

Method determines cell age more accurately, could help elderly patients

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Sure, you know how old you are, but what about your cells? Are they the same age? Are they older, younger? Why does it matter?

Led by scientists at the Johns Hopkins University, a team of researchers is reporting progress in developing a method to accurately determine the functional age of [cells](#), a step that could eventually help clinicians evaluate and recommend ways to delay some health effects of aging and potentially improve other treatments, including skin graft matching and predicting prospects for wound healing.

In the current issue of *Nature Biomedical Engineering*, lead author Jude M. Phillip, who conducted this research while completing his doctorate in chemical and [biomolecular engineering](#) at Johns Hopkins, reports success in creating a system that considers a wide array of cellular and molecular factors in one comprehensive aging study.

These results show that the biophysical qualities of cells, such as cell movements and structural features, make better measures of functional age than other factors, including cell secretions and cell energy.

The multidisciplinary team of engineers and clinicians examined dermal cells from just underneath the surface of the skin taken from both males and females between the ages of 2 to 96.

The researchers from Johns Hopkins, Yale University and the National Cancer Institute of the National Institutes of Health hoped to devise a system that through computational analysis could take the measure of various factors of cellular and molecular functions. From that information, they hoped to determine the biological age of individuals more accurately using their cells, in contrast to previous studies, which makes use of gross physiology, or examining cellular

mechanisms such as DNA methylation.

"We combined some classic biomolecular hallmarks of aging, and sought to further elucidate the role of biophysical properties of aging cells, all in one study," said Phillip, now a post-doctoral fellow at Weill Cornell Medicine.

Researchers trying to understand aging have up to now focused on factors such as tissue and organ function and on molecular-level studies of genetics and of epigenetics, meaning heritable traits that are not traced to DNA. The level in between - cells - has received relatively little attention, the researchers wrote.

This research was meant to correct for that omission by considering the biophysical attributes of cells, including such factors as the cells' ability to move, maintain flexibility and structure. This focus emerges from the understanding that changes associated with aging at the physiological level - such as diminished lung capacity, grip strength and mean pressure in the arteries - "tend to be secondary to changes in the cells themselves, thus advocating the value of cell-based technologies to assess biological age," the research team wrote.

For example, older cells are more rigid and do not move as well as younger cells, which, among other consequences, most likely contributes to the slower wound healing commonly seen in older people, said Denis Wirtz, the senior author, Johns Hopkins' vice provost for research and the Theophilus H. Smoot Professor of Chemical and Biomolecular Engineering at the Whiting School of Engineering. Wirtz and Phillip conducted their research in the Johns Hopkins Institute for NanoBioTechnology.

From the analysis, they were able to stratify individuals' samples into three groups: those whose cells roughly reflected their chronological age, those whose cells were functionally older, and those whose cells were functionally younger. The

results also showed that the so-called biophysical factors of cells determined a more accurate measure of age than biomolecular factors such as cell secretions, cell energy and the organization of DNA.

Phillip explained that this better accuracy from the biophysical factors most likely results from the orchestration of many biomolecular factors. He compared it to the more complete picture you get looking at a forest from a distance without binoculars.

"With binoculars you can see details about the individual trees, the color and shapes of the leaves, the roughness of the bark, the type of tree, but without the binoculars you can now see the density of the trees, and whether there is a barren plot, or a group or dying trees," Phillip said. "This is something you may miss with the binoculars, unless you are looking at the correct spot."

The more accurate system could eventually enable clinicians to see aging in cells before a patient experiences age-related health decline. This in turn could allow doctors to recommend treatments or changes in life habits, such as exercise or diet changes, Wirtz said. Phillip said the work could potentially help clinicians produce more successful skin grafts by matching cell characteristics of the donor and the graft site. Other potential applications range from toxicology screening for cosmetics and topical therapeutics to predicting progression of some age-related diseases.

The researchers acknowledge that the system needs further testing with a larger cell sample, but the results are robust and encouraging. Conducted along with clinicians such as Jeremy Walston, the Raymond and Anna Lublin Professor of Geriatric Medicine, and co-director of the Biology of Healthy Aging program at the Johns Hopkins School of Medicine, this work promises to allow clinicians to measure a person's health in the present and the future.

"It opens the door to finally be able to track how a person is doing at the cellular level," Wirtz said. "This platform is also more than just a cellular age predictor, it has the ability to do so much more in

terms of assessing an individual's cellular health," Phillip said.

More information: Jude M. Phillip et al, Biophysical and biomolecular determination of cellular age in humans, *Nature Biomedical Engineering* (2017). [DOI: 10.1038/s41551-017-0093](https://doi.org/10.1038/s41551-017-0093)

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