

Taking a deep breath

Opinion

Biomarkers are the measurable changes associated with the disease. Urine accumulates lots of changes and was proposed to be a better biomarker source than blood, because it lacks the homeostatic mechanisms which maintain the stability and remove the biomarkers (changes) from the blood.¹ Are there any other places which have no homeostatic mechanisms and accumulate lots of changes? They should be good places for searching biomarkers too.

- I. Any places that accept the wastes of the blood should be good biomarker sources. Blood mainly exchange with outside world at four organs, kidney, lung, liver and skin. They are all important major organs. The end processed products are urine, breath, bile and sweat. I personally still prefer urine as the best source because it directly linked to blood, but does not directly expose to the outside environment, which means less contamination. Bile is unfortunately mixed with food which makes it hard to be used as biomarker source. Sweat is not as easy to collect as urine and breath. And it can be contaminated once it appears on the skin. Breath can be contaminated by the smell of food too. But breath should not be underestimated at all, since food smell can be easily controlled by fasting.
- II. There are many advantages of using breath as biomarker source. As biomarker source, breath is complementary to urine. The water soluble wastes in the blood are more likely to be removed at kidney while gaseous wastes are more likely to be removed at lung. Diseases may discharge at least one type of waste or another, or both. Biomarker panel from both urine and breath can increase the specificity when complicated conditions need to be differentiated. They can also help us to understand the disease more comprehensively.
- III. Like urine was taken as biomarker source of diseases of urinary system, currently breath has more often been studied as source of diseases of respiratory and upper digestive track. More studies should be done to reveal the potential of both sources as better biomarker sources than blood on diseases of all organs, even though they may reflect their respective neighboring organs more sensitively and accurately.
- IV. The advantage of breath over urine is that we are rarely short of breath, unlike oliguria or anuria which I believe happens more often. We produce breath constantly no matter good or bad.
- V. There are many basic tools need to be prepared before this area can cruise. Like the most difficult part of biomarker discovery in urine is to find association rather than to find changes, the biomarkers discovery in breath will have the same problem: too

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many changes make it hard to identify which ones are associated with the disease. Using the same roadmap of urine biomarker discovery, animal models need to be used first to identify changes associated with disease before validation in large number of human samples.² For animal experiments, collecting clean samples are essential. It is not as easy as collecting urine from animals, even though both breath and urine are much easier to collect from human beings.

- VI. Unlike urinary samples can be saved simply and economically on membrane, the storage of breath sample is still challenging.³ All those fundamental methods need to be developed before breath biomarkers discovery studies can be a major choice for most biomarker laboratories.
- VII. Let's take a deep breath; we will eventually see urine and breath surpass blood as two major biomarker sources in the future. Breath smells good too.

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Conflict of interest

The author declares no conflict of interest.

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