WHY THIS REVOLUTIONARY TREATMENT MIGHT NOT BE SO REVOLUTIONARY AFTER ALL

BY AG

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When I first started learning about mRNA immunotherapy vaccines, it felt like a revolutionary discovery that could transform the future of cancer treatment. The idea that we could design vaccines that can train the immune system to target tumors with immense precision is incredible. But the more I investigated this idea, the more I realized something uncomfortable. These breakthroughs may exist, and they may have the possibility to change the face of cancer treatment, but they aren't truly accessible.

mRNA vaccines involved the genetic insertion of mRNA into antigen-presenting cells (APC's) such as dendritic cells, B-cells, etc. so when these cells present the resulting peptides on the cell surface, your immune system becomes primed/activated towards these peptides, and when a tumor cell presents it your immune system can more effectively identify the tumor cells as harmful, and eliminate them.

mRNA cancer vaccines are often described as revolutionary, especially for difficult cancers like triple negative breast cancer (TNBC). TNBC is an aggressive subtype of breast cancer that typically makes up ~15-20% of breast cancer cases. Testing negative for estrogen receptors, progesterone receptors, and the HER2 protein, triple negative breast cancer typically doesn't respond to hormone therapy or targeted HER2 treatments, which makes it more advanced and harder to treat (Bianchini et al.). Researchers are turning to mRNA-based immunotherapy vaccines because they can help stimulate stronger T cell responses and potentially help the immune system recognize tumors that would otherwise go undetected (Zhang et al.).

But here's the problem that can't be ignored. These therapies are expensive, and not just slightly expensive. Current immunotherapies for cancer can cost well over $100,000 per year, and some treatments exceed $300,000 depending on the drug and duration (Prasad and Mailankody). This typically happens because most mRNA immunotherapy vaccines are completely personalized to the patient's tumor, a process that involves sequencing tumor DNA, identifying neoantigens, and manufacturing a custom vaccine, all of which significantly raise production costs (Sahin et al.).

To me, this raises a serious question. What's the point of developing cutting edge treatments if only a fraction of patients can actually access them?

This issue is even more critical for TNBC patients because it highlights a fundamental inequity in our healthcare system. The impact of TNBC isn't distributed equally, and neither is access to treatment. Triple negative breast cancer disproportionately affects women in underserved communities, including those of African ancestry and those living in low resource settings, where both incidence and mortality are higher. In some regions of sub-Saharan Africa and India, this subtype accounts for ~25-30% of breast cancer cases, compared to just 10-15% in Western populations, reflecting a much heavier disease burden in areas with fewer treatment resources. At the same time, these populations often face limited access to early detection, clinical trials, and advanced therapies, which leads to later diagnoses and even worse health outcomes.

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But what stands out to me the most is the contradiction. The patients most affected by aggressive cancers like TNBC are the same patients least likely to benefit from innovations like mRNA immunotherapy. Even in the United States, structural disparities mean that underserved populations such as those from low-income neighborhoods are less likely to receive newer treatments, even when they're eligible. This creates a system where scientific innovation and revolution don't align with patient needs.

This is where the conversation needs to change. Right now, most discussions focus on whether mRNA cancer vaccines work, and how effective they can be. And while that's an important point that should be addressed, it isn't enough. We should be asking who these treatments are actually reaching. If therapies remain expensive, personalized, and difficult to scale, they'll only benefit patients with greater access to care, while those facing the highest risk are left behind. To me, that's not just a limitation of technology, it shows systemic failure in how we're choosing to develop and implement it.

There are ways forward, but they require more attention and more research. Scientists need to focus not just on efficacy but on optimization. That includes developing shared neoantigen panels instead of fully personalized vaccines, improving manufacturing efficiency, and reducing the cost of sequencing and production (Sahin et al.). Policymakers and funding agencies also need to prioritize accessibility early, not after these clinically promising therapies are already priced completely out of reach

The issue isn't that we lack innovation. If anything, we're moving faster than ever. The real problem is that innovation is outpacing accessibility. If we don't address that gap now, mRNA immunotherapies could become another example of a lifesaving breakthrough that doesn't benefit the people that truly need it.

To me, that isn't progress. Real progress doesn't mean just discovering new treatments, it means making sure that the people who need them the most can actually receive them.

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