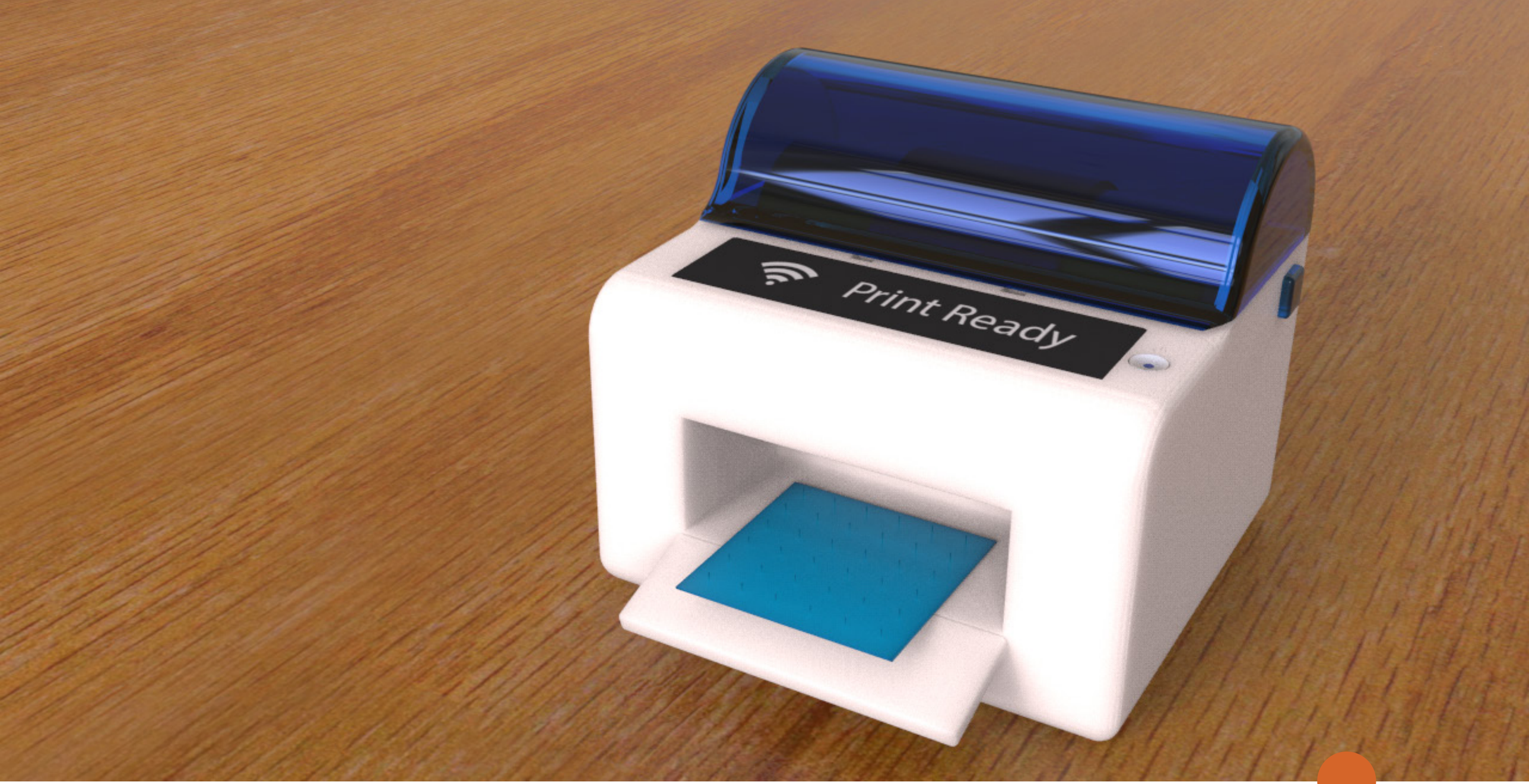
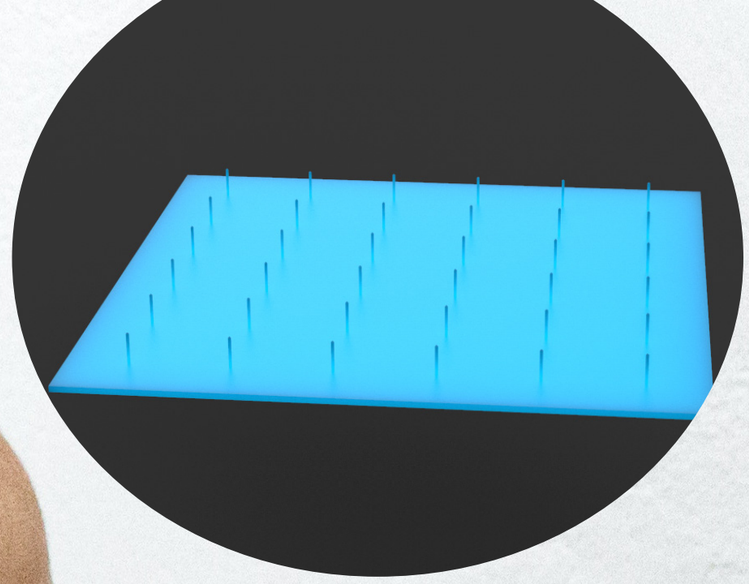


Distributed Vaccine Maker

The COVID-19 pandemic has made vaccine distribution a major challenge. How do we quickly develop and distribute them widely?

With mutating virus variants, current vaccines soon become obsolete. We need a way to get regular updates. Borrowing from software development techniques, what if we could receive a new formulation vaccine over the internet? mRNA vaccine synthesis is currently in its infancy, but is now available on desktop sized machines. It is not inconceivable that future miniaturisation can take place.

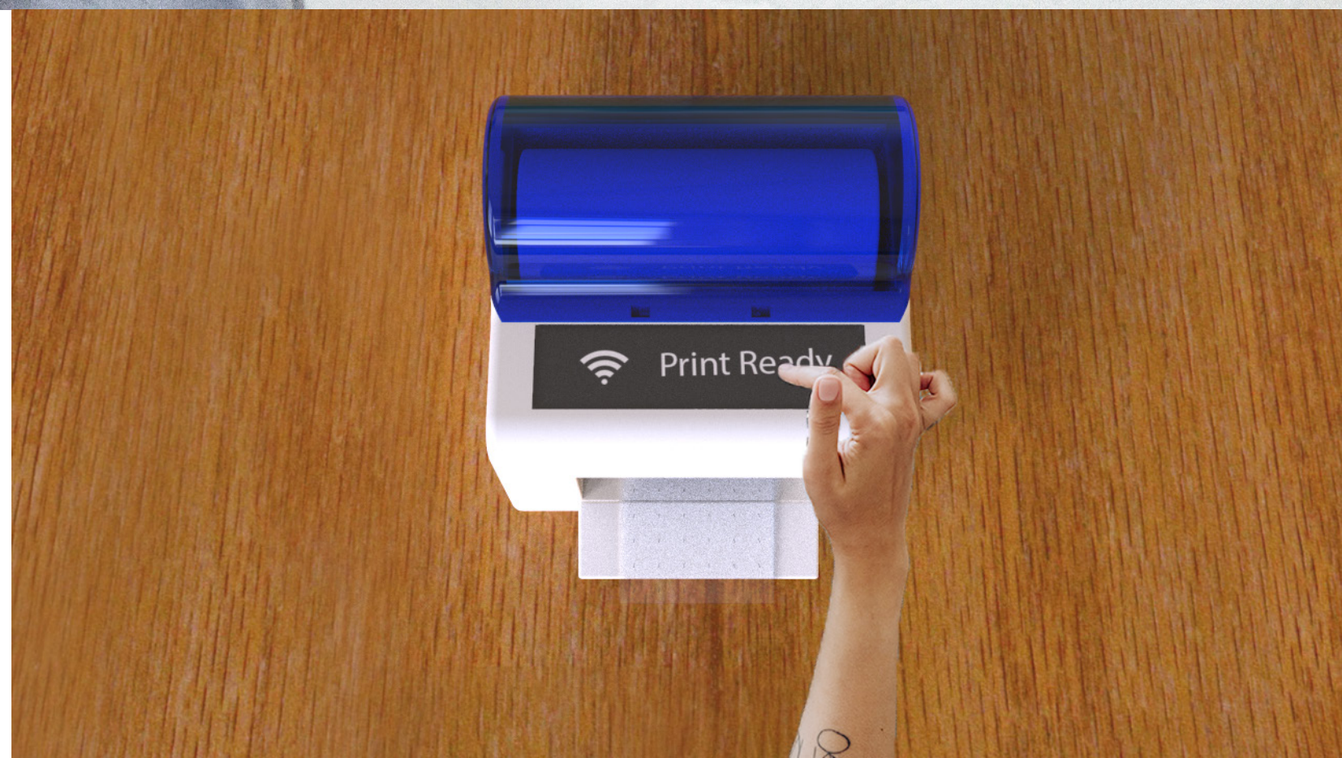
What if we could produce the latest mRNA vaccines at home? If at all possible, how would the machine that makes it look like?



Print and Apply

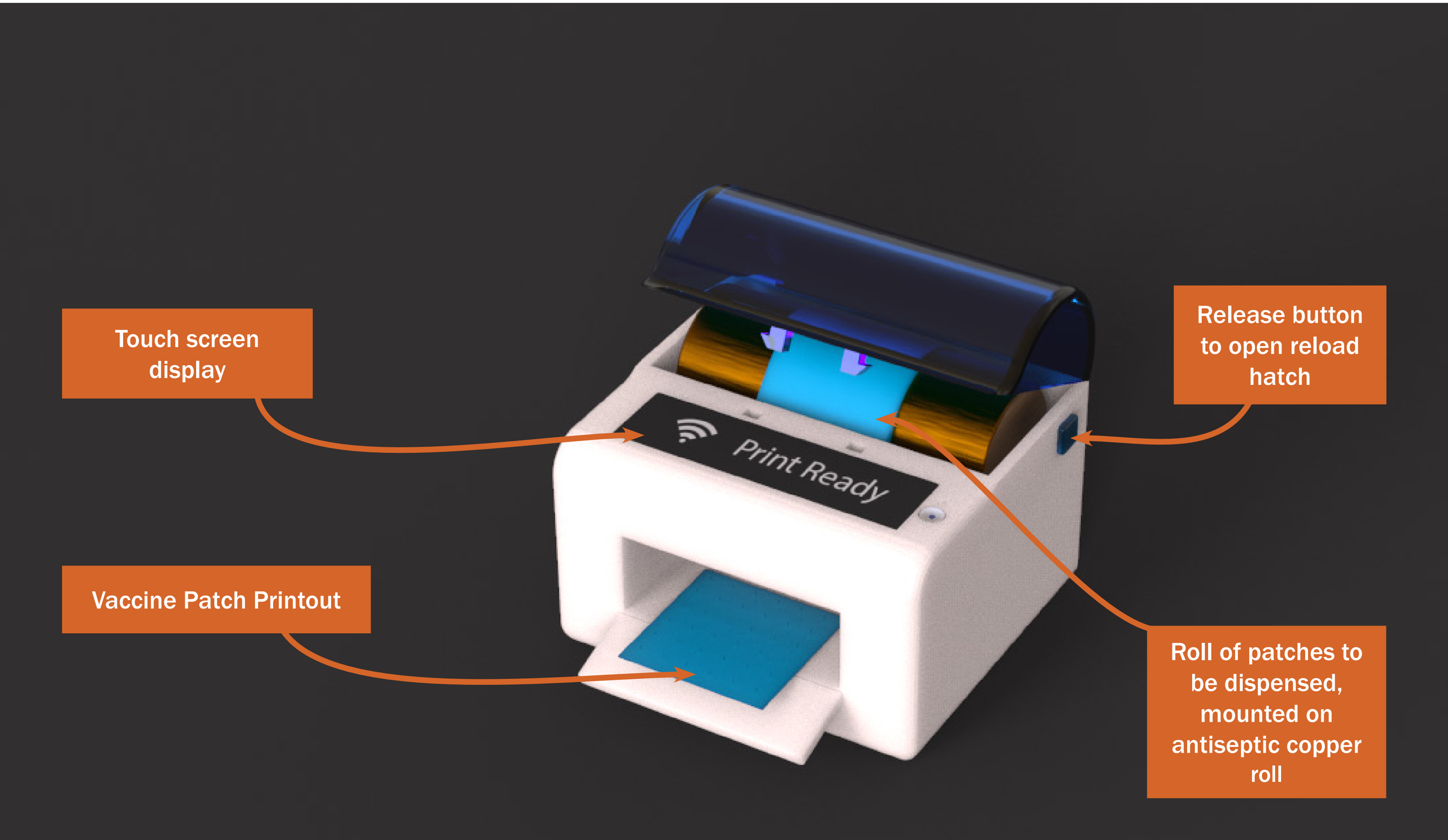
1. *Download* vaccine data
2. *Print* vaccine
3. *Paste* patch on arm for 4 minutes for vaccine to take effect

Behind the scenes, the machine synthesises the vaccine, based on the latest blueprint data from a trusted pharmaceutical company. It fills the micro-needles with synthesised mRNA vaccine and prints it.

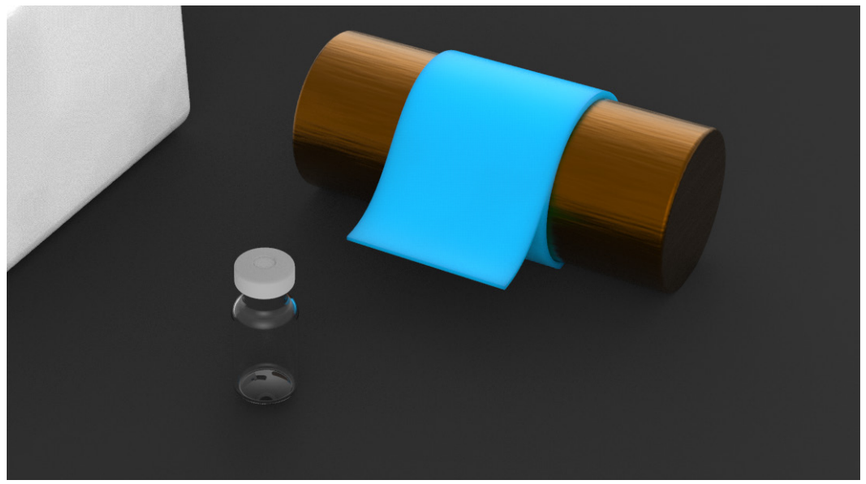


The Device

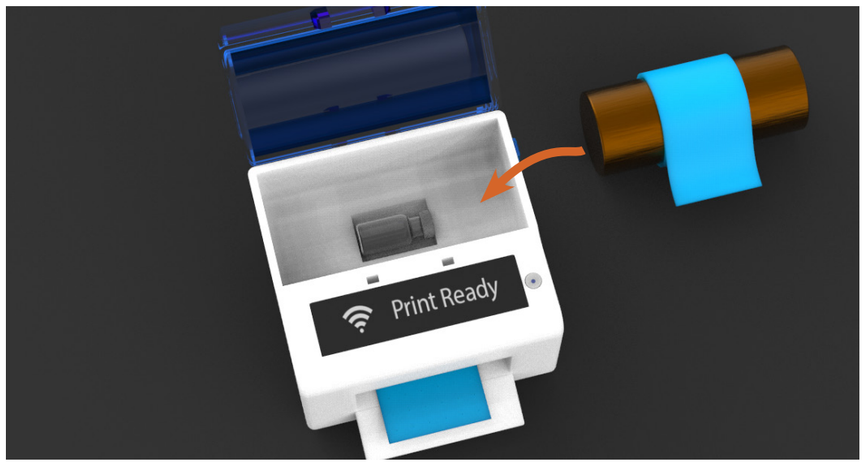
Users can interact with the touch screen to start a print, and can reload the machine with new serum precursor and vaccine patch rolls.



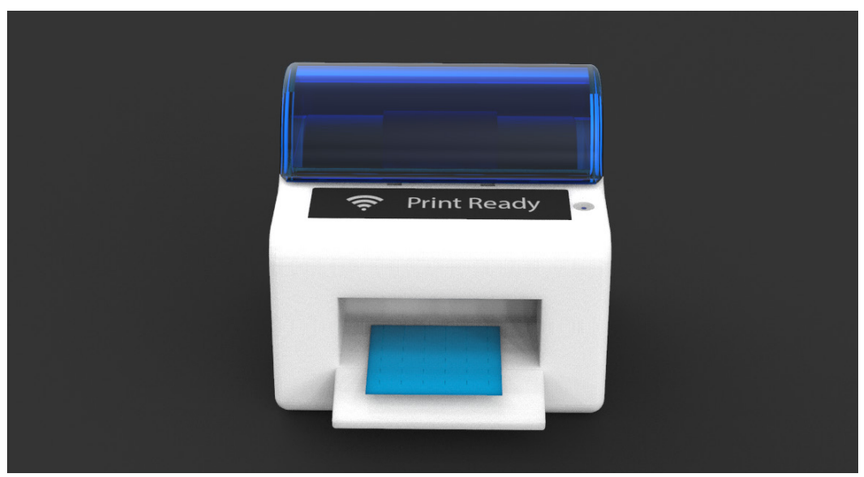
Setup & Refill



1 Receive DNA synthesis precursor serum and vaccine patch roll in the post.



2 Load DNA synthesis precursor serum and vaccine patch roll into machine.



3 Download latest vaccine blueprints and print out patch.
Up to 20 prints can be done on a single refill.

Security

Vaccine blueprints are transferred over the internet over encrypted channels, to ensure no tampering or corruption.

Quality & Testing

The vaccines are extensively tested by the pharmaceutical company before being sent over the air to the vaccine printer. At the printer end, every microgram of mRNA produced is sequenced to verify if it is of the correct formulation.

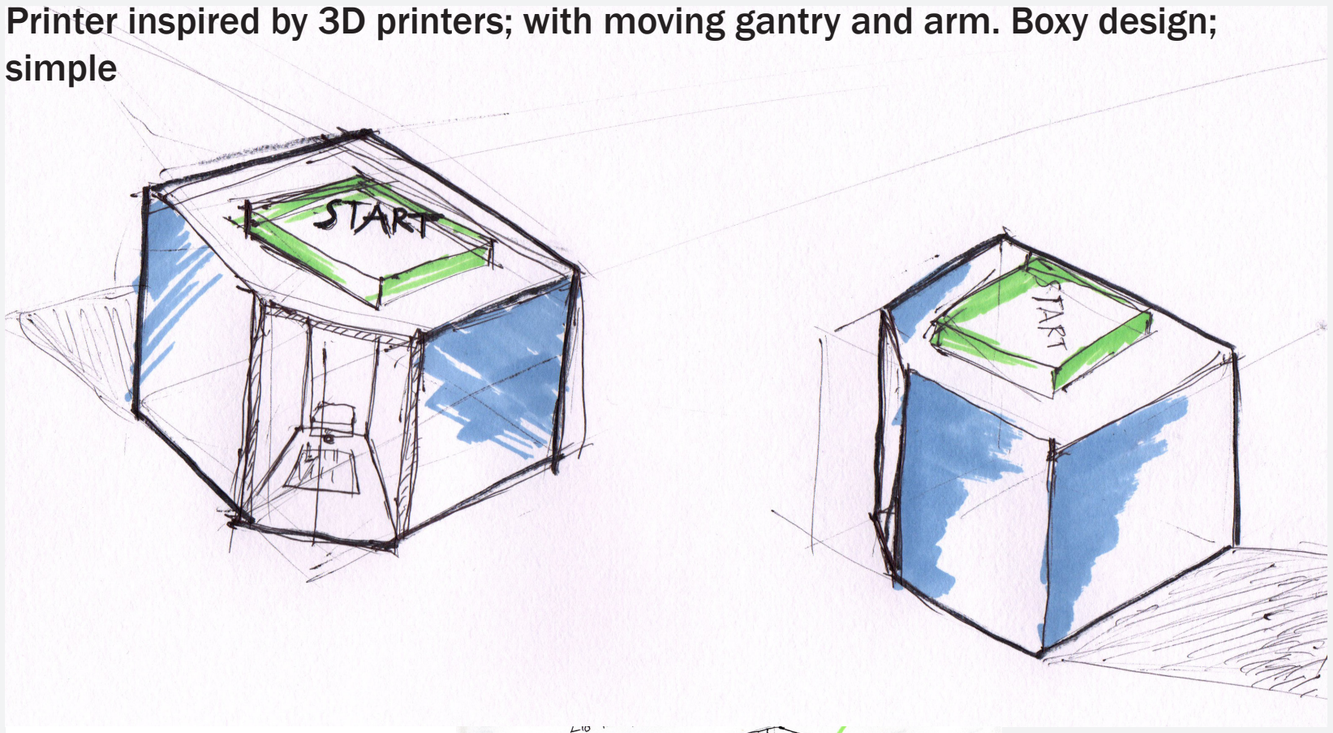
Fitting In

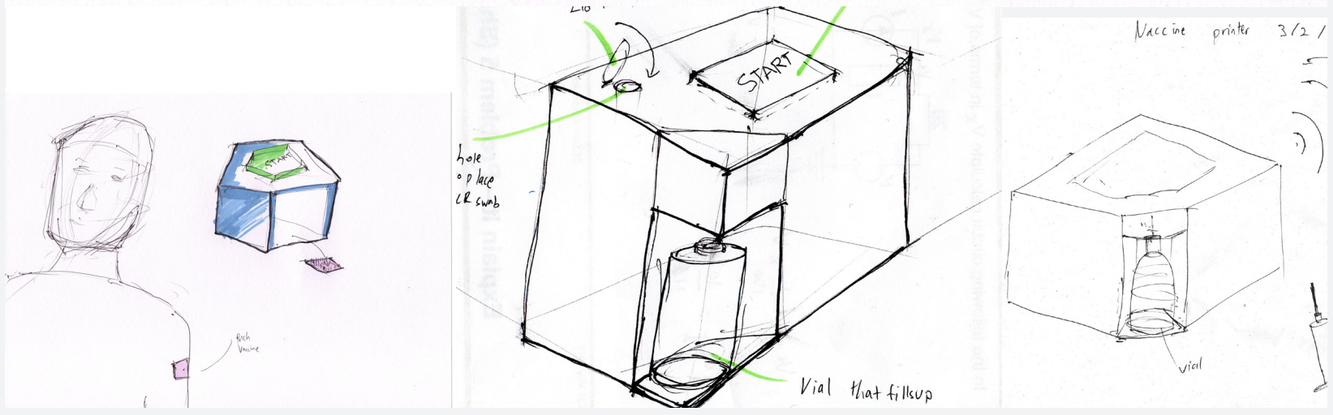
The printer can fit any kitchen top, while still becoming a conversation starter. It exudes the appearance of a high-tech device, similar to the latest mobile devices. Refills in roll and vial however must be stored in fridge and loaded when printing

Sketch compilation

The sketches explore different form factors and mechanisms

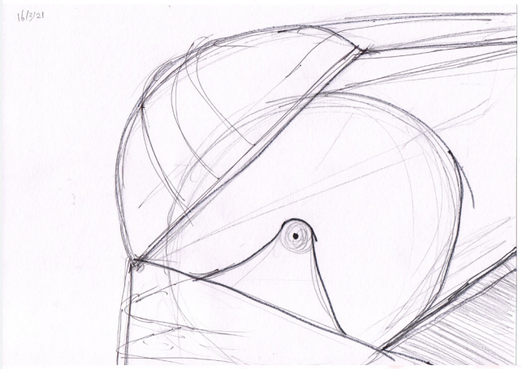
Printer inspired by 3D printers; with moving gantry and arm. Boxy design; simple



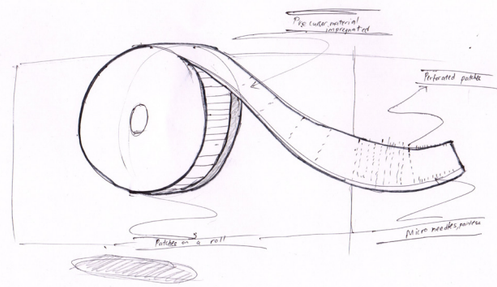


Initial experiments with vial/injection dispenser

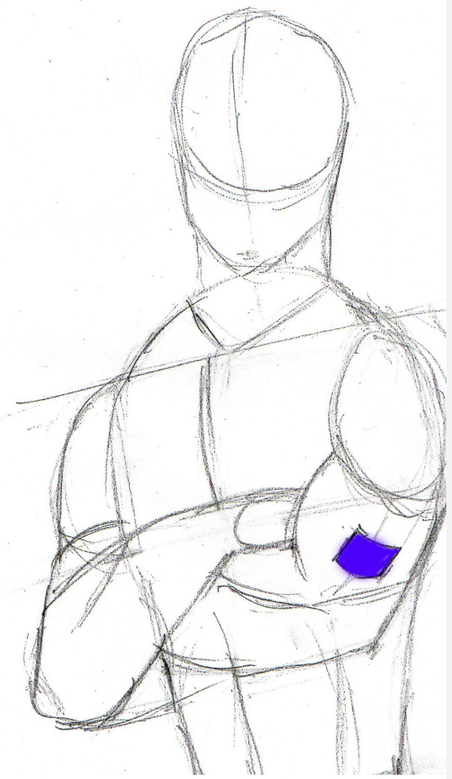
Refill hatch mechanism

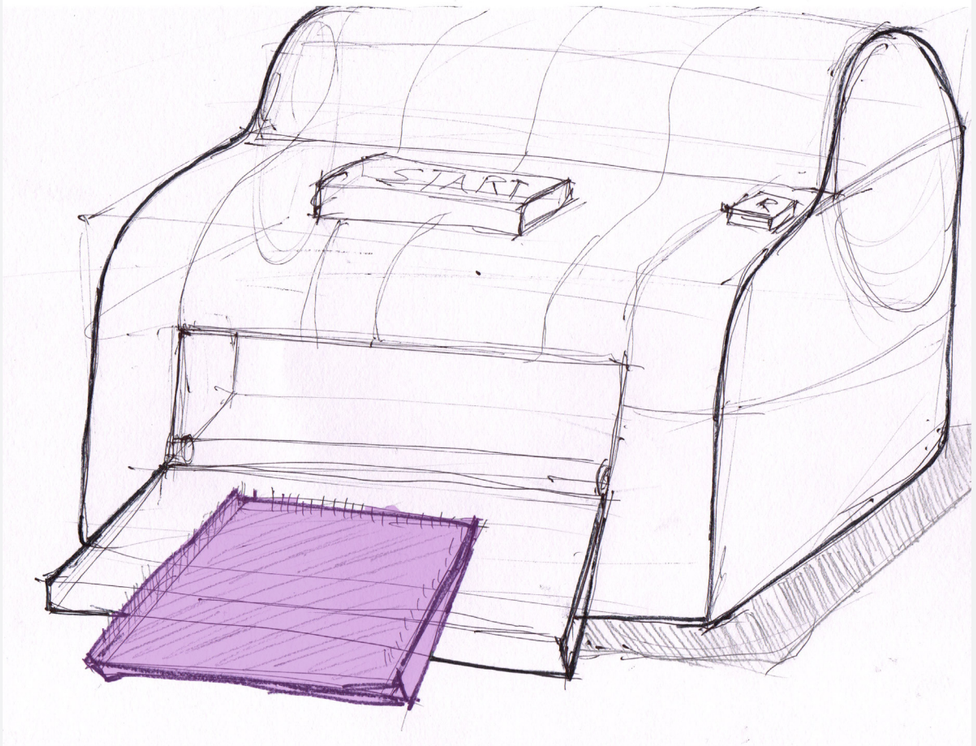


Roll based patch idea



Patch application visual





Design inspired by paper printers; smoother curves for stylish/modern look

Inspiration from similar products

We use the following similar products to explore the user interactions people are already familiar with: printing, dispensing, refilling. The interactions can be replicated by the vaccine printer, making it simpler to learn how to use. We also consider people's perceptions of these devices. Does it inspire confidence in reliability, sturdiness? The vaccine printer device must give the impression of a modern piece of electronics; sophisticated; advanced.

Dispensing Devices







Some people use these dispensing devices on a daily basis, and cannot function without them, especially the coffee. It has simple buttons that start the process to dispense. Generally, they are reliable, proven by daily usage.

Therapeutic Devices



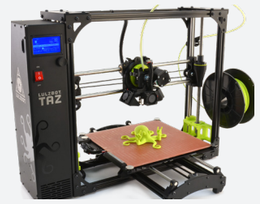




These devices, although not invasive, are useful therapeutic aids that make life better for people suffering but also to make a perfectly healthy person feel better(massager). They are viewed as life enhancers, rather than something that fixes an illness.

Printing Devices



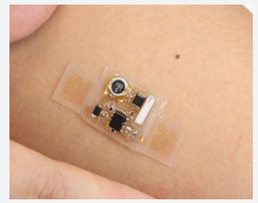




Users are familiar with the model of purchasing refills, and getting multiple outputs(prints) from each refill. However, these devices seem to break down when they are most needed!

Patches



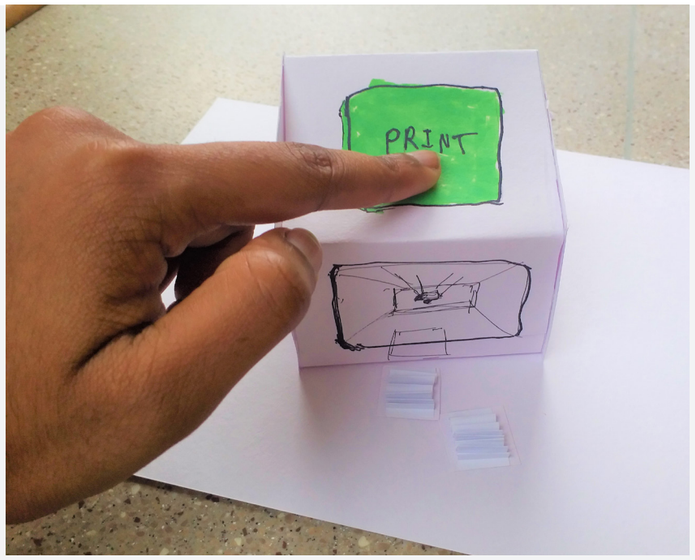


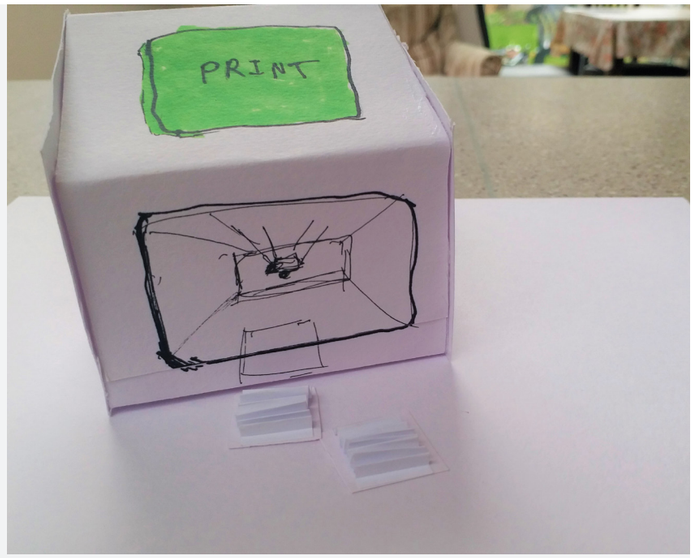


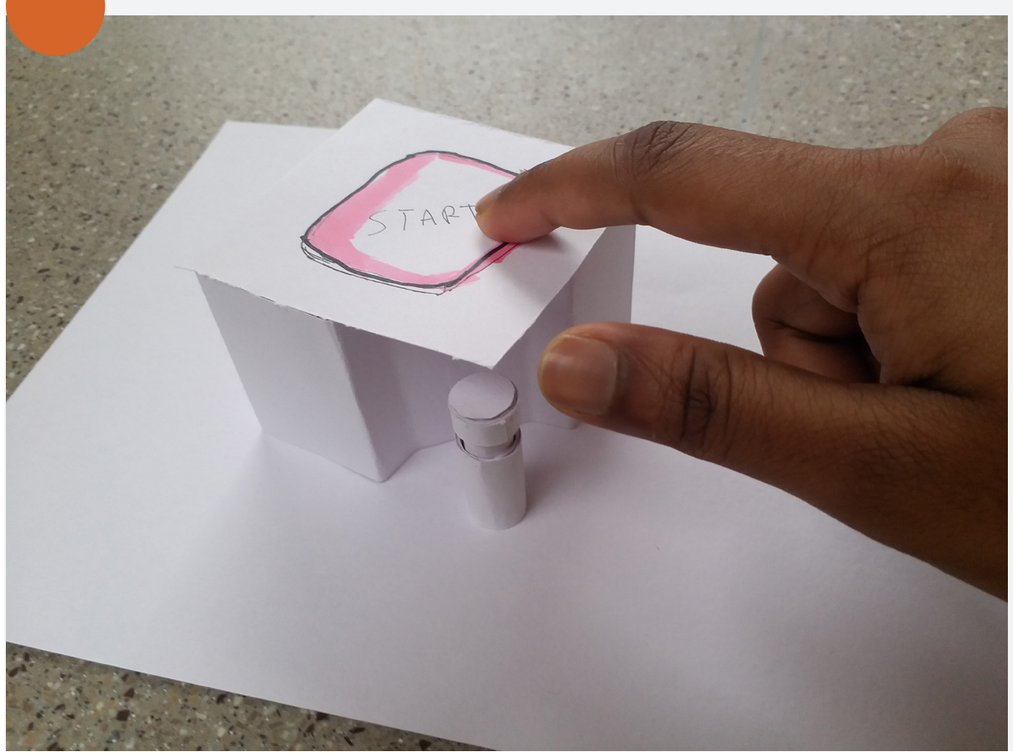
Patches for drug delivery has been used for years; to combat nicotine addiction, slow drug diffusion and even bio-markers monitoring. The concept of a patch can easily be transferred to a vaccine.

Physical Form Factor Experiments

Paper based models were created to see how easy it would be to interact with a touch screen on the device, and how will it fit within a domestic environment, in this case, a medicine cabinet. Touch input location and comfort was also tested on the paper model.









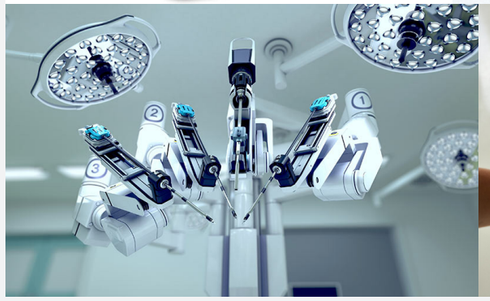
Colours, Materials, Finish

The colour scheme of the device must convey the fact that the device is a medical device, yet must not be intimidating. Blues and whites seem to be dominant in the medical device colours. The device must look modern, sophisticated so that it fits in well within a domestic household setting.













Home medical devices: Blue & White
Most home medical devices are coloured white and blue such as the Omron blood pressure monitor, Oximeter and hand-held thermometer. It seems to signify safety, medical and antiseptic.

Medical context: Blues & Greens
Blues and “hospital green” can be found in medical settings. These strongly signify sanitary conditions.

Material & Finish: ABS
Injection moulded ABS is widely used as enclosure material, with a matte/ smooth finish. This maximises grip while hiding unsightly fingerprints. It is easy to clean/sanitise. It also has a low price point, suitable for consumer goods like the vaccine printer.





Technology Advances

Latest development in RNA production has made it possible to use a machine to convert digital data to physical RNA. It has come in handy in testing out the latest mRNA based vaccines, such as the BioNTech/Pfizer vaccine. It is early days, with the machine costing at least £100k. The next leap forward is miniaturing and price reduction for household use.

DNA synthesis
The Codex DNA BioXp 3200 DNA printer is a state-of-the-art desktop DNA synthesiser



mRNA encoding
The BNT162b2 mRNA vaccine, also known as BioNTech/Pfizer SARS-CoV-2 can be encoded in a series of symbols and transmitted over the internet.

WHO 9/2020
International Nonproprietary Names Programme

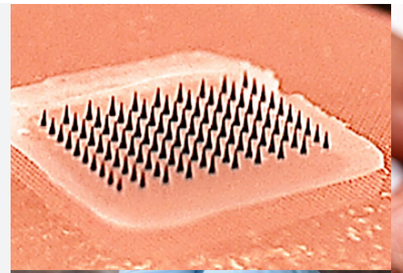
Sequence / Séquence / Secuencia

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CACCAΨGΨΨC GΨGΨΨCCΨGG ΨGCΨGCΨGCC ΨCΨGGΨGΨCC AGCCAGΨGΨG  100
ΨGAACCΨGAC CACCAGAACA CAGCΨGCCΨC CAGCCΨACAC CAACAGCΨΨΨ  150
ACCAGAGGCG ΨGΨACΨACCC CGACAAGGΨG ΨΨCAGAΨCCA GCGΨGCΨGCA  200
CΨCΨACCCAG GACCΨGΨΨCC ΨGCCΨΨΨCΨΨ CAGCAACGΨG ACCΨGGΨΨCC  250
ACGCCAΨCCA CGΨGΨCCGGC ACCAAΨGGCA CCAAGAGAΨΨ CGACAACCCC  300
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Vaccine Delivery Methods
The future is painless vaccine delivery. Needles simply cannot become a regular means of vaccine delivery considering their invasive nature.



Micro-needle patches
New less intimidating, largely painless micro-needle patches for vaccine delivery are being developed.
If it were mass manufactured, it could be delivered on a roll.







Oral delivery
Widely used but not suitable for mRNA vaccine

