OPPORTUNITY 2

SCOPE TRANSITIONAL

**UNCERTAINTIES**

Technology, Systems

**MEGATRENDS**

Materials Revolution

**TRENDS**

Biomaterials
Longevity & Vitality
Mobilising Innovation
Nanomedicine
Personalised Medicine

**SECTORS IMPACTED**

Agriculture & Food
Chemicals & Petrochemicals
Communication Technologies & Systems
Consumer Goods, Services & Retail
Cyber & Information Security
Data Science, AI & Machine Learning
Digital Goods & Services
Government Services
Health & Healthcare
Manufacturing
Materials & Biotechnology

## What if clothes kept us healthy?

# CLOTHES THAT CARE

Smart fabrics with nanobiomaterials autonomously deliver health-boosting nutrients that meet minimum daily requirements, promote wellness, and address nutritional deficiencies.

## WHY IT MATTERS TODAY

In 1912, biochemist Casimir Funk linked diseases like scurvy and rickets to specific vitamin deficiencies.[197] Initially sourced solely from food, vitamins became available as commercial supplements from the 1930s.[198]

Even though vitamins are considered crucial for growth, health, and disease prevention,[199] vitamin deficiency is a significant public health issue in many countries around the world. For example, almost one billion people worldwide have a vitamin D deficiency,[200] even in countries of relative sunshine abundance.[201] Iron, folate, and vitamins B12 and A deficiencies can lead to serious health issues such as anaemia, which affects an estimated 42% of children under five years and 40% of pregnant women globally.[202] Vitamin A deficiency, a leading cause of preventable childhood blindness, also heightens the risk of severe infections that cause diarrhoea or measles, for example.[203]

Wellness clothing[204] and textile coating for wellness[205] are not new. Beyond sustainability and comfort, innovators have, for at least 15 years,[206] been working on infusing clothing with what makes people feel better, from vitamins[207] and collagen[208] to antimicrobials[209] and antioxidants.[210] For example, smart fabrics from Fi Milano claim to allow sunlight to filter through and provide the UVB rays needed to produce vitamin D.[211] Similarly, Textile-Based Delivery states that its fabrics release consistent doses of medicines, vitamins, and supplements, creating laundry-safe, reusable healing garments and textile products.[212] Nevertheless, there are limitations in terms of scope, and research has not validated the effectiveness of some of the products to date[213] or the ability to manage waste in an environmentally friendly way.[214]

**One billion**

**people worldwide have a vitamin D deficiency**

## OPPORTUNITY

Smart fabrics, made possibile by nanobiomaterials, release nano doses of vitamins and minerals that are subsequently absorbed through the skin to meet minimum daily requirements and promote wellness. These fabrics can also be enhanced through synthetic biology,[215] wearable biosensors,[216] or a combination of both[217] to address nutritional deficiencies to prevent, manage, or even – when safe to do so – reduce the effects of disease treatment.[218]

As metamaterials,[219] these innovative fabrics can adapt to their environment and autonomously make decisions[220] to deliver the needed vitamins and minerals in a personalised way. Blending nanotechnology, biomaterials, and biosensors into clothing or even blankets, for example, could be a solution that can be delivered in places where malnutrition is prevalent.

## BENEFITS

Vitamin-infused fabrics using nanobiomaterials offer a scalable, global solution for nutrient delivery that is especially beneficial for those with dietary challenges or specific health conditions and aim to prevent macronutrient deficiencies and associated diseases.

## RISKS

Despite advances, the efficacy of this approach is uncertain. Vitamins may degrade over time, particularly with frequent washing of fabrics. There is also a risk of toxicity due to malfunction in sensor technologies or the accumulation of unneeded vitamins.