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A long shot: The importance of needle length in vaccinating patients with obesity against COVID-19

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Individuals living with overweight, as defined by body mass index (BMI), over 25 kg/m² or obesity (BMI ≥ 30) are at significantly elevated risk of severe illness with COVID-19 infection. Obesity has been shown to triple the risk of hospitalization due to COVID-19, and there is evidence that the risks of hospitalization, critical care admission, invasive mechanical ventilation and death all increase with BMI. These outcomes may be linked to impaired immune function and reduced ventilation [1]. The CDC therefore determined that individuals with obesity, a complex and high-risk disease were eligible to receive the vaccine in Phase 1C of the initial vaccine rollout [1]. The Obesity Society (TOS) recently found that each of the three vaccines approved in the US, Pfizer-BioNTech, Moderna and Johnson & Johnson/Janssen, has demonstrated high efficacy in preventing symptomatic COVID-19 in clinical trials in both individuals with and without obesity. TOS therefore recommends that individuals with obesity be vaccinated against COVID-19 using approved vaccines and administration regimens [2].

However, vaccines are most effective when administered using proper technique, including needle length, injection site and angle. The CDC and Advisory Committee on Immunization Practices recommend that for all intramuscular injections, adults 19 years of age or older with body weight greater than 152 lbs (70 kg) be immunized with a needle between 1 and 1.5 in. (25–38 mm), and that women with a body weight greater than 200 lb (90 kg) and men with a body weight greater than 260 lb (118 kg) be immunized using a 1.5-inch (38 mm) needle [1]. While the recommended body weight cutoffs may not adequately predict body composition, they are a proxy for subcutaneous tissue thickness by body weight and sex [3].

1.5-inch needles are longer than standard 1-inch (25 mm) needles to allow for complete penetration of the subcutaneous deltoid fat pad and to ensure deposition of the vaccine into the muscle [4]. In 1997, one study showed that standard-length needles were unable to penetrate the deltoid muscle in 17% of men and 48% of women enrolled [4]. This is a crucial consideration, as correct

delivery of intramuscular injections into the muscle is needed to achieve therapeutic efficacy of vaccines [5]. Use of inappropriately short needles may preclude immunity or cause vaccine failure because poor vascularity in subcutaneous fat can result in slow mobilization and processing, and denaturation of antigen [3,4]. This immunologic understanding has been substantiated by evidence of reduced antibody responses with vaccination into thicker skinfolds. Most recently, a 2010 study showed that adolescents with obesity had 80% more titers after being immunized against Hepatitis B with a 1.5-inch rather than 1-inch needle [3,6].

Furthermore, studies that have long shown that patients with obesity have increased susceptibility to infectious diseases including influenza A, given a baseline multifactorial inflammatory state with delayed or blunted immune response [7]. Additionally, variable seroconversion has been seen in patients with obesity after vaccination against multiple diseases including rabies, tetanus, hepatitis A and B, and influenza A [8]. Data from specific subpopulations has even shown positive seroconversion in patients with obesity who were immunized against influenza A with standard-length needles [9]. However, more generalizable data on influenza A vaccination in patients with obesity points to a general trend of high initial seroconversion with a greater subsequent decline in vaccine efficacy over time compared to those without obesity [7]. Therefore, while trial data supporting the efficacy of COVID-19 vaccines in patients with obesity is promising to date, long-term immune protection must be further investigated in this high-risk population and preventable causes of reduced vaccine efficacy, including needle length, are critical considerations.

While we currently lack population-level evidence quantifying the scope of inappropriate needle length use, published clinical observation and single-center studies support a general understanding that longer needles are widely underutilized [10]. One such study found that incorrect needle length is used up to 75% of the time when administering vaccines or drugs via intramuscular injection to individuals with overweight and obesity [11].

As CDC guidelines around physical distancing and masking continue evolving to match the assumed immunity of fully vaccinated individuals, we must ensure that patients receive the expected benefit to the best of our capacity [1]. This is particularly important as we consider the many ways in which the COVID-19 pandemic

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has widened health disparities. In the US, Black, Latinx and Indigenous people have faced elevated rates of COVID-19 morbidity and mortality, while also facing disproportionately high burdens of obesity and vaccine hesitancy. 40% of Black and 34% of Latinx adults live with obesity, and in 2020, Black Americans were found to face a more than a 6-fold higher risk of not intending to be vaccinated against COVID-19 (RRR = 6.4, 95% CI: 3.2–13.0) compared to White Americans in a national survey [1,12]. Systemic racism is a well-established driver of these manifested inequities, and the high rates of initial vaccine hesitancy seen among these groups were likely driven by both historic and ongoing, modern violations of this trust [13,14].

Therefore, it is not only that the 70% of Americans living with overweight or obesity face potential harm due to improper vaccine administration; these harms may also multiply the syndemics of communicable and non-communicable diseases in a deeply inequitable system to further widen health disparities [1]. When members of these vulnerable communities still choose to place their trust in public health and medical guidance and receive their COVID-19 vaccines, we cannot afford to fail them. Ensuring maximal vaccine benefit is crucial to respecting and saving the greatest possible number of lives.

The good news is that the solution is a feasible matter of implementing existing guidance to use 1.5-inch needles to administer the COVID-19 vaccine when indicated. Given the pressure vaccinates sites face to operate at maximal efficiency, one common strategy used to optimize patient turnover is to have multiple 1-inch needles prefilled for vaccinators, with 1.5-inch needles typically filled from a vial by pharmacy staff only on a case-by-case basis. This is done in the setting of tight regulation of the number of vials opened each day, as to minimize wastage of both vaccine doses and longer needles. However, the process of filling a 1.5-inch needle for a single patient can take several additional minutes and cause significant delays, thus disincentivizing vaccinators and staff to request these. Additionally, while BMI documented in medical records may be used to determine eligibility for vaccination, measures of body weight are often not elicited during the process of vaccine registration. Given that those who meet the criteria for use of a longer needle do not have a singular body habitus, it can be difficult for clinical vaccination staff to identify eligible patients. Reliance on visual screening methods is also likely to introduce sexist and racist bias, and given the high prevalence of weight stigma, both staff and patients may be uncomfortable with verbal screening for body weight in vaccination centers where little privacy may be afforded. Lastly, supply of 1.5-inch syringes may be limited.

Potential strategies that vaccination sites and overseeing agencies could employ to improve the quality and effectiveness of administration include: 1) Ensuring adequate supply of 1.5-inch syringes, based on estimates of local obesity prevalence and anticipated vaccination demand, 2) Pre-screening patients for body weight while making appointments, 3) Pre-filling enough 1.5-inch needles each day based on registration screens, 4) Use of a colored sticker or other non-stigmatizing symbol upon check-in to ensure identification by staff, 5) Training staff in non-stigmatizing methods of broaching the topic with patients who may not have been screened properly, and 6) Developing protocols to efficiently obtain additional filled 1.5-inch syringes for administration. Recently published literature also recommends use of point-of-care ultrasound to ensure deltoid muscle penetration where available, in addition to ensuring proper technique in vaccination site and angle including avoidance of skin and subcutaneous bunching [10,15]. These recommendations are mere examples, but each vaccine clinic will need to adapt, as contextually appropriate, to ensure the proper administration of every vaccine without intro-

ducing stigma or significant delays. Additionally, health care providers should counsel and educate patients living with obesity about the importance of being vaccinated with the appropriate length needle, and encourage their patients to self-advocate and request such if not otherwise provided.

The availability of vaccinations offers promise and hope to vulnerable groups, including those living with overweight or obesity, racial and ethnic minorities, and others at elevated risk of severe COVID-19 illness and death. As a public health and medical community, we must do our best to ensure proper administration of these vaccines to maximize benefit and protection against COVID-19. Doing so is vital to the success and equity of our pandemic response.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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