

SOCIAL AND PHILOSOPHICAL RAMIFICATIONS OF THE HUMAN MICROBIOME PROJECT

UNIVERSITY
of GUELPH

CHANGING LIVES
IMPROVING LIFE

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Science in Context

- ▣ Searching for the Truth ... but in a world of social forces, cultural trends, and human meanings
- ▣ The HMP constitutes and generates new forms of meaning
- ▣ Ramifications:
 - Clinical application
 - Individual and public health
 - Interface between science and society
- ▣ Main interest here in raising and defining relevant questions

Metagenomic Metaphors (Juengst, 2009)

1. “the human *genome* should be understood as part of a larger sensorymotor organ, the human ‘meta-genome’, picking up and reacting to cues from its environment much like our nervous or immune systems;
2. ... the human *body* should be understood as a ecosystem with multiple ecological niches and habitats in which a variety of cellular species collaborate and compete; and
3. ... human *beings* should be understood as ‘super-organisms’ that incorporate multiple symbiotic cell species into a single individual with very blurry boundaries, like a colony of blue-green algae on a massive scale of complexity.”

A Central Question

- ▣ How integral is the microbiome to our conception of the human being as a whole?
- ▣ How fundamental are changes to the microbiome, relative to the human being as a whole?
- ▣ Of philosophical interest, but with important practical consequences

Human Genome Manipulation

- ▣ Ban on human germline manipulation in most jurisdictions
- ▣ E.g., in Canada, Assisted Human Reproduction Act, Section 5 (1) (f):
- ▣ “No person shall knowingly alter the genome of a cell of a human being or *in vitro* embryo such that the alteration is capable of being transmitted to descendants”

Rationale for Prohibition

- ▣ Focused on any biomedical intervention that modifies the genome that can be transmitted to offspring
- ▣ Safety objections
- ▣ Moral objections: 'essential characteristics' of future person are altered, possibly violating right to 'open future'
- ▣ Resistance to new forms of eugenics

Manipulation of the Microbiome

- ▣ How fundamental are changes to the microbiome, relative to the whole person?
 - Is the microbiome an 'environment' or part of us?
- ▣ In part, philosophical question: how do we define a person?
- ▣ But, in large part, a scientific question:
 - How heritable is a microbiome (independent of components pre-determined by human genetic factors)?
 - How stable is a person's microbiome?
 - Is there a 'core microbiome'?

Heritability of Microbiome

- ▣ How much *vertical transfer* of microbial genomes to offspring and infants?
- ▣ Degree to which microbiome determined by genetic factors unknown
- ▣ More important, role of maternal (vaginal and other) microbiome in 'priming' infant's microbiome

Stability of Microbiome

- ▣ How much can a person's microbiome be affected by microbiomes of the people around us?
 - 'horizontal' transfer of microbial genomes
 - Threshold effects
- ▣ How permanent are changes to a person's microbiome through 'artificial' manipulation?

Practical and Ethical Consequences

- ▣ Trans-generational effects of manipulation of maternal microbiomes?
- ▣ Use of GM strain of *Streptococcus mutans* for dental caries prevention (Hillman et al, 2007)
- ▣ Implications of hypothetical anti-obesity probiotic

- ▣ To what degree might alterations to individual microbiomes also affect changes to a putative 'collective' microbiome?

Public Health Implications

1. Manipulations targeted to affect the microbiome of large numbers of individuals may have implications for public health
2. Likelihood that 'optimal' microbial profiles will be identified
 - ▣ Applications to public (as opposed to individual) health interventions
 - Cf. micronutrient fortification of staple foods

But we're already changing the microbiome ...

- ▣ Diet
- ▣ Pollution
- ▣ Antibiotics

- ▣ We know of some ill effects (e.g. antibiotic resistance), but to what degree do modern practices affect a shared human microbiome?

In Conclusion

- ▣ If the microbiome is indeed as fundamental to human existence as is often implied then there seems to be
 - An opportunity: to use knowledge from the HMP to dramatically re-evaluate current practices that affect individual and collective microbiomes negatively
 - An obligation: to be cautious in implementing microbial technologies that may lead to permanent changes to 'the human super-organism'

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