The $99 Question: Can a DIY Home Test Really Tell Your Biological Age?

Mary Armanios
Department of Oncology & Telomere Center
Johns Hopkins University School of Medicine

Science Writers’ Boot Camp-DC
May 7, 2018
Abnormally short telomere length causes disease

Clinically available test, Johns Hopkins Pathology Labs

Alder et al. PNAS 2018
Telomerase mutations carriers have short telomeres

Alder et al.
The manifestations of telomere-mediated disease are age-dependent.

- IPF
- IPF with low blood counts
- Liver disease
- Bone marrow failure

Age at Diagnosis (years)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPF</td>
<td>57.7</td>
</tr>
<tr>
<td>IPF with low blood counts</td>
<td>56.5</td>
</tr>
<tr>
<td>Liver disease</td>
<td>40.6</td>
</tr>
<tr>
<td>Bone marrow failure</td>
<td>24.5</td>
</tr>
</tbody>
</table>
Genetic anticipation of lung disease in Johns Hopkins Family 1

**TERT K902N**

Armanios *PNAS* 2005
Telomere length results altered a major clinical decision in ~25% of cases

Lymphocyte telomere length

Alder et al. *PNAS* 2018
Diagnostic utility of telomere length testing in a hospital-based setting

Jonathan K. Alder\textsuperscript{a,b,1}, Vidya Sagar Hanumanthu\textsuperscript{a,b}, Margaret A. Strong\textsuperscript{b,c}, Amy E. DeZern\textsuperscript{a,d}, Susan E. Stanley\textsuperscript{a,b,}, Clifford M. Takemoto\textsuperscript{a}, Ludmilla Danilova\textsuperscript{a}, Carolyn D. Applegate\textsuperscript{a,b,f}, Stephen G. Bolton\textsuperscript{9}, David W. Mohr\textsuperscript{f}, Robert A. Brodsky\textsuperscript{a,d}, James F. Casella\textsuperscript{a}, Carol W. Greider\textsuperscript{a,b,c,2}, J. Brooks Jackson\textsuperscript{9}, and Mary Armanios\textsuperscript{a,b,c,d,g,2}

\textsuperscript{a}Department of Oncology and Sidney Kimmel Comprehensive Cancer Center, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; \textsuperscript{b}Telomere Center at Johns Hopkins, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; \textsuperscript{c}Department of Molecular Biology and Genetics, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; \textsuperscript{d}Department of Medicine, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; \textsuperscript{e}Department of Pediatrics, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; \textsuperscript{f}McKusick-Nathans Institute of Genetic Medicine, The Johns Hopkins University School of Medicine, Baltimore, MD 21287; and \textsuperscript{g}Department of Pathology, The Johns Hopkins University School of Medicine, Baltimore, MD 21287

Contributed by Carol W. Greider, January 9, 2018 (sent for review November 28, 2017; reviewed by Thomas R. Cech and Agata Smogorzewska)
Telomere length has discrete, definable boundaries in the human population.

Data from CLIA/CAP certified assay Johns Hopkins Pathology; Alder et al. *PNAS* 2018 compared with Aubert et al. *PLoS Genetics* 2012.
Lung disease is the third leading cause of death in the United States

<table>
<thead>
<tr>
<th>Age 54</th>
<th>Age 59</th>
<th>Age 61</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Armanios *Mutation Research* 2012
Why a DIY $99 test cannot tell biological age?

- Reproducibility arguments
- Interpretation issues
- Biological arguments

and potential harm
Telomere length measurement by flowFISH is highly reproducible

Same Day, 3 replicates

Different Days

Alder et al. *PNAS* 2018
Outstanding inter-lab correlation

slope: 0.955 \quad r^2=0.97

Telomere Length
Repeat Diagnostics (Kb)

n=16
P<0.0001

Telomere Length Johns Hopkins (Kb)
Telomere length has discrete, definable boundaries in the human population.

Data from CLIA/CAP certified assay Johns Hopkins Pathology; Alder et al. PNAS 2018 compared with Aubert et al. PLoS Genetics 2012.
Telomere length by flow cytometry and FISH is the gold standard for clinical use

Alder et al. PNAS 2018

Clinically available test, Johns Hopkins Pathology Labs
Summary

• Short telomeres cause a group of discrete clinical phenotypes; their recognition is critical for patient care decisions

• The telomere length distribution is definable; harm at both extremes

• Telomere length measurements available to the public use problematic methodologies and provide information that is not evidence-based; argument for potential harm