

natureOUTLOOK

BIG DATA IN BIOMEDICINE

5 November 2015 / Vol 527 / Issue No 7576



Cover art: Tatiana Plakhova

Editorial

Herb Brody
Michelle Grayson
Eric Bender
Nick Haines
Jenny Rooke

Art & Design

Wesley Fernandes
Denis Mallet
Annthea Lewis

Production

Karl Smart
Ian Pope
Mira Loufti

Sponsorship

George Sun
Samantha Morley

Marketing

Hannah Phipps

Project Manager

Anastasia Panoutsou

Art Director

Kelly Buckheit Krause

Publisher

Richard Hughes

Magazine Editor

Rosie Mestel

Editor-in-Chief

Philip Campbell

It may now cost less to sequence the three billion DNA base pairs of a human genome than to do a brain scan. But how does all that genomic data translate into treatment?

Life scientists are bringing together astonishing volumes of information from genomic sequencing, lab studies and patient records. And the resulting era of 'precision medicine' is already delivering treatments tailored to individual needs.

These 'big data' efforts face huge challenges, from creating analytic tools and solving scientific puzzles to accessing millions of gigabytes of data and overcoming barriers to accessing patients' health records (see pages S2 and S19).

Dozens of international projects are producing huge amounts of biomedical information, not just on the genome but on many other '-omes' (S8). Giant strides are being made in mapping the human proteome and building a 'parts list' of the body (S6). Meanwhile, smartphones and other wearable devices are generating continuous flows of health data from large numbers of people (S12). This vast array of data will allow a more detailed understanding of disease traits in analyses known as deep phenotyping (S14). Research organizations are assembling cloud-based 'information commons' to standardize, store and share the data (S16).

Drug companies are facing complex choices (S18). Many are opting to treat cancer, a main thrust in national programmes such as the UK 100,000 Genomes Project (S5). And some of these therapies are already changing clinical practice (S10).

We are pleased to acknowledge that this Outlook was produced with support from the National Center for Protein Sciences–Beijing, Beijing Proteome Research Center, State Key Laboratory of Proteomics, China Human Proteome Organization, Beijing Institute of Radiation, and the Academy of Military Medical Sciences. As always, *Nature* retains sole responsibility for all editorial content.

Eric Bender

Contributing Editor

CONTENTS

S2 BIG DATA

The power of petabytes

Searching for meaning in the data

S5 Q&A

National genomics

Mark Caulfield discusses the UK approach to big data

S6 PROTEOMICS

High-protein research

The challenge of 'practical genetics'

S8 COLLABORATIONS

Mining the motherlodes

International projects dig for data

S10 CANCER

Reshaping the cancer clinic

A personalized approach to disease

S12 MOBILE DATA

Made to measure

Sensing a health revolution

S14 DEEP PHENOTYPING

The details of disease

Deep data leads to precision medicine

S16 PERSPECTIVE

Sustaining the big-data ecosystem

Evolving models to access information

S18 Q&A

Better insights, better drugs

Perry Nisen discusses drug discovery

S19 RESEARCH CHALLENGES

4 big questions

Puzzles facing the drive for data

RELATED RESEARCH

S20 Teaching 'big data' analysis to young immunologists

J. L. Schultze

S24 Genome-wide patterns and properties of *de novo* mutations in humans

L. C. Francioli et al.

S29 Wirelessly powered, fully internal optogenetics for brain, spinal and peripheral circuits in mice

K. L. Montgomery et al.

S35 The big medical data miss: challenges in establishing an open medical resource

E. J. Topol

S37 A comprehensive transcriptional portrait of human cancer cell lines

C. Klijn et al.

Nature Outlooks are sponsored supplements that aim to stimulate interest and debate around a subject of interest to the sponsor, while satisfying the editorial values of *Nature* and our readers' expectations. The boundaries of sponsor involvement are clearly delineated in the *Nature Outlook* Editorial guidelines available at go.nature.com/e4dwzw

CITING THE OUTLOOK

Cite as a supplement to *Nature*, for example, *Nature* Vol. XXX, No. XXXX Suppl., Sxx–Sxx (2015).

VISIT THE OUTLOOK ONLINE

The *Nature Outlook Big Data in Biomedicine* supplement can be found at <http://www.nature.com/nature/outlook/big-data>. It features all newly commissioned content as well as a selection of relevant previously published material.

All featured articles will be freely available for 6 months.

SUBSCRIPTIONS AND CUSTOMER SERVICES

For UK/Europe: Nature Publishing Group, Subscriptions, Brunel Road, Basingstoke, Hants, RG21 6XS, UK. Tel: +44 (0) 1256 329242. Subscriptions and customer services for Americas – including Canada, Latin America and the Caribbean: Nature Publishing Group, 75 Varick St, 9th floor, New York, NY 10013-1917, USA. Tel: +1 866 363 7860 (US/Canada) or +1 212 726 9223 (outside US/Canada). Japan/China/Korea: Nature Publishing Group – Asia-Pacific, Chiyoda Building 5-6th Floor, 2-37 Ichigaya Tamachi, Shinjuku-ku, Tokyo, 162-0843, Japan. Tel: +81 3 3267 8751.

CUSTOMER SERVICES

Feedback@nature.com
Copyright © 2015 Nature Publishing Group