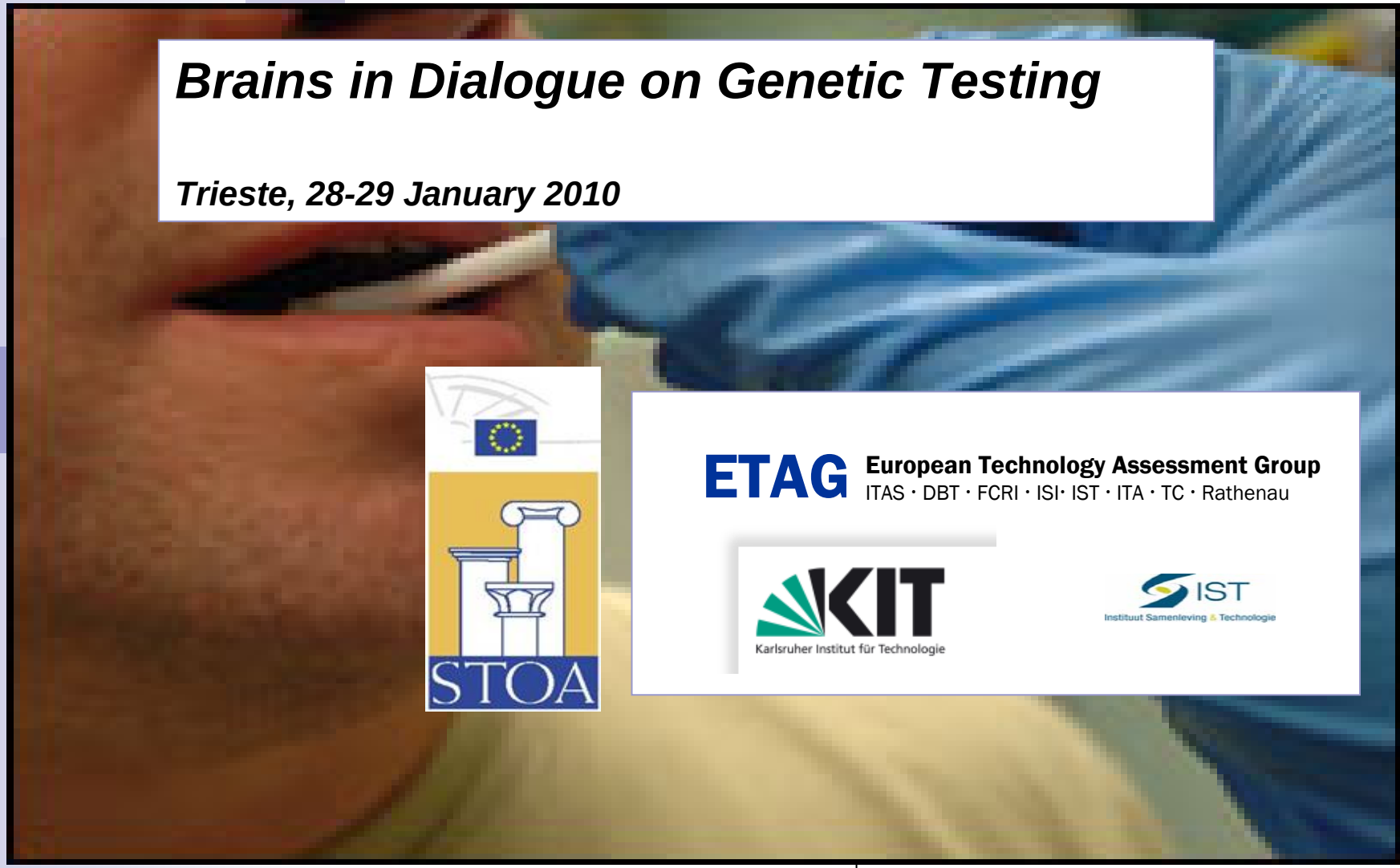
“Send your saliva sample and know your fate”

Dr. Leonhard Hennen, KIT/ITAS



Direct to Consumer Genetic Testing (DCGT)

(L. Hennen, E. v. d. Cruyce, A. Sauter)

STOA Project

(November 2007 – November 2008)

- Literature and Document Analysis
- Expert Consultations
- Internet Survey

Karlsruher Institut für Technologie

ETAG

European Technology Assessment Group

ITAS · DBT · IST · POST · Rathenau

Genetic Testing - in the realm of the medical sector

- Genetic testing based on DNA entered medical practice in the mid 1980ies
- Tests available mainly for a restricted number of relatively rare Mendelian diseases
- Offers of genetic testing and counselling restricted to medical experts working mainly at university hospitals
- Self regulated practice – ethical guidelines, professional standards (informed consent, genetic counselling, validity of tests, tests only for medical purposes)

Predictive Character of Genetic Testing

- Detection of disposition or risk for developing a disease before the disease's onset
- Can provide security about whether or not being carrier of a genetic trait for an hereditary disease (monogenetic disease)
- In case no therapy option is at hand predictive testing may imply a burden to the quality of life and may not be welcome (right not to know)
- Testing for complex (common diseases) can only indicate an (above average) risk (probability) for developing a disease (with ambiguous value for the patient)

Guidelines for Genetic Testing and Counselling

- Informed Consent
  Free choice for or against testing
  Right not to know
  Genetic counselling before and after testing
- Clinical validity and Utility of Tests
  professional self control, public health insurance,
  approval of tests by public authority
- Privacy and Data protection
  test results not available for third parties (e.g. employers)
- Health Purpose
  exclude application of tests for non medical purposes (sex selection)
- Quality Assurance
  tests have to be performed under supervision by a doctor,
  Qualification of laboratory and counselling staff

Genetic Testing – Recent Trends

- More and more gene **tests for common diseases** and susceptibilities are available (cancer; cardiovascular diseases). Genetic Testing becomes an interesting business option.
- Technical developments (DNA microarrays) **reduce the technical and financial barriers** for a private market for genetic testing.
- Genetic testing is about to become an **integrated part of preventive medicine in general**. With “pharmacogenetics” and “nutrigenomics” a new market becomes visible.

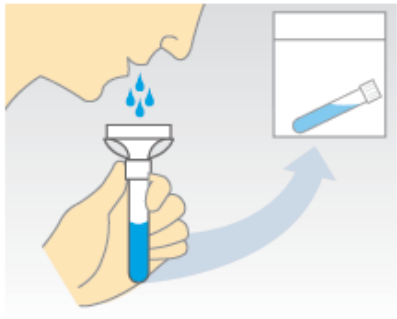
DCGT – a new business model

- Advertising and offering genetic testing direct to consumers, mainly via internet
- DNA specimen (cheek swab) is taken at home by the client and send for analysis to DCGT company
- Test result together with recommendations is send to the consumer directly
- ***No direct patient-doctor consultation at all, or only recommendation to consult a doctor***

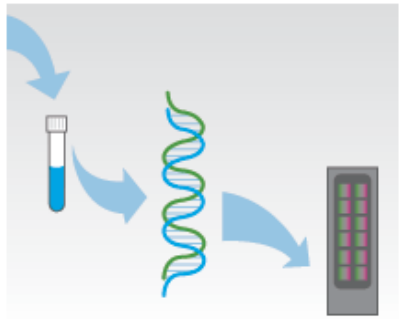
Get the latest on your DNA with $399 and a tube of saliva.

Here's what you do:

1. Order a kit ($399 USD) from our online store.



2. Claim your kit, spit into the tube, and send it to the lab.



3. Our CLIA-certified lab analyzes your DNA in approximately 10 weeks.

4. Log in and start exploring your genome.

Our high-density, custom genome scan includes:

Health and Traits

Discover how your genes affect your health. Get information on 90+ traits and diseases. New additions each month!

- See the complete list of traits and diseases we cover.

Ancestry

See your personal history through a new lens with detailed information about your ancient ancestors and comparisons to global populations today.

buy $399 USD

try a demo

Frequently Asked Questions

- How does 23andMe genotype my DNA?
- Why can't 23andMe diagnose me?
- What is the difference between genotyping and sequencing?

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deCODE your health

Calculate genetic risk – Empower prevention
your genes are a road-map to better health

Discover your ancestral roots
your genetic relationship to world populations

Introductory price from $100

Go To Store

News > Discussing Genetic Risk Testing on Martha Stewart Show

"Empowered by a greater understanding... I have become even more proactive about prevention"
Anna Peterson, deCODEme customer

» read our customer stories

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Complete Scan

Discover your Genetic risk for 37 diseases and traits ranging from Heart Attack and Diabetes to Alcohol Flush Reaction.

» our Complete Scan

NEW

deCODEme
Cardio Scan

February is American Heart Month. Discover your genetic risk for the most common types of cardiovascular diseases.

Cardiovascular Diseases

» our Cardio Scan

NEW

deCODEme
Cancer Scan

Calculate your genetic risk for six common cancers including Lung Cancer, Skin Cancer, Breast Cancer and Prostate Cancer.

» our Cancer Scan

Scientific leadership
deCODE leads the field in the discovery of genetic variants for common diseases

» deCODE's scientific discoveries

Accuracy and reliability
We capture more medically relevant genetic variants than our competitors

» compare our genetic scans

RSS News from our blog > Map of Kinship - An exciting new ancestry feature in deCODEme

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Personal Genetic Health™

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Get Started with a Personal DNA Analysis

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› Partner Login › Become A Partner

The Suracell Program brings you optimal genetic health to help you look and feel your best

The foundation of the Suracell program is described in The Gene Makeover, the best-selling book from age management pioneer Vincent Giampapa, MD, FACS, with Frederick Buechel, MD, FACS and Ohan Karatoprak, MD

VeriSign

eHealth reviewed by TRUSTe site privacy statement

Core Nutrition: Essential Genetic Formula

A daily dense nutrition formula that combines over 70 essential nutrients with Uncaria tomentosa, a rainforest botanical that interacts with the body's own natural DNA Repair processes.

› LEARN MORE

Essential Genetic Formula: AM / PM

Repair: Personal Genetic Formulations

A personalized protocol of nutraceutical formulations designed to interact with five cellular processes that are key to wellness and aging: methylation, inflammation, glycation, oxidation and DNA repair.

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Select a specific product

Science: Personal DNA Analysis

The Suracell personal DNA Analysis program combines your Suracell test results with the answers to your health and lifestyle questionnaire, to create your personalized nutraceutical regimen.

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Get Started with a Personal DNA Analysis

› Place Order › Register A Test › Access Test Results

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See your genes in a whole new light.

TIME Magazine's 2008 Invention of the Year, now $399.

How it works | Buy US $399 | Try a demo

Just got your kit?

Click to claim your kit

Already have an account?

Login name

Password

Login

Forgot password?

News: SNPwatch: Two Gene Variations Linked to Thyroid Cancer

Health and Traits

Ancestry

Sharing and Community

Research

Problems associated with DCGT

- The proper procedures to ensure “informed consent” of the client can not be assured via internet. Counselling before and after the test is needed because of complexity of information involved and possible serious consequences for the client.
- Lack of evidence for clinical validity/utility of tests offered (SNPs): misleading information and harm to clients possible

nature

www.nature.com/nature

Vol 456 | Issue no. 7218 | 6 November 2008

My genome. So what?

Research is needed into the way individuals use their genomic information, and into protection from its abuse by others.

Human genome research has proved itself predictably unpredictable. As was widely anticipated, the speed of sequencing has escalated, the pace of linking genes to disease has quickened, and practically anyone can have their genome investigated and fed back to them in electronic format to do with it what they will. In this issue, two groups reveal individual genome sequences of a Yoruba man from Ibadan, Nigeria (see page 53), and of a Han Chinese individual (see page 60) for a cost of less than US$500,000 each — a fraction of that of the human genome's first drafts or subsequently published editions.

The age of personal genomes is here. What many promoters of genomics did not predict are the challenges that individuals face in using this information. One is the limited extent to which the genetic constitution revealed says anything about future health. The predictive value of genetic associations has fallen short of some expectations, often in dramatic ways (see page 18), and fails to augment in any meaningful way more traditional predictors for health, such as lifestyle and family history.

Another largely unpredicted outcome were the private companies that sprang up to capitalize on these genetic clues, selling individuals genotype information and predictions about health based on the incomplete information available. Yet more services are now springing up to help people make sense of the data (see page 11). It's obvious that this genetic fortune-telling will be murky and inconclusive for many years to come. What is not clear is how people will act on it. However questionably, these companies are blazing a trail that could provide insight into ways in which people interact with these sensitive personal data. Researchers should look for more ways to investigate these consumer interactions from the perspective of public health, social sciences and potential biomedical applications.

One predicted outcome of human genome sequencing was the stocking of the drained pipelines of pharmaceutical companies with drug targets in the hope of ultimately developing cures for common afflictions. Although there have been some rousing signs of success, the refrain is that the complexity of the problem requires more data and more research (see page 26). Personal genomes may have a useful role: more human sequences complete with thorough medical histories and information about the environments in which the individuals grew up and lived will be the richest source of data to understand the genetic underpinnings of disease.

But making such information easily available to researchers has predictably challenged valued principles of privacy. Current protection for research subjects is inadequate in this respect (see page 32). In the United States, the Genetic Information Nondiscrimination Act of 2008 provides safeguards against discrimination by employers and health-insurance companies but does not protect against other potential misuse, including intrusion by law-enforcement agencies. Anonymizing data is not the answer, as re-identification of anonymous data can be easy. And researchers' discretion cannot be relied on.

Notions of privacy are changing — many people seem quite willing to share information about their genomes and medical histories. But researchers could make better use of available ways of protecting the privacy of their research subjects. Certificates of confidentiality in the United States give researchers the right to refuse disclosure to any civil authority of any information that could identify a subject, and are one example of a possibly underused protection. Researchers need to collaborate with social scientists, legal experts and regulators to improve on such models, both for the current challenges to privacy that personal genomes pose and for challenges that have yet to present themselves. We can't predict everything that will happen next, but we can be prepared. ■

For podcast and more online extras see www.nature.com/nature/focus/personal genomes/index.html

Doubts about validity of gene tests for common diseases based on genome wide association studies

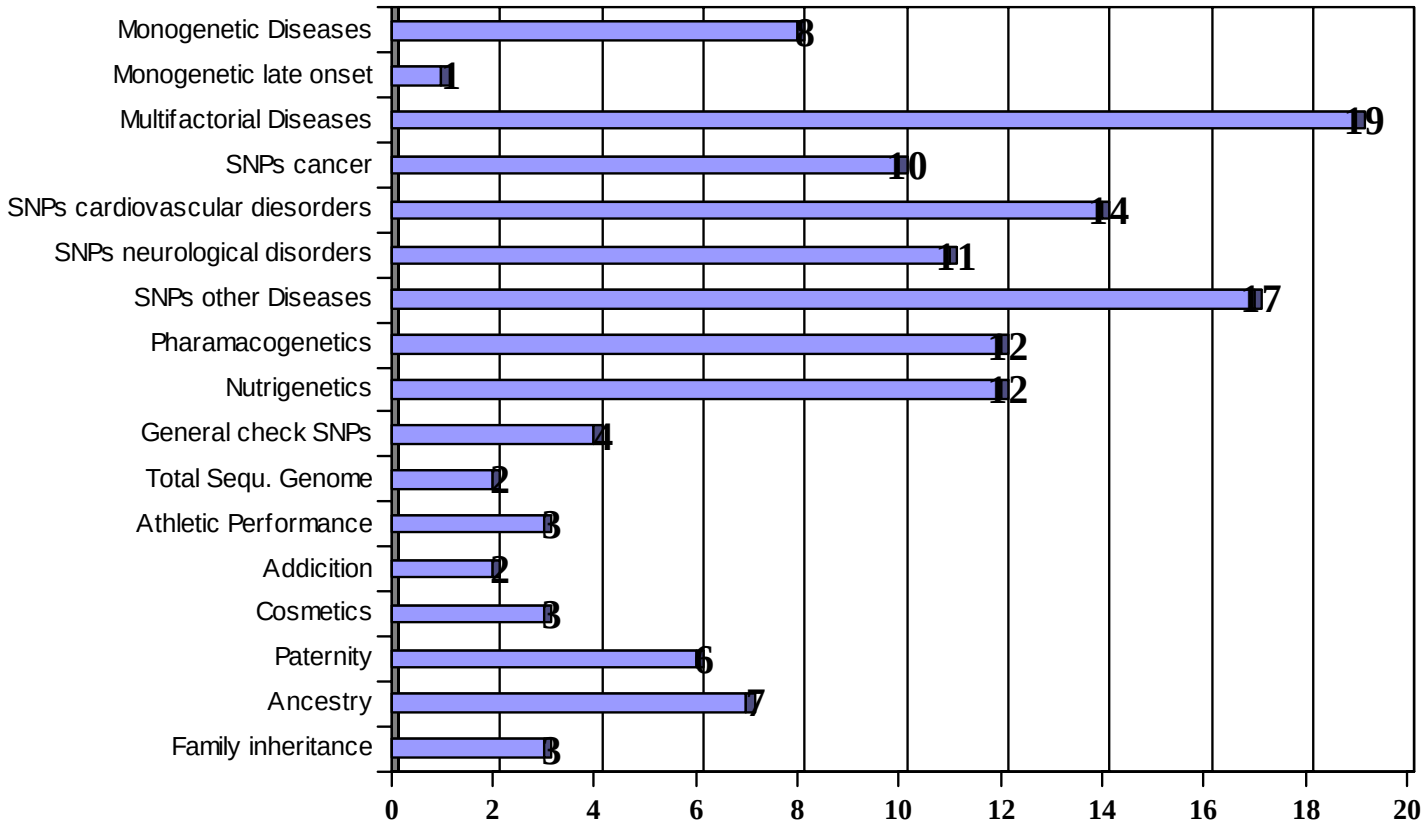
"The age of personal genomes is here. What many promoters of genomics did not predict are the challenges that individuals face in using this information. One is the limited extend to which the genetic constitution revealed says anything about future health. The predictive value of genetic association has fallen short of some expectations, often in dramatic ways, and fails to augment in any meaningful way more traditional predictors of health, such as lifestyle and family history."

Editorial, Nature, 6 November 2008

Internet Survey

- Conducted in Summer 2008
- 38 DCGT offering health related and “life style” testing (32 based in the U.S., 5 in Europe)
- Assessment of web pages with regard to
  - Company data
  - Type of offers
  - Testing procedure (testing and counselling)
  - Quality of Information offered to clients

Types of tests offered



Testing Procedure and Submission of Results

- 33% offer a test kit to be used under supervision of a doctor
- 76%: Submission of result online/by E-mail
- 41%: Submission of result without the option of consulting an expert
- **19% (7 websites): Submission of result with consultation as a mandatory part of the process**

Information about the validity and utility of tests

- Analytical validity: 14

  (accuracy, reliability to identify the genotype of interest)

- Clinical validity: 9

  (Accuracy in detecting or predict the associated disorder)

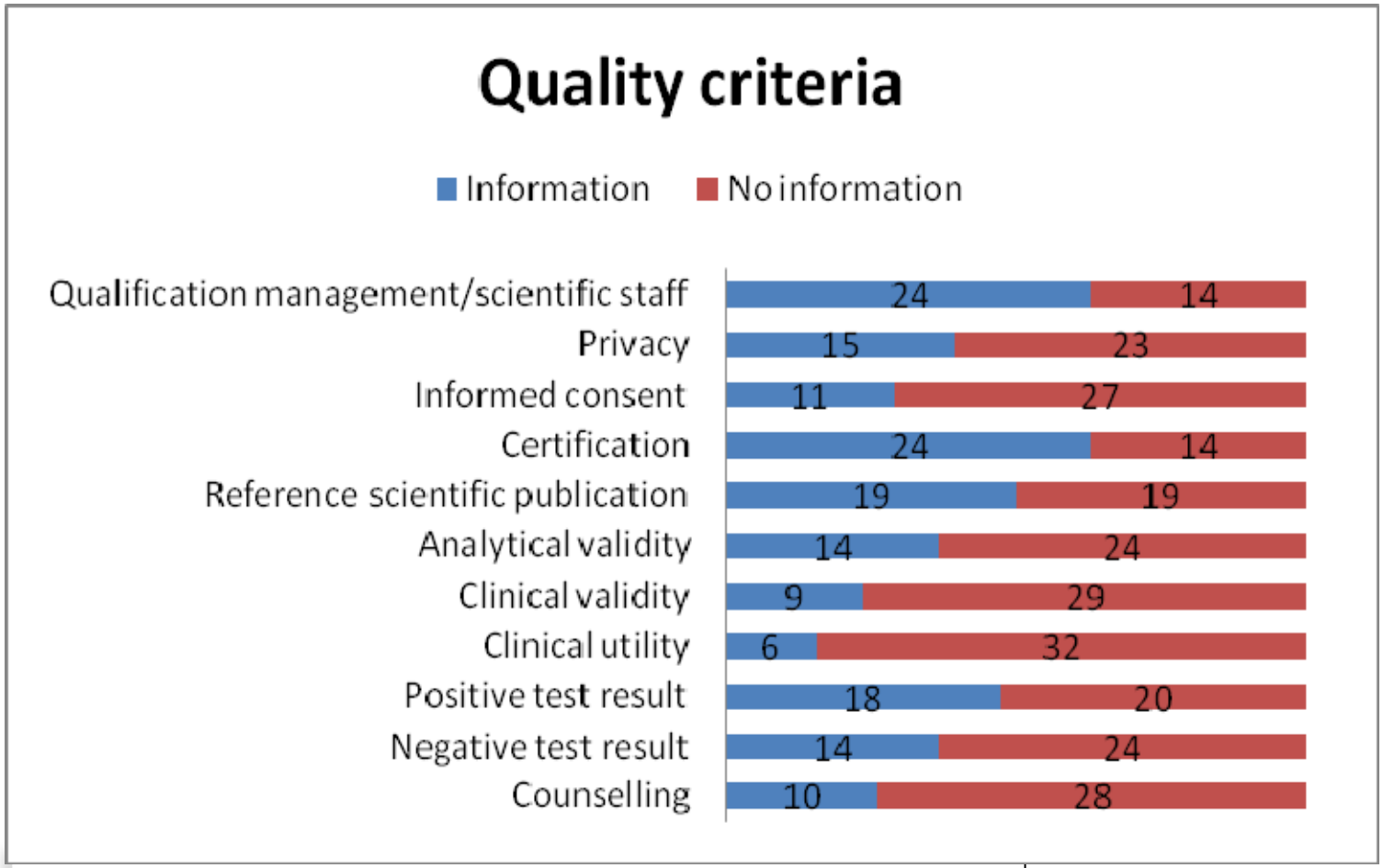
- Clinical utility: 6

  (usefulness for the patient, likelihood that the use of the test will lead to an improved outcome for the patient)

Information about Genetic Counselling

- **10 out of 38 companies mention on their websites that they offer counselling**
- 19 companies do not offer counselling
- 4 websites are not clear.
- 5 websites give no information on this topic.

Assessment of Website information with 11 Qual. Criteria



Quality Assessment

- One website complied with 11 of the criteria
- Only a quarter (9/38) of websites complied with at least 7 criteria
- **More than half of the websites (21/38) complied with only 4 or less criteria**
- 8 websites complied with only 2 or fewer of the 12 criteria

Need for regulation?

- Poor scientific evidence of clinical validity and usefulness of tests (for common diseases and lifestyle purposes)
- Bad quality of information provided at websites, danger of customers being mislead
  (GAO 2006: “Tests purchased at 4 websites mislead consumers”)
- It is doubtful to what extend (or whether at all) individual counselling that is needed to assure “informed consent” can be provided via websites or e-mail communication

Reactions by Public Authorities

- ***Human Genetics Commission***, U.K.: Report on DCGT in 2003, follow up report in 2007, ongoing efforts to establish a code of practice
- Intervention in the market by Departments of Public Health in ***California and New York***: Letters to companies complaining about “missing license of laboratories” and offering genetic testing “without a physicians order” (2008)
- ***Council of Europe’s*** Additional Protocol on Genetic Testing (2008): Art. 7.1: “a genetic test for health purposes may only be performed under individualized medical supervision.”
- Ongoing amendment of the ***European IVD-Directive***: Include genetic testing in pre-market approval procedures?

Options for regulatory intervention (I)

- **Restrict practice of genetic testing to prescription by a medical doctor (Switzerland, Austria, CoE)**
  - Genetic testing for hereditary (Mendelian) diseases
  - “Predictive” gene tests indicating risks for developing a common disease (cancer)
  - How to deal with “lifestyle” testing, or “non-medical” testing offers?

Options for regulatory intervention (II)

- **Pre-market Approval of Gene Tests**
  - Private companies offering genetic testing have to convince an authority of the clinical validity of the test offered
  - A European Approach?
    IVD-Directive: Classification of Gene tests (low, medium, high risk)
    Supervision by a European Body: EMEA?

Options for regulatory intervention (III)

- **Quality Control – Code of Practice**
  - Licensing of laboratories, Qualification of staff
  - Self-regulation by an agreement on a Code of Practice for DCGT. Commitment to standards of:
    - Scientific evidence for validity of tests
    - Quality of information offered to consumers
    - Genetic Counselling
  - Enforcement of the code by a pubic authority entitled to deal with complaints and to intervene in cases of non compliance