

The PhenX Toolkit - make data sharing easier

NIEHS Data Sharing Workshop

Carol M. Hamilton, PhD
February 6, 2012

RTI International is a trade name of Research Triangle Institute

PhenX: consensus measures for Phenotypes and eXposures

- In September 2007, RTI International was awarded (via a Cooperative Agreement with NHGRI) this project to select and define high priority measures for Genome-wide association studies (GWAS)
- NHGRI recognized that the development of standard measures for use in GWAS would have significant impact on biomedical research – and decided to address the problem
- The development of a PhenX Toolkit is envisioned as a way to facilitate broad use of these measures by the research community

Standard Measures Needed

- **Multi-IC Symposia on Applying Genomics Technologies to Population Studies (2006)**

- **Recommendations:**

- Limited subsets of phenotypic and exposure data that are amenable to common definition and standardized collection in GWAS should be identified in near future
- Better methods for phenotyping (rigorous, standardized, inexpensive, non-invasive, limited burden, appropriate for asymptomatic individuals) are needed, particularly for phenotypes relevant to a wide variety of diseases and disabilities

- **Frontiers in Population Genomics (2007)**

- **Recommendations:**

- Identify a subgroup of phenotypes and exposures with strong genetic associations for standardization and addition to GWAS
- Support the review of phenotype and exposure data deposited in dbGaP to identify the most common measures and those that can be used in multiple studies.

PhenX Approach

- The approach was to select 15 high-priority measures for each of 21 research domains
 - Domains were selected by the PhenX Steering Committee
 - Measures and protocols were chosen by Working Groups which are assembled for each domain
 - Scientific community had the opportunity to review and comment on initial set of up to 25 measures for each domain
- Selected measures are made available to the research community via the PhenX Toolkit to facilitate future cross-study analysis
- Initial phase was launched in October 2008; all 21 domains were in the Toolkit in December 2010

PhenX - Building Consensus

- PhenX Steering Committee (SC)
 - Provides guidance to the project
 - Selects domains and define scope
- NIH Institutes and Centers (IC) Liaisons to SC
 - Provide expertise, outreach
- Expert Working Groups assembled for each domain
 - Refine the scope
 - Select specific measures and protocols
- Outreach to Scientific Community
 - Obtain comments for consideration by the Working Groups

PhenX Definitions

- **DOMAIN:** Topical area with a unifying theme (organ system, complex disease, lifestyle factors, etc.)
- **MEASURE:** Broadly refers to a certain characteristic of, or relating to, a study subject that you are interested in capturing data on
- **PROTOCOL:** standard procedure recommended by a Working Group for investigators to collect and record a PhenX measure

PhenX Definitions

- DOMAIN: Topical area with a unifying theme (organ system, complex disease, lifestyle factors, etc.)

Environmental Exposures

- MEASURE: Broadly refers to a certain characteristic of, or relating to, a study subject that you are interested in capturing data on

Air Contaminants in the Home Environment

- PROTOCOL: standard procedure recommended by a Working Group for investigators to collect and record a PhenX measure

Atmospheric and Environmental Research (AER) Inc.

PhenX Domains

- Alcohol, Tobacco, and Other Substances
- Anthropometrics
- Cancer
- Cardiovascular
- Demographics
- Diabetes
- Environmental Exposures
- Gastrointestinal
- Infectious Diseases and Immunity
- Neurology
- Nutrition and Dietary Supplements
- Ocular
- Oral Health
- Physical Activity and Physical Fitness
- Psychiatric
- Psychosocial
- Reproductive Health
- Respiratory
- Skin, Bone, Muscle, and Joint
- Social Environments
- Speech and Hearing

Welcome to the PhenX Toolkit

The Toolkit provides *standard* measures related to complex diseases, phenotypic traits and environmental exposures. Use of PhenX measures facilitates combining data from a variety of studies, and makes it easy for investigators to expand a study design beyond the primary research focus

Toolkit Users can:

- Search or Browse the Toolkit to review and select PhenX measures
- Generate Data Collection Worksheets and Data Dictionaries for Selected Measures

Information about the project is available at www.phenx.org

[More »](#)

Please Read Toolkit Guidance

Please cite use of the PhenX Toolkit:

Carol M. Hamilton; et al. (2011) The PhenX Toolkit: Get the Most From Your Measures. American Journal of Epidemiology 2011; doi: 10.1093/aje/kwr193.

Measures from the PhenX Toolkit version November 29 2011, Ver 4.6 (www.phenxtoolkit.org) were included in this study. PhenX (consensus measures of Phenotypes and eXposures) is supported by NHGRI award No. U01 HG004597.

[PhenX Toolkit Release Notes](#)

Please take a quick survey to tell us how we can improve the Toolkit.

There are a total of 295 measures in the PhenX Toolkit.

Top 5 Measures - Release 4.6

1. Current Age
2. Gender
3. Ethnicity
4. Race
5. Weight

[View Top 20 Measures](#)

Top 5 Domains - Release 4.6

1. Demographics
2. Anthropometrics
3. Alcohol, Tobacco and Other Substances
4. Cardiovascular
5. Environmental Exposures



Browse



Search



My Toolkit



Registration

Registration

You may [browse](#) the PhenX Toolkit, but to save your work, you need to [Register](#).

Existing users may login:

User ID:

Password:

[Forgot Password](#)

[Forgot User ID](#)

[Help With Login](#)



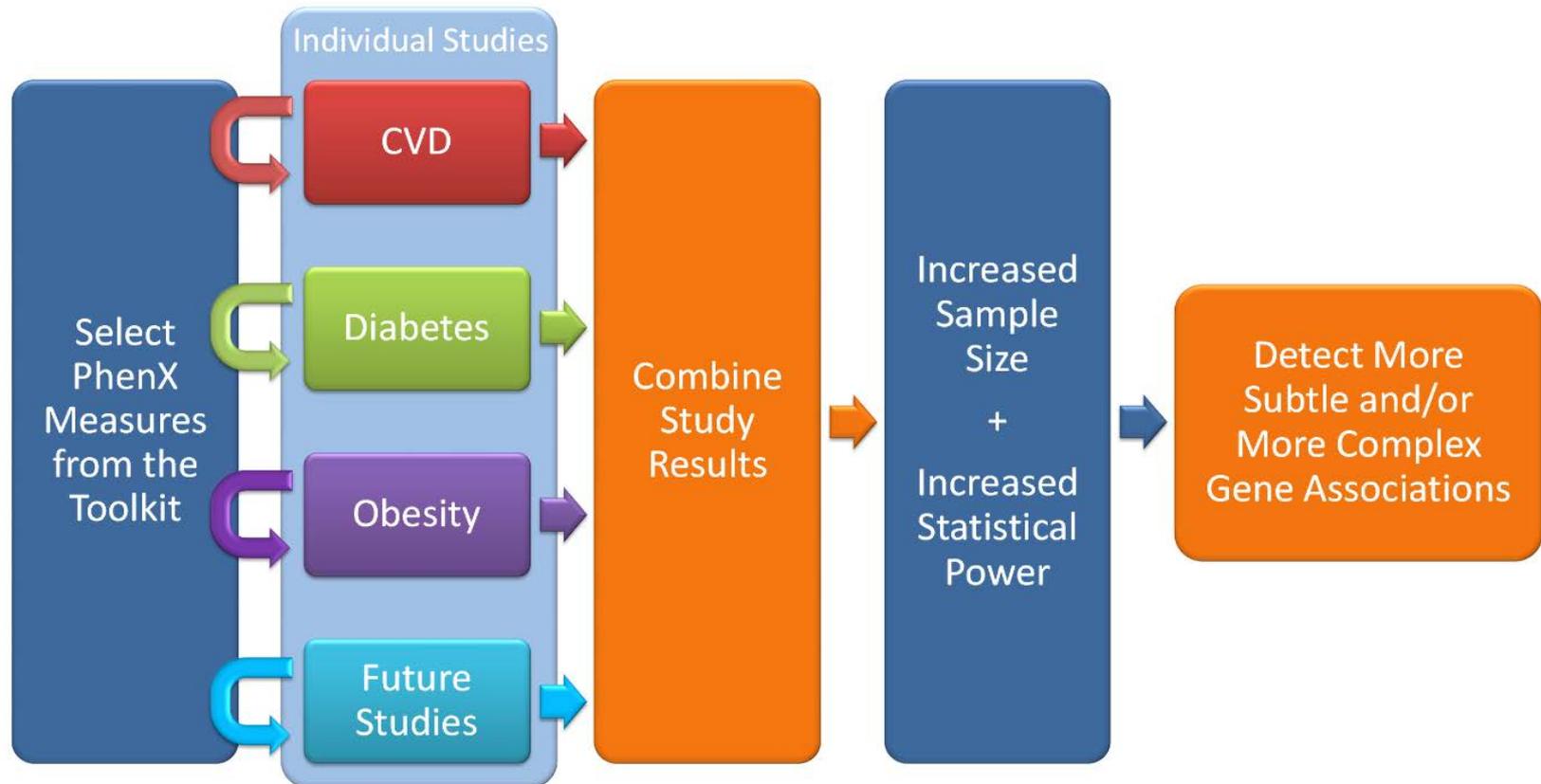
[PhenX Updates:](#)

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PhenX Toolkit

- Researchers will visit the Toolkit to:
 - Add standard measures to ongoing studies
 - Consider PhenX measures when planning new studies
 - Obtain high quality measures outside of their area of expertise
 - Review PhenX measures that relate to their primary research focus
- By selecting some of the PhenX measures:
 - Ensure that their study will be compatible with others that also incorporate PhenX measures
 - Combine studies to increase statistical power and the ability to identify genes associated with complex diseases
 - Potential to cumulatively combine with future studies

Facilitating Cross-Study Analysis



PhenX Toolkit Contents

- Recommended measures for each research domain
- Detailed protocols for collecting the measures
- Information about the measures
 - Rationale for inclusion
 - References
- User support
 - User's Manual, Data Dictionary, and Glossary of Terms
 - Quick Start Guide
 - Frequently Asked Questions (FAQs)
 - Derived Variables
 - Cancer Bioinformatics Grid (caBIG) Common Data Elements (CDEs)
 - Supplemental Information

Toolkit Features

- Users can Search or Browse Measures
 - Browse by domain or collection
 - Search using “Smart Query Tool”
- Users choose Measures and add them to “My Toolkit”
 - Alerts Users to add “essential measures” (additional PhenX measures that are needed to effectively interpret the data)
 - Recommends related measures
 - Registration allows users to save and share multiple Toolkits
- Users can generate Reports
 - Download, review, print or save
 - Registered users can add notes to measures, and protocols
- Integrating PhenX Measures
 - Data Collection Worksheet
 - Data Dictionary (variable names and characteristics)

Browse Measures

 Show Tree

Browse through Measures to view Protocols.

Browse » [Domains](#) »

◀ **DOMAIN:** Environmental Exposures #060000 ▶

Release Date: October 30, 2009

[View scope of domain](#) »

[View Supplemental Information](#) » 

[View Working Group Roster](#) »

- | | |
|---|---|
| <input type="checkbox"/> Add to My Toolkit #061100 Air Contaminants in the Home Environment » | <input type="checkbox"/> Add to My Toolkit #061000 History of Being Breast Fed » |
| <input type="checkbox"/> Add to My Toolkit #060100 Characteristics of Current Residence » | <input type="checkbox"/> Add to My Toolkit #060500 Occupation/Occupational History » |
| <input type="checkbox"/> Add to My Toolkit #060700 Current Environmental Tobacco Smoke Exposure » | <input type="checkbox"/> Add to My Toolkit #061400 Plastic Exposures at Work and Home » |
| <input type="checkbox"/> Add to My Toolkit #060900 Day Care/Preschool Attendance » | <input type="checkbox"/> Add to My Toolkit #060300 Residential History » |



Protocol Overview

Show Tree

[Browse](#) » [Domains](#) » [Physical Activity and Physical Fitness](#) » [Cardiorespiratory Fitness - Exercise Test Estimate](#) » [Card \[One Mile Walk\]](#)

Note: Some Protocols contain images. You may click the thumbnails to preview the full image. To print Protocols with full size images, please [a Report](#).

CARDIORESPIRATORY FITNESS-EXERCISE TEST ESTIMATE [ONE MILE WALK] #150101

Jump to section:



Show Summary

Protocol Release Date

May 12, 2010

Description of Protocol

The participant is asked to complete a one-mile walk test as quickly as possible on a track. A technician utilizes a stopwatch to rate monitor that records h/her heart rate continuously through the test. After the test is completed the technician records the test. In addition, the participant's age, sex, and body weight are needed to complete an equation to determine maximal oxygen

Specific Instructions

Protocol Text

Track or pre-measured one-mile distance

Protocol Overview

[Show Tree](#)

[Browse](#) » [Domains](#) » [Physical Activity and Physical Fitness](#) » [Cardiorespiratory Fitness - Exercise Test Estimate](#) » [Cardiorespiratory Fitness-Exercise Test Estimate \[One Mile Walk\]](#)

Note: Some Protocols contain images. You may click the thumbnails to preview the full image. To print Protocols with full size images, please add those Protocols to your Toolkit and Generate a Report.

CARDIORESPIRATORY FITNESS-EXERCISE TEST ESTIMATE [ONE MILE WALK] #150101

Jump to section:

- Jump to section:
- Description of Protocol
- Special Instructions
- Protocol Text
- Protocol Release Date
- Selection Rationale
- Source
- Personnel and Training Required
- Equipment Needs
- Standards
- General References
- Protocol Type
- Derived Variables
- Requirements

Track or pre-measured one-mile distance

Searching the Toolkit

- There is some overlap between the 21 research domains
- For example, not all “tobacco” related measures are in the ATOS domain; not all diabetes related measures are in the Diabetes domain
- Each WGs reviewed the measures already in the Toolkit before proceeding, but this became more complicated as more domains were completed
- The Search features of the Toolkit make it easy for users to find measures of interest from any domain in the Toolkit

PhenX Smart Query Tool

- Search with Filters
 - Filter search results using protocol characteristics (Data Collection Mode, Lifestage, Time to Complete, and Language)
- Smart Search
 - Searches through measure names, aliases, and keywords; high specificity
- Text Search
 - Searches through full text of measures and protocols; high sensitivity
- Supplemental Information
 - Searchable in the full-text search only

Smart Query Tool

Enter search term or PhenX ID:

Show results per page

Search with Filters: To filter results by the following parameters, please identify desired types of measures by clicking the filter name.

The filters are: Data Collection Mode, Lifestage, Time to Complete and Language.

If no boxes are checked, then search results will reflect all Toolkit contents.

Data Collection Mode

- Interviewer-administered questionnaire
- Self-administered questionnaire
- Physical Measurement
- Bioassay
- Clinical Examination
- Medical records abstraction
- Secondary Data Analysis

Lifestage

- Infant
- Toddler
- Child
- Adolescent
- Adult
- Senior
- Pregnancy

Time to Complete

- <=15 minutes
- >15 minutes

Language

- English
- Spanish
- Other

9 search results in terms and synonyms for "alcohol", 0 supplemental (27 filtered -hide filters):

Search result 1 - 9 of 9 results

<input type="checkbox"/> PhenX Measure	Definition	Domain/Collection Name
<input type="checkbox"/> Expectancies - Alcohol, Tobacco, and Other Substances	Instruments used separately to assess expectations of the positive and negative effects of drinking alcohol, smoking cigarettes, using marijuana, using illegal stimulant drugs, or misusing prescription stimulant drugs.	Substance-specific Intermediate Phenotypes
<input type="checkbox"/> Alcohol - 30-Day Quantity and Frequency	Questions asking the respondent about quantity and frequency of alcohol consumption during the past 30 days.	Alcohol, Tobacco and Other Substances

Smart Query Tool

Enter search term or PhenX ID:

Show results per page

Search with Filters: To filter results by the following parameters, please identify desired types of measures by clicking the filter name. The filters are: Data Collection Mode, Lifestage, Time to Complete and Language. If no boxes are checked, then search results will reflect all Toolkit contents.

Data Collection Mode

Lifestage

Time to Complete

Language

36 search results in terms and synonyms for "alcohol", 0 supplemental (0 filtered - view filters):

Search result 1 - 10 of 36 results

<input type="checkbox"/> PhenX Measure	Definition	Domain/Collection Name
<input type="checkbox"/> Expectancies - Alcohol, Tobacco, and Other Substances	Instruments used separately to assess expectations of the positive and negative effects of drinking alcohol, smoking cigarettes, using marijuana, using illegal stimulant drugs, or misusing prescription stimulant drugs.	<input checked="" type="checkbox"/> Substance-specific Intermediate Phenotypes
<input type="checkbox"/> Cumulative Lifetime Alcohol Exposure	Measure to determine total lifetime alcohol use	Cancer
<input type="checkbox"/> Motives - Alcohol, Tobacco, and Other Substances	Instruments used separately to assess the motives (reasons) for drinking alcohol, smoking cigarettes, or using drugs.	<input checked="" type="checkbox"/> Substance-specific Intermediate Phenotypes
<input type="checkbox"/> Perceived Availability of Illegal Drugs and Alcohol	Instrument used to gather respondents' perceptions of the availability of substances including illegal drugs and alcohol.	<input checked="" type="checkbox"/> Substance Use-related Community Factors
<input type="checkbox"/> Unmet Need for Alcohol or Drug Treatment	A measure of the treatment needs, service utilizations, and barriers of alcohol and drug treatment, based on data from the National Survey on Drug Use and Health (NSDUH).	<input checked="" type="checkbox"/> Substance Use-related Community Factors

Statistics-Based Recommendations

My Toolkit

Show Tree

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[Download Data Collection Worksheet](#)

[Download Data Dictionary](#)

USERS WHO CHOSE THIS MEASURE ALSO CHOSE:

- [Add to My Toolkit](#) Sudden Cardiac Arrest (Cardiovascular)
- [Add to My Toolkit](#) Family History of Heart Attack (Cardiovascular)
- [Add to My Toolkit](#) Blood Pressure (Adult/Primary) (Cardiovascular)
- [Add to My Toolkit](#) Angina (Cardiovascular)
- [Add to My Toolkit](#) Lipid Profile (Cardiovascular)

Empty My Toolkit

Measure	Protocol	Requirements?	Essential Measures?
<input checked="" type="checkbox"/> Current Age Find related measures »	Current Age		
<input checked="" type="checkbox"/> Gender Find related measures »	Gender		
<input checked="" type="checkbox"/> Myocardial Infarction Find related measures »	Myocardial Infarction	<input type="checkbox"/>	<input checked="" type="checkbox"/> Current Age <input checked="" type="checkbox"/> Gender

✓ All Essential Measures have been added to your Toolkit

You must click on to review Special Requirements.

[Download Report](#)

[Download Data Collection Worksheet](#)

[Download Data Dictionary](#)

[Share this Toolkit](#)

<https://www.phenxtoolkit.org/index.php?pageLink=browse.measures>

Data Sharing and Data Interoperability

Collaborations:

- National Library of Medicine (NLM)
 - National Center for Biotechnology Information (NCBI) database of Genotypes and Phenotypes dbGaP
 - Logical Observation Identifiers Names and Codes (LOINC)
- Cancer Data Standards Registry and Repository (caDSR) Common Data Element (CDE) at cancer Biomedical Informatics Grid (caBIG)
- electronic Medical Records & Genomics (eMERGE) network
- Public Population Project in Genomics (P3G) Data Schema and Harmonization Platform for Epidemiological Research (DataSHaPER)

Collaboration with dbGaP

- Highlight PhenX measure for variables in dbGaP



Variable mapped to PhenX measure can be flagged

Clinical Variable	Dataset	Variable Description	PhenX Measure	Variable ID
HBP_SBHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa02L1_2_trans GenADA CSA0211 Medical History	HIGH BLOOD PRESSURE: Subject History of disease		phv00081405.v1.p1
HBP_FAMHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa02L1_2_trans GenADA CSA0211 Medical History	HIGH BLOOD PRESSURE: Family History of disease		phv00081406.v1.p1
HBP_FAMNO GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa02L1_2_trans GenADA CSA0211 Medical History	HIGH BLOOD PRESSURE: Number of family members with history of disease		phv00081407.v1.p1
HBP_SBHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa04L1_trans GenADA CSA0411 Medical History	HIGH BLOOD PRESSURE: Subject History of disease		phv00081536.v1.p1
HBP_FAMHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa04L1_trans GenADA CSA0411 Medical History	HIGH BLOOD PRESSURE: Family History of disease		phv00081537.v1.p1
HBP_FAMNO GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa04L1_trans GenADA CSA0411 Medical History	HIGH BLOOD PRESSURE: Number of family members with history of disease		phv00081538.v1.p1
HBP_SBHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa06_trans GenADA CSA06 Medical History	HIGH BLOOD PRESSURE: Subject history of disease		phv00081683.v1.p1
HBP_FAMHS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa06_trans GenADA CSA06 Medical History	HIGH BLOOD PRESSURE: Family history of disease		phv00081684.v1.p1
HBP_FAMNO GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_csa06_trans GenADA CSA06 Medical History	HIGH BLOOD PRESSURE: Number of family members with history of disease		phv00081685.v1.p1
BPD GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_vitl GenADA Vital Signs - Measurements	Diastolic Blood Pressure		phv00082599.v1.p1
BPS GenADA/LONG/Imaging (Genetic Alzheimer's Disease Associations)	d_vitl GenADA Vital Signs - Measurements	Systolic Blood Pressure		phv00082600.v1.p1

Toolkit Use Summary

(www.phenxtoolkit.org December 2011)

Number of Visits:	259,077
Number of Unique Visits: (by unique IP address)	52,992
Total Page Views:	1,072,785
Average Number Visits Per Day:	223
Total # of Countries with Toolkit Accesses:	146
Number of Registered Users:	696

PhenX – more

- NIDA is currently sponsoring a one year Administrative Supplement to expand the Toolkit to support NIDA research
 - Envision product as one “Core” collection of measures and six “Specialty” collections of measures
 - Core measures would be suitable for all NIDA investigators, Specialty measures would be included as appropriate
- NHGRI – OBRRS Administrative Supplement to incorporate PhenX measures (for NIH funded projects)
 - PhenX RISING, Real World Implementation, and SharING

Substance Abuse and Addiction (SAA) Collections

- coming soon, Feb 24

- **Core Collections**
 - Core: Tier 1
 - Core: Tier 2
- **Specialty Collection**
 - 1. Assessment of Substance Use and Substance Use Disorders
 - 2. Substance-specific Intermediate Phenotypes
 - 3. Substance Use-related Neurobehavioral and Cognitive Risk Factors
 - 4. Substance Use-related Psychosocial Risk Factors
 - 5. Substance Use-related Community Factors
 - 6. Substance Use-related Co-morbidities and Health-related Outcomes

Presenting SAA measures in the Toolkit



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Quick Start

QuickStart



Tutorial

NEW!



Substance Abuse and Addiction



Welcome to the PhenX Toolkit

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Browse



Search



My Toolkit



Registration

Registration

You may browse the PhenX Toolkit, but to save your work, you need to Register.

Existing users may login:

User ID:

Password:

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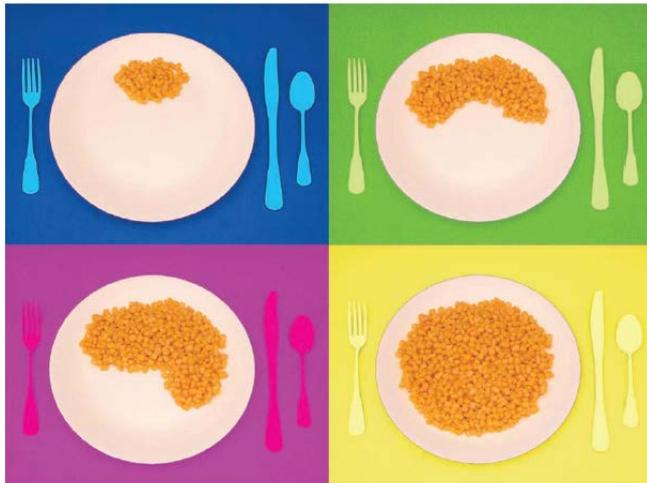


PI/Institution	Study Name	NIH IC	Phenotype
Allison Aiello, Ph.D., University of Michigan	Ecologic Stressors, Post-Traumatic Stress Disorder, and Drug Use in Detroit	NIDA	PTSD co-morbidities; illicit drug use and coronary artery disease
Robert Bilder, Ph.D., UCLA	Human Translational Applications Core	NIMH	Neuropsychiatric and cognitive phenotypes
Terry Jernigan, Ph.D., UCSD	Creating a Pediatric Imaging-Genomics Data Resource	NIDA	Young adult risk and substance abuse behaviors; public pediatric imaging genomics db
Catherine McCarty, Ph.D., Essentia Institute of Rural Health	Genome-Wide Study of Cataract and Low HDL in Personalized Medicine Research Project	NHGRI	Cataract and HDL levels
Dharambir Sanghera, Ph.D., University of Oklahoma	Genome-Wide Association Scan to Identify Risk Genes for Type 2 Diabetes in Asian Indians	NIDDK	Type 2 diabetes and cardiovascular disease complications
Timothy Strauman, Ph.D., and Ahmad Hariri, Ph.D., Duke University	Self-Regulation Failure: Identifying and Modifying a Risk Phenotype	NIDA	Environmental influences on genes, brains, and behavior. Also includes MRI imaging
Zeng Yi, Ph.D., Duke University	Determinants of Healthy Longevity in China	NIA	Health and survival at old ages

PhenX Measures – Early Adopters

- NEIGHBOR Consortium (NEI funded)
- Gulf Long-Term Follow-up Study (GuLF STUDY) (NIEHS funded)
- Children’s Health after the Storm (CHATS)
(CDC funded)
- Ethnic/Racial Variations of Intracerebral Hemorrhage (ERICH)
(NINDS funded)
- North American Pancreatitis Study 2 Continuation and Validation
(NAPS2-CV) (NIDDK funded)
- GARM II: A Study on the Genetics of Age-related Maculopathy (NEI
funded)

Measuring Exposures



EVERY BITE YOU TAKE

high-tech gadgets to measure the human 'exposome'

Brandon Borrell,
Nature Vol 270, 17 Feb 2011

The Economist

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How to collect data on asthma while, at the same time, treating it

Apr 7th 2011 | from the print edition

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IN 1985 and 1986 an epidemic of asthma hit Barcelona. The city's researchers first turned to the usual suspects, such as air pollution, pollen and mould. But a series of telephone interviews with the sufferers pointed to a much more precise cause. All the attacks had occurred by the harbour, and at times when ships were unloading soya beans. The cause was clear: soya-bean dust. So was the solution: the installation of filters on the harbour's silos.

Asthma is one of the world's most common chronic diseases. It affects about 300m people (almost 5% of the population). Yet what triggers any given asthma attack is often unclear and, as a consequence, most asthmatics are not properly treated. Stories of success, like that of Barcelona.

Asthmapolis

Big Doctor is watching you

Resources

- www.phenx.org
 - Register to receive periodic updates via e-mail of the PhenX Newsletter and notification of new surveys
- www.phenxtoolkit.org
 - Additional measures and protocols will be included in the toolkit as they become available
- www.genome.gov/gwastudies/
 - A catalog of published Genome-Wide Association Studies (Hindorff et al. PNAS 2009)

Acknowledgements

- NHGRI
 - **Erin Ramos (Project Scientist)**
 - Heather Junkins (Project Analyst)
 - Teri Manolio
- SC Members (12)
 - **Jonathan Haines, Chair**
 - **Bill Harlan, Vice-Chair**
- WG Chairs / Members
- SSP (Advisory Panel for NIDA funded Substance Abuse and Addiction Supplement)
- IC Liaisons
- dbGaP
 - Kim Tryka
 - Jayashri Mehta
 - Steve Sherry
- LOINC
 - Clem McDonald
 - Daniel Vreeman
- P3G
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 - Paul Burton
- eMERGE
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- RTI Team
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 - Dana Hancock
 - Jane Hammond
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 - Wayne Huggins
 - Dean Jackman
 - Richard Kwok (NIEHS)
 - Debbie Maiese
 - Destiney Nettles
 - Helen Pan
 - WG Managers
 - Toolkit team
 - XC team
 - Communications team
 - Logistics team