Biospecimen Operations

This section describes the collection, processing, storing, and shipping of biospecimens during the NHANES cycles. All biospecimens are collected and processed at the MEC by a laboratory team consisting of a phlebotomist and medical technologists who are certified in accordance with the guidelines of the American Society for Clinical Pathology (3).

Blood Collection for Serum or Plasma

Blood is collected from NHANES participants aged 1 year and over by a phlebotomist. Prior to blood collection (venipuncture), the participant (or parent or guardian) completes a questionnaire to screen for conditions that would exclude him or her from the blood draw, such as hemophilia, having received chemotherapy in the previous 4 weeks, and various reasons that would preclude the use of the participant's arms for a blood draw. The amount of blood drawn varies by age and survey year, ranging from 7 ml in participants aged 1 to 3 in NHANES III to not more than 128 ml in participants aged 12 and over in NHANES 1999–2014 (2,3). Blood is processed by centrifuging and separating serum or plasma from the appropriate collection tube, and then aliquoting the specimens into vials. As a biospecimen vial is processed, it is barcoded with a label for the participant and given a laboratory number. All vials are verified for correct labeling. Vials are stored under appropriate cold (4°C–8°C) or freezing (–20°C) conditions in preparation for shipment to the testing laboratories (2,3).

In each NHANES cycle, more than 25 laboratories receive NHANES biospecimens for testing. Biospecimens are packed in wet or dry ice, depending on the analyte to be tested, and shipped at least once a week, again depending on the analyte. Each shipment contains a log transmittal form or shipping manifest. Extra serum or plasma are aliquoted into cryovials for long-term storage. These biospecimens are considered pristine and are directly stored in vapor-phase liquid nitrogen (–80°C or below) and shipped to the CDC and Agency for Toxic Substances and Disease Registry (ATSDR) Specimen Packaging, Inventory, and Repository (CASPIR) for long-term storage.

Urine Collection

Starting in 1999, a random urine specimen was collected by having participants aged 6 and over void into a sterile container (2,3). Urine specimens are processed by aliqoting varied amounts of urine into vessels appropriately sized for specific laboratory assays. During NHANES 1999–2014, a 5-ml aliquot of extra urine was placed in a cryovial for long-term storage. In NHANES 2009–2012, participants aged 6 and over also provided a first morning void urine specimen from home. Preprinted bar code labels for each participant are affixed to the urine vessels. The vessels are stored in specific containers, frozen, and shipped weekly or at the completion of a survey location. Each shipment contains a log transmittal form or shipping manifest.

Pristine Biospecimens

Pristine biospecimens from NHANES III and NHANES 1999–2014 were shipped from the MEC and stored at CASPIR. On average, six vials of 0.5- to 1.0-ml serum per vial per participant aged 3 or over (and one 0.5-ml plasma per vial from participants aged 6 and over from NHANES 1999–2010) are stored in vapor-phase liquid nitrogen (–80°C or below). Pristine NHANES III biospecimens underwent one freeze-thaw cycle (for aliquoting only) before storage; pristine biospecimens from NHANES 1999–2014 have not undergone any freeze-thaw cycles (3). Pristine urine specimens from NHANES 1999–2014 (one or two vials of 5-ml urine per participant aged 6 or over) are stored at CASPIR in vapor-phase liquid nitrogen (–80°C or below). Additionally, two aliquots of 5-ml urine collected from first void home urine specimens from NHANES 1999–2012 participants,

processed at the University of Minnesota, were sent to CASPIR for storage. See Table.

Surplus Biospecimens

After laboratories complete their testing, surplus serum, plasma, and urine specimens are shipped to the NHANES biorepository (a commercial biorepository under contract to NCHS) for long-term storage. These biospecimens have been through at least two freeze-thaw cycles prior to being shipped to the biorepository. At the biorepository, surplus serum or plasma specimens are stored at –80 °C. During NHANES 1999–2002, surplus urine specimens (one or two vials of 0.2- to 5-ml urine per participant aged 6 or over) were shipped from the testing laboratories to the NHANES biorepository for long-term storage. See Table.

DNA Specimens

Blood collection for the extraction of DNA (NHANES III Phase II and NHANES 1999–2002, 2007–2008, 2009–2010, and 2011–2012) followed the same NHANES screening procedures described previously for blood collected for serum and plasma. Blood specimens for DNA extraction were shipped to CDC's NCEH Division of Laboratory Sciences for processing and long-term storage. For NHANES III Phase II, DNA was extracted from crude lysates of cell lines from participants aged 12 and over. For these specimens, DNA concentrations vary and are estimated to range from 7.5 to 65 ng/µl, with an average of approximately 4 µg in 100 µl (4). For NHANES 1999–2002, 2007–2008, 2009–2010, and 2011–2012, DNA was purified from the blood of consenting participants aged 20 and over. DNA was isolated from two 10-ml aliquots of whole blood per participant. A master set of DNA specimens per survey cycle was stored at –80°C. A partial second DNA set from the second aliquot of blood was also frozen and stored at –80°C. Additionally, aliquots of purified DNA were normalized to concentrations of approximately 50 ng/µl (4).

Forty microliters of each DNA specimen were supplied to researchers who had an approved project. To prepare a complete DNA set for researchers, a 96-well plate map format is created to document the location of each DNA sample and to incorporate blanks and blind duplicates for quality control. For all survey cycles, each 96-well plate is barcoded and labeled with a readable identifier. These plate replicates are sealed in bags for shipping and frozen at –20°C. To prepare for shipping, plate replicates are retrieved from storage, the manifest listing is verified, and plates are packaged with appropriate shipping labels. Each shipment contains a shipping manifest.

For a flow chart of NHANES biospecimen operations, see Figure I in Appendix I.

Access to Biospecimens

Research Proposal Review Process for Serum, Plasma, and Urine Specimens

All NHANES serum, plasma, and urine specimens from NHANES III and the 2-year survey cycles from NHANES 1999–2014 (Appendix I, Tables I–IV) are available to researchers. Those interested in using serum, plasma, or urine specimens for research must submit a proposal to the DHANES Biospecimen Program Project Officer (5). The proposal includes specific aims, background and public health significance, research design and methods, clinical significance of results, qualifications of the principal investigator, period of performance, and proposed or received funding. All proposals are evaluated by a technical panel for scientific merit, public health significance, and clinical significance. The panel consists of scientists from within and outside NCHS.

Because NHANES participants receive the results of their survey laboratory tests 12–16 weeks after examination at the MEC and have no further contact with NHANES staff, there is no plan to contact participants with results of future tests resulting from research on biospecimens. Therefore, researchers wishing to access biospecimens cannot test for analytes that could have clinical significance for participants. A laboratory analyte is considered clinically significant if laboratory tests are performed by a Clinical Laboratory Improvement Amendments (CLIA)-certified laboratory and therefore deemed valid, the findings have significant implications for the participant's health, and a course of action is readily available to treat the associated health concern (5).

After a proposal is approved by the technical panel, it is evaluated by the NCHS Confidentiality Officer for disclosure risk, and by the NCHS Human Subjects Officer and the ERB for any potential human subjects concerns. The technical panel, Human Subjects Officer, and ERB also evaluate whether the test has clinical significance. The ERB reviews the proposal even if it was previously approved by the researcher's institutional review panel. Researchers can request changes to the protocol only through an ERB amendment process.

After 5 years of annual continuations, if there is need for continued use of biospecimens to complete the protocol study, a new protocol is required. This protocol is reviewed by the technical panel to assure the ERB that the sole purpose of the new protocol is to complete the original study. More information on the proposal process is available on the biospecimen program website at http://www.cdc.gov/nchs/nhanes/genetics/stored_specimens.htm and on the Federal Register website (5).

Once their proposal is approved, researchers complete and sign the Material Transfer Agreement (MTA) and send payment for the biospecimens. After the MTA and payment are received, the request to send samples to the researcher is authorized. If the researcher is within the federal government, biospecimens are provided after receipt of a signed Interagency Agreement rather than an MTA. If an approved project is unable to obtain funding, the project is canceled.

The researcher confirms the approved study population for testing with the DHANES Biospecimens Project Officer, who ensures that the requested biospecimens are available at CASPIR or the contract biorepository. The project officer places the researcher in contact with the biorepository to schedule overnight delivery of biospecimens.

After laboratory testing is complete, all results are sent to NCHS to be linked to the sequence number (SEQN) ID (the linking identifier on the public-use data files), and a data file is prepared. The data file, linked to NHANES public-use data, is returned to the researcher for quality control testing. See the NHANES biospecimen program website (http://www.cdc.gov/nchs/nhanes/genetics/stored_specimens.htm) for updated guidelines. The researcher has up to 90 days to complete this testing, after which the data are released to the public on the NHANES website.

Research Proposal Review Process for DNA Specimens

DNA specimens were stored in NCEH's molecular biology laboratory. In 1999, NHANES announced that it would provide the public with an anonymized set of genetic data (from the DNA specimens collected in NHANES III Phase II) with a limited number of demographic variables (i.e., age, race, and sex) for analyses. This minimized the research potential for genetic data by limiting access to the full array of NHANES data. In 2002, NHANES obtained approval from the NCHS ERB to allow researchers to request DNA samples for approved research. Resulting genetic data could be linked with other NHANES data through NCHS' Research Data Center (RDC).

In 2012, the ERB suspended the NHANES DNA Specimen Program from receiving new proposals due to concerns about reporting of incidental findings from research results. As of March 2015, DHANES has received approval to reopen the program. Refer to the NHANES website (http://www.cdc.gov/nchs/nhanes/genetics/genetic.htm) in late 2015 for the updated Federal Register notification (Table V).

From 2002 through 2012, researchers could submit a new research proposal on either January 1 or July 1 of each year to request DNA specimens (4). The proposal was first submitted to the DHANES Genetics Project Officer. It was then sent to the Genetics Technical Panel, comprised of experts in the genetics field, for review. When the comments and questions from the panel had been appropriately addressed by the requesting researcher, the approved proposal was sent to the NCHS Human Subjects Contact, Confidentiality Officer, and ERB for review and approval. Once a research proposal was approved—and after receipt of a completed and signed MTA and payment—the biospecimens were shipped to the researcher. If the researcher was within the federal government, biospecimens were provided after receipt of a signed Interagency Agreement rather than an MTA. For projects requiring funding, DNA specimens were not provided to the requesting researcher until the project had received funds. Requests from approved projects that were unable to obtain funding were canceled. For a flow chart showing the NHANES DNA request proposal process, see Figure II.

Following approval, researchers were shipped an approved and complete set of participants' samples, plus quality control samples that represented 5% of the complete set. Quality control samples are blinded to the researchers. All test results from DNA specimens are returned to NCHS for quality control review. The first step in quality control review is to test the percentage of the quality control specimens that were discordant with their corresponding specimens in the complete set; if more than 5% are discordant, then the genetic variable failed quality control (i.e., 95% or greater duplicate concordance is required). The second step is to assess deviations from Hardy-Weinberg proportions separately for each of the three main race and ethnicity groups (non-Hispanic white, non-Hispanic black, and Mexican-American) using chi-square goodness-of-fit tests. If two of the three race and ethnicity groups deviate from Hardy-Weinberg proportions at $p < 0.001$, the genetic variable fails quality control (6).

Test results that pass quality control review are linked to NHANES data by SEQN ID. After 6 months, the genetic data are deposited in the NHANES Genetic Data Repository and made available, by proposal, to other researchers.

Researchers depositing genetic data or researchers wanting to analyze secondary genetic data in the NHANES Genetic Data Repository are required to submit a proposal and access the data through the NCHS RDC. All proposals are reviewed for potential disclosure issues. All analyses are performed in the RDC at NCHS in Hyattsville, Md.; in the RDC on the CDC campus in Atlanta, Ga.; or through the NCHS remote access system. A fee is charged to use RDC services.

For more information on gaining access to NHANES' Genetic Data Repository for research, see http://www.cdc.gov/nchs/nhanes/genetics/genetic_access.htm. For a flow chart showing the RDC genetic proposal process, see Figure II.

Linked Genetic Data Sets

Linking of NHANES III Phase II, NHANES 1999–2002, and NHANES 2007–2008 public-use and restricted data with the genetic information available in the NHANES Genetic Data Repository provides researchers with the opportunity to conduct a vast array of outcome studies to investigate the association between a wide variety of health factors and genetic variation (7). The linkage process continues as more genetic variation information becomes available. Data in the repository can be accessed through the RDC. The majority of genetic data in the repository are single nucleotide polymorphisms (7).

Summary

This report has provided an overview of the collection, storage, and availability for research of biospecimens collected through NHANES. More detailed information is available on the NHANES website at http://www.cdc.gov/nchs/nhanes.htm.

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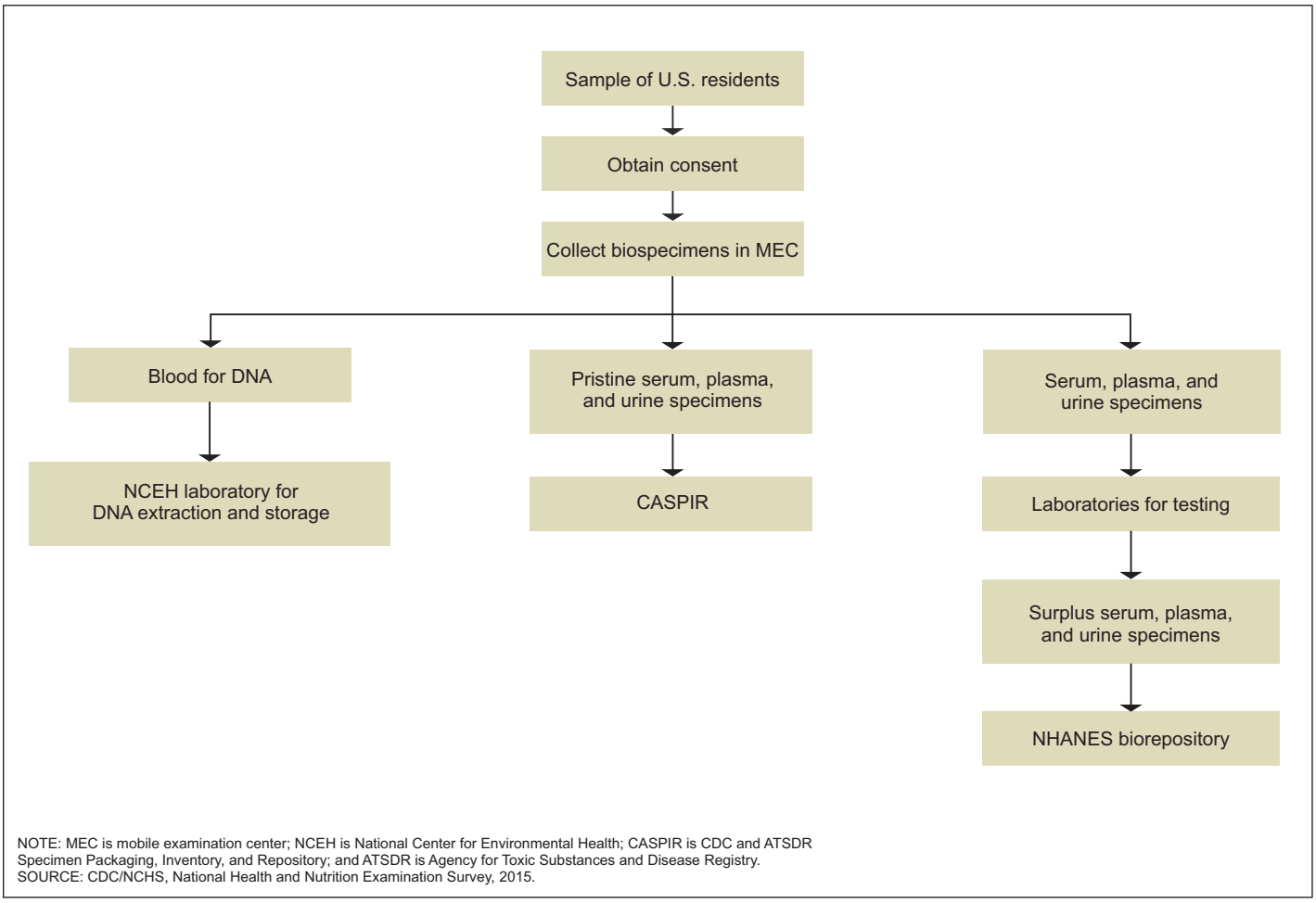
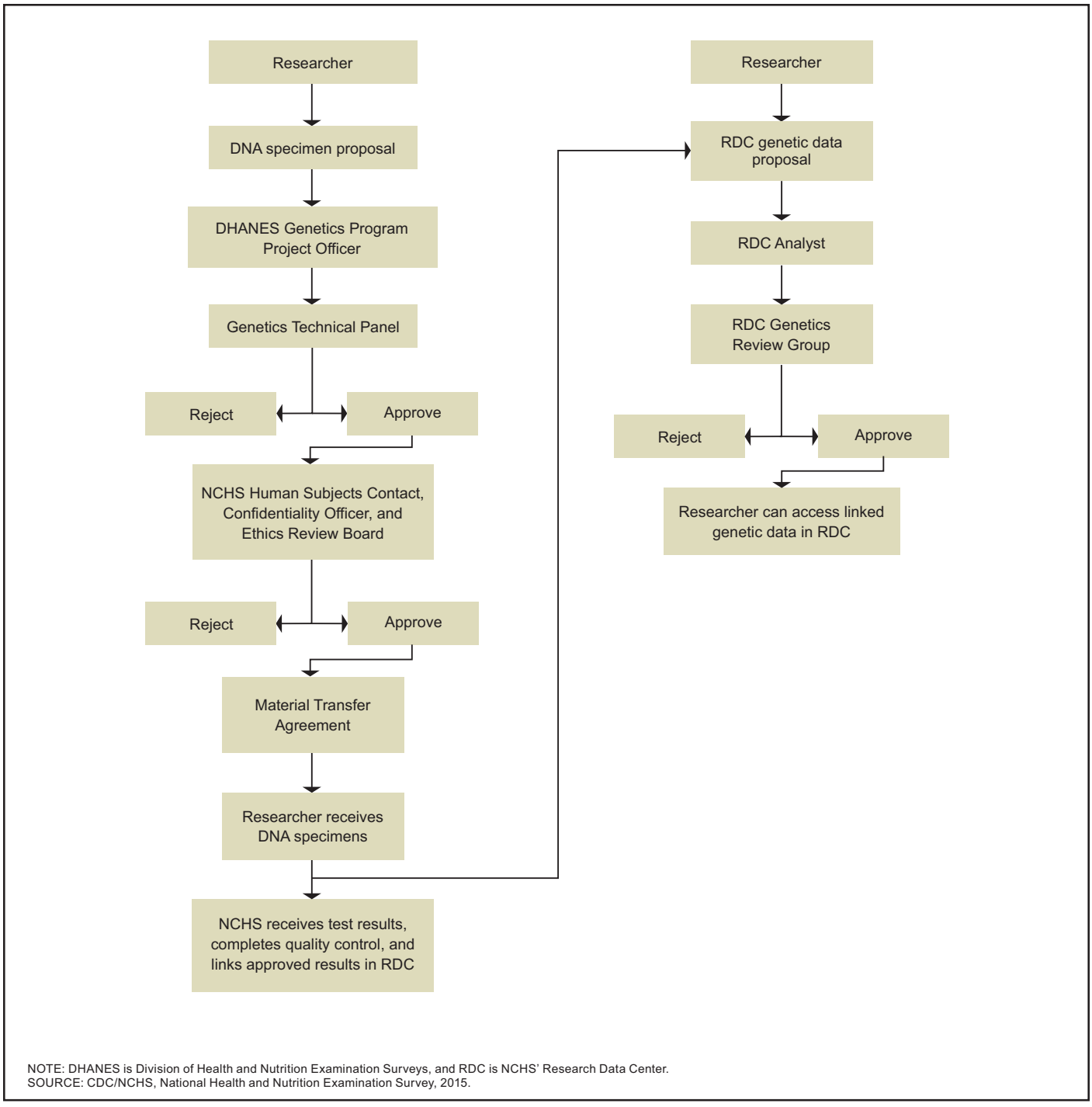
Appendix I. Supporting Figures and Tables



NOTE: MEC is mobile examination center; NCEH is National Center for Environmental Health; CASPIR is CDC and ATSDR Specimen Packaging, Inventory, and Repository; and ATSDR is Agency for Toxic Substances and Disease Registry.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Figure I. Flow chart of NHANES biospecimen operations



NOTE: DHANES is Division of Health and Nutrition Examination Surveys, and RDC is NCHS' Research Data Center.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Figure II. Flow chart for DNA specimen proposals and Research Data Center genetic data proposals

Table I. Pristine and surplus serum specimens available, from NHANES III

Age group and specimen source	Pristine serum	Surplus serum
3–5 years		
Participants	…	1,381
Vials	…	2,955
6–11 years		
Participants	2,469	2,568
Vials	12,781	6,342
12–19 years		
Participants	2,586	2,918
Vials	16,308	16,667
20 and over		
Participants	15,029	16,035
Vials	140,806	103,706

… Category not applicable.

NOTES: Specimens accessible for testing under approved protocols. Numbers are current based on data available at publication. Vials contain ≥0.2 ml.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Table II. Pristine serum, plasma, and urine specimens available, from NHANES 1999–2014

Survey cycle, age group, and specimen source	Serum	Plasma	Urine
1999–2000			
6–11 years:			
Participants	705	730	788
Vials	2,381	730	1,492
12–19 years:			
Participants	1,846	1,825	1,919
Vials	20,701	1,825	3,577
20 and over:			
Participants	3,724	1,305	3,839
Vials	41,327	1,305	7,336
2001–2002			
6–11 years:			
Participants	917	968	1,017
Vials	2,578	968	1,753
12–19 years:			
Participants	2,017	2,081	2,105
Vials	20,116	2,081	3,475
20 and over:			
Participants	4,398	4,527	4,511
Vials	43,259	4,527	7,950
2003–2004			
3–5 years:			
Participants	315	…	…
Vials	315	…	…
6–11 years:			
Participants	719	489	850
Vials	1,299	489	1,513
12–19 years:			
Participants	1,899	1,200	1,995
Vials	16,732	1,200	3,393
20 and over:			
Participants	4,244	2,545	4,260
Vials	37,106	2,545	8,383
2005–2006			
3–5 years:			
Participants	302	…	…
Vials	302	…	…
6–11 years:			
Participants	789	845	935
Vials	2,773	845	935
12–19 years:			
Participants	1,884	1,859	1,899
Vials	16,534	1,859	1,899
20 and over:			
Participants	4,252	4,151	4,160
Vials	36,706	4,151	4,812
2007–2008			
3–5 years:			
Participants	329	…	…
Vials	1,269	…	…
6–11 years:			
Participants	866	864	526
Vials	5,190	864	526
12–19 years:			
Participants	955	967	532
Vials	9,815	967	532
20 and over:			
Participants	4,832	4,840	2,638
Vials	49,060	4,840	2,638

See footnotes at end of table.

Table II. Pristine serum, plasma, and urine specimens available, from NHANES 1999–2014 —Con.

Survey cycle, age group, and specimen source	Serum	Plasma	Urine
2009–2010			
3–5 years:			
Participants	347	…	…
Vials	772	…	…
6–11 years:			
Participants	811	869	973
Vials	1,003	869	1,111
12–19 years:			
Participants	1,008	1,020	1,062
Vials	4,618	1,020	1,246
20 and over:			
Participants	5,072	5,129	5,181
Vials	25,026	5,129	6,137
2011–2012			
3–5 years:			
Participants	259	…	…
Vials	461	…	…
6–11 years:			
Participants	749	…	958
Vials	1,350	…	1,901
12–19 years:			
Participants	916	…	990
Vials	3,327	…	1,968
20 and over:			
Participants	4,273	…	4,470
Vials	16,195	…	8,886
2013–2014			
3–5 years:			
Participants	334	…	…
Vials	651	…	…
6–11 years:			
Participants	852	…	934
Vials	1,688	…	1,719
12–19 years:			
Participants	1,026	…	1,085
Vials	4,013	…	2,000
20 and over:			
Participants	4,771	…	4,785
Vials	18,786	…	9,765

… Category not applicable.

NOTES: Specimens accessible for testing under approved protocols. Numbers are current based on data available at publication. Vials contain ≥0.2 ml.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Table III. Surplus serum, plasma, and urine specimens available, from NHANES 1999–2012

Survey cycle, age group, and specimen source	Serum	Plasma	Urine
1999–2000			
3–5 years:			
Participants	351	240	…
Vials	929	240	…
6–11 years:			
Participants	867	638	975
Vials	3,447	638	1,440
12–19 years:			
Participants	2,110	1,460	2,125
Vials	12,758	1,506	3,660
20 and over:			
Participants	4,173	3,663	4,242
Vials	21,767	5,529	7,582
2001–2002			
3–5 years:			
Participants	431	…	…
Vials	1,063	…	…
6–11 years:			
Participants	1,007	…	764
Vials	3,928	…	764
12–19 years:			
Participants	2,203	…	2,281
Vials	17,990	…	2,375
20 and over:			
Participants	4,835	2,960	4,492
Vials	36,743	3,200	4,925
2003–2004			
3–5 years:			
Participants	444	…	…
Vials	1,509	…	…
6–11 years:			
Participants	838	…	…
Vials	3,784	…	…
12–19 years:			
Participants	2,048	…	…
Vials	12,078	…	…
20 and over:			
Participants	4,473	…	…
Vials	22,587	…	…
2005–2006			
3–5 years:			
Participants	482	…	…
Vials	1,783	…	…
6–11 years:			
Participants	926	…	…
Vials	4,505	…	…
12–19 years:			
Participants	1,978	…	…
Vials	12,532	…	…
20 and over:			
Participants	4,490	…	…
Vials	29,248	…	…
2007–2008			
3–5 years:			
Participants	406	…	…
Vials	552	…	…
6–11 years:			
Participants	986	…	…
Vials	1,477	…	…
12–19 years:			
Participants	1,074	…	…
Vials	4,429	…	…
20 and over:			
Participants	5,342	…	…
Vials	24,888	…	…

See footnotes at end of table.

Table III. Surplus serum, plasma, and urine specimens available, from NHANES 1999–2012 —Con.

Survey cycle, age group, and specimen source	Serum	Plasma	Urine
2009–2010			
3–5 years:			
Participants	323	…	…
Vials	323	…	…
6–11 years:			
Participants	887	…	…
Vials	1,646	…	…
12–19 years:			
Participants	1,177	…	…
Vials	3,585	…	…
20 and over:			
Participants	5,708	…	…
Vials	19,105	…	…
2011–2012			
6–11 years:			
Participants	845	…	…
Vials	898	…	…
12–19 years:			
Participants	1,035	…	…
Vials	1,510	…	…
20 and over:			
Participants	4,605	…	…
Vials	6,759	…	…

… Category not applicable.

NOTES: Specimens accessible for testing under approved protocols. Numbers are current based on data available at publication. Vials contain ≥0.2 ml. Total number of surplus specimens (participants and vials) for 2013–2014 was not available at time of publication. Updates are available on the NHANES website at http://www.cdc.gov/nchs/nhanes.htm.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Table IV. Biospecimens available for participants aged 0–2 years, from NHANES 2003–2006

Specimen source[1]	Surplus serum
Participants	873
Vials	1,214

[1]Specimens only available for 4 years combined.

NOTE: Additional specimens for 2002 available by special request.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Table V. NHANES DNA specimens available

Survey cycle	Age group	Participants	DNA source
NHANES III	12 and over	7,159	Crude cell lysates
1999–2002	20 and over	7,839	Blood
2007–2008	20 and over	4,615	Blood
2009–2010	20 and over	3,898	Blood

NOTE: Total number of participants for 2011–2012 was not available at time of publication.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2015.

Appendix II. Glossary

Biorepository—A place where biologic specimens are stored and made available for research purposes.

Biospecimens—Materials taken from the human body.

CASPIR—Centers for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) Specimen Packaging, Inventory, and Repository for biospecimens.

Civilian noninstitutionalized population—Includes all people living in U.S. households and excludes those living in institutionalized group quarters and persons on active duty with the military.

DNA—Deoxyribonucleic acid, the hereditary material in humans and almost all other organisms.

Ethics Review Board—A committee within NCHS that performs ethical review of proposed research.

National Center for Health Statistics (NCHS)—The principal health statistics agency in the United States. NCHS compiles statistical information to help guide public health and health policy decisions to improve the health of the American people. It also designs, develops, and maintains a number of systems that produce data related to demographic and health concerns, including data on registered births and deaths collected through the National Vital Statistics System (NVSS), as well as data from the National Health Interview Survey (NHIS), the National Health and Nutrition Examination Survey (NHANES), the National Health Care Surveys (NHCS), and the National Survey of Family Growth (NSFG), among others. NCHS is part of the U.S. Department of Health and Human Services' Centers for Disease Control and Prevention.

Plasma—The pale yellow liquid component of nonclotted blood after the blood settles.

Pristine biospecimen—A biospecimen that, once frozen, has never been thawed.

Public-use data—An electronic data set containing participant records from a survey, with a subset of variables collected in the survey that have been reviewed by analysts within NCHS to ensure participant identity is protected.

Research Data Center (RDC)—An NCHS entity that provides researchers access to restricted data from NCHS surveys.

Restricted-use data—An electronic data set containing participant records from a survey that contain some information that may, if released to the public, risk disclosure of individual participants. These data are available through the NCHS RDC and include data sets with (a) data items that were collected for an odd number of calendar years (1, 3, or 5 years); (b) data linked geographically to some other contextual data file (often supplied by the data user); and (c) data items that are determined to be too sensitive or too detailed to be released to the public due to confidentiality restrictions.

Serum—The clear liquid portion of blood after it clots.

Surplus biospecimen—A biospecimen that was used for other laboratory tests and is now available for future research.

Urine—Waste material secreted by the kidneys.

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