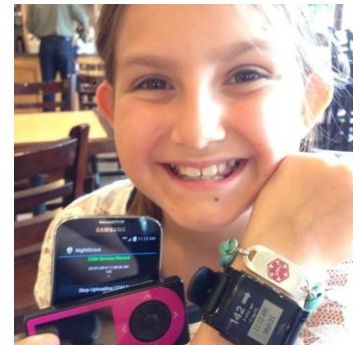


## NIGHTSCOUT

***A cloud-based software that helps children with diabetes***

### **The challenge:**

Managing type 1 diabetes requires a precise combination of insulin injections and the consumption of carbohydrates. A proper monitoring of glucose levels diminishes the risks of complications related to the disease. Diabetes is ranked 12<sup>th</sup> in the list of causes of the global burden of disease. (3)



### **The innovation:**

Nightscout is a cloud-based software that enables the continuous monitoring of glucose (CGM) levels in real-time for children with type 1 diabetes. The Nightscout technology was developed by CGM users with the collaboration of an online community of patients, their parents, and healthcare providers, all of whom share their knowledge and time on a volunteer basis. (1)

## **What We Know**

### **How it works:**

- The technology helps patients with diabetes and their caregivers to better manage the disease and could reduce the workload of healthcare providers. (2)
- Nightscout is an open-source project and improvements are made over time. Instructions for its use are downloadable and the installation can take anywhere from 30 minutes to several hours. (2)
- Code functionality cannot be guaranteed since the project was created and developed by volunteers. Each element of the system can fail at any time and render it unusable. (2)

### **The cost:**

- The innovation is free and the Nightscout Facebook group (CGM in the Cloud) offers free technical support for all users. (1, 2, 4) As of June 14<sup>th</sup> 2017, the group reached over 23,000 members.
- Though the innovation is free, it functions with a continuous glucose monitoring system (CGMS) and requires the use of electronic devices like smartphones or smartwatches. The global cost of using Nightscout depends on the devices used and on Internet access (Internet plan or Wi-Fi). (2)
- There is no cost-benefit analysis available at the moment.

### **The environmental impact:**

- The environmental impact is difficult to assess because the system relies on the use of other electronic devices.

### **The approval status:**

- The Nightscout system is not yet approved by the Food and Drug Administration. Other mobile solutions that display glucose levels on electronic devices using CGMs do exist and are already approved. (5)

## RUBY CUP

### **A free anti-bacterial menstrual cup for women and girls in East Africa**

#### **The challenge:**

Menstrual hygiene is an important issue in parts of the world where women do not have access to sanitary products because of cost or unavailability. Access to sanitary products is essential. Without them, millions of women and girls around the world miss school or work days, or use less hygienic and less safe alternatives, thereby making them susceptible to infections or diseases. It is estimated that girls can lose up to 20% of their school year due to a lack of access to sanitary products. (13)



#### **The innovation:**

The Ruby Cup is a menstrual cup distributed for free to users in East Africa through a “buy one, give one” model. It promotes the social integration of women and girls by increasing their quality of life and enabling them to go to school and/or work. (13)

#### **What We Know**

##### **How it works:**

- The Ruby Cup is made from a super anti-bacterial silicone elastomer. As of 2017, it has been distributed to more than 24,000 women in East Africa through the company's procurement program and field agencies. (13)

##### **The cost:**

- Although the initial cost is higher than for sanitary napkins or tampons and is equivalent to 5 or 6 months of use of conventional products, the Ruby Cup has a lifespan of 10 years, which makes it 95% more economical. (13-15)
- A Ruby Cup is distributed free of charge with each purchase made from the manufacturer. They are free for those who need it in East Africa (through the redistribution program) but cost about forty dollars when purchased through the website or in-store. (13)

##### **The environmental impact:**

- On average, a woman will use up to 12,000 disposable sanitary products throughout her reproductive life, which, for example, is equivalent to 200,000 tons of water wasted each year in the United Kingdom. The Ruby Cup is an ecological option because it can be used for 10 years. (13)

##### **The approval status:**

- Although the product is generally well accepted, in some cultural contexts, individuals believe it is inappropriate as it robs teenage girls' virginity. (13, 14)

## E-NABLE

### *A network that makes free 3D-printed mechanical prostheses*

#### **The challenge:**

Traditional prostheses cost an average of US\$8,000. (10) The amputation of one or more upper limbs can result from, amongst other causes, congenital abnormalities, road injuries, self-injury, or interpersonal violence. These are ranked in the top 25 causes on the list of causes of the global burden of disease. (3)



#### **The innovation:**

The e-NABLE community stands apart from traditional prostheses manufacturers by connecting volunteers who design 3D-printed upper limbs with people who need them. Models are created using a collaborative approach where printing plans are made available at no cost. Prostheses are printed free of charge from anywhere in the world and delivered directly to the user.

#### **What We Know**

##### **How it works:**

- e-NABLE designs created by volunteers are open-source and shared on Thingiverse, a site dedicated to the sharing of digital design files created by its users. It also connects volunteers with people wishing to try 3D-printed prostheses. (10, 12)
- The prostheses are mechanical, do not need electricity, are customizable, and easy to assemble. (10)
- The e-NABLE prostheses work particularly well for people with a full or partial palm and 30-degree wrist motion. They cannot be used in manual labour-intensive environments (10)
- Children can easily use the prostheses because the latter can perform simple tasks, such as holding a ball, pressing buttons, and turning pages. (11)
- Between July 2013 and June 2015, e-NABLE volunteers made approximately 1,500 prostheses for children and adults in over 40 countries. (12)

##### **The cost:**

- The prostheses created and printed by e-NABLE volunteers are free. (10)

##### **The environmental impact:**

- e-NABLE prostheses are 3D-printed from all over the world and there are more than 100 models. The environmental impact is therefore difficult to estimate and varies according to the model. (10, 12)

##### **The approval status:**

- e-NABLE prostheses have been evaluated by clinical studies but have not been approved by organizations such as the Food and Drug Administration. (11)

## HUMAN POWERED NEBULIZER

***A portable nebulizer for the diagnosis and treatment of respiratory health problems***

### **The challenge:**

A nebulizer is a device used to transform liquid medicine into a mist to diagnose and treat many respiratory health problems. Nebulizers currently available on the market are costly and rely on electricity. Consequently, they are not designed for use in areas where lung disease is most prevalent: in the least developed countries. Respiratory health problems, including tuberculosis, chronic obstructive pulmonary disease, asthma, and lower respiratory tract infections are ranked in the top 25 causes on the list of causes of the global burden of disease. (3)



### **The innovation:**

The Human Powered Nebulizer (HPN) is a portable and manually activated nebulizer.

### **What We Know**

#### **How it works:**

- This nebulizer is manually activated by a healthcare worker or caregiver and does not use batteries or any other external source of energy. The technology is easy to use, even though the World Health Organization recommends a quick training for users. (4, 6)
- The HPN's performance is equivalent to that of an electric-powered nebulizer. (8,9)
- The HPN has a lifespan of 10 years and was designed to be used in areas where access to electricity is limited or non-existent. (4, 6, 8)

#### **The cost:**

- An electric nebulizer can cost over US\$100. With large-scale production, the projected price of each HPN would be under US\$50. The cost of operation and maintenance for each device is estimated to be low. (9)
- According to the manufacturer, a cost-effectiveness study was carried out in El Salvador in 2015, but the data are still being analyzed. Another study was planned in Guatemala in 2016. (4, 9)

#### **The environmental impact:**

- The environmental impact is difficult to assess because the device is not yet manufactured in its final version.

#### **The approval status:**

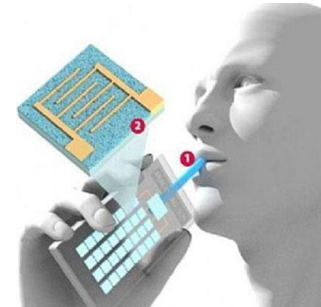
- Although clinical studies have been conducted, this innovation is not yet available on the market. Funding is still required for its manufacture and approval by the Food and Drug Administration. (4, 6)

## NA-NOSE

### ***A technology that detects volatile compounds from breath***

#### **The challenge:**

Early detection of lung cancer requires a long series of tests as well as often invasive procedures. Lung cancer and respiratory tract infections are ranked 20th in the list of causes of the global burden of disease. (3)



#### **The innovation:**

With a high degree of precision, Na-Nose technology detects volatile compounds using breath only, allowing for early and detailed diagnosis. The technology can also be paired with smartphones to form the SNIFFPHONE, which can be used in remote areas. Using the SNIFFPHONE to detect cancer would greatly shorten the diagnostic process, making it almost instantaneous. The diagnosis could be made automatically and thus reduce the work intensity of health professionals. (20)

#### **What We know**

##### **How it works:**

- Studies demonstrate the effectiveness and accuracy of Na-Nose technology in the early diagnosis of lung cancer. The tests distinguished healthy patients from lung cancer patients with 85% accuracy and divided the early stages from the advanced stages with 79% accuracy. (16-19)
- Studies predict that the SNIFFPHONE could also be used to diagnose and track other cancers or respiratory diseases. (16-19)
- Because it includes a smartphone, the SNIFFPHONE system can be used in rural areas or in developing countries where costly traditional equipment is not available or accessible. This innovation could therefore contribute to a fair and more equitable model of care. (20)

##### **The cost:**

- No studies have been conducted on the cost and the use of Na-Nose technology at this time and a potential sale price is not yet established. However, it is estimated that the SNIFFPHONE (or other Na-Nose technologies) will be less expensive than the currently used technologies. (21)

##### **The environmental impact:**

- It is expected that the SNIFFPHONE device will consume little energy. However, there is not enough information on the characteristics of the product to determine its true environmental impact. (20)

##### **The approval status:**

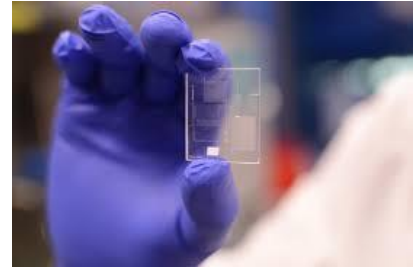
- Na-Nose technology is not commercially available at this time and could only be used in a laboratory setting prior to the invention of the SNIFFPHONE. Food and Drug Administration tests are underway in the United States and could take a few years to complete. (20)

## SENSOREAL

### *Ultra-fast detection of diseases with a single drop of blood using microchips*

#### **The challenge:**

Laboratory diagnostic tests are costly, require equipment and specialized reagents, and take time. Diseases that require expensive diagnostic tests include, amongst others, cervical cancer, ranked 106th in the list of causes of the global burden of disease, and sexually transmitted diseases such as human papillomavirus and hepatitis C, ranked 75th. (3)



#### **The innovation:**

Sensoreal microchips detect small amounts of disease biomarkers within minutes using a single drop of blood. Sensoreal technology can currently be used to detect several biomarkers, including vitamin D, human papillomavirus, hepatitis C, certain thyroid hormones, and folic acid. It can also screen for prostate and cervical cancer, as well as identify biomarkers to detect heart disease. (22)

#### **What We Know**

##### **How it works:**

- The device needs less than one drop of blood to make a diagnosis, about 15 microliters. (22)
- Microfluidics allows diagnostic tests to be performed in a matter of minutes, greatly reducing the usual delays caused by sending the collected samples to laboratories. (22)
- Diagnostic tests using Sensoreal technology have the same quality as those performed in laboratories. (22)

##### **The cost:**

- The small volumes required to perform tests using Sensoreal reduce the cost of purchase of reagents and equipment use. (23)
- The cost of using Sensoreal microchips has been estimated in the diagnosis of elephantiasis, a disease which increases the size of a body part. In this case, microchips with biosensors could be produced for approximately \$0.60 per unit and the analytical device is estimated to cost approximately \$200. (24)

##### **The environmental impact:**

- The analytical device works with batteries and consumes little energy. The microchips would be for single use. However, there is not enough information on the characteristics of the product to determine its true environmental impact. (24)



## STEADIGLOVE

### **A stabilizing glove to diminish hand tremors**

#### **The challenge:**

Tremors and abnormal movements of the hand can have several causes which are often difficult to identify. They affect between 4% and 6% of people over the age of 40 (25), totalling approximately 280 million people worldwide. (26) Diseases that can cause tremors include Parkinson's Disease, which is ranked 187th in the list of causes of the global burden of disease. (3) There are few treatments that can eliminate hand tremors and they include drugs with serious side effects, invasive procedures, and Botox injections. (27)



#### **The innovation:**

The Steadiglove was invented to provide an accessible solution for hand tremors and to allow affected people to regain the ability to perform essential movements, such as drinking or eating.

#### **What We Know**

##### **How it works:**

- The Steadiglove incorporates technology used in the construction of buildings to withstand earthquakes. This nanotechnology uses fluids to immediately compensate for vibrations and tremors, and thus stabilize the movements. (27)
- The technology used by the Steadiglove does not require batteries or electricity. As such, the glove can be worn anywhere. (27)
- The glove is washable, adaptable to several degrees of tremors, is lightweight, and is designed to be worn all day. (27)

##### **The cost:**

- The purchase price and cost of the Steadiglove are not currently available. It is therefore impossible to determine its accessibility in relation to other alternatives. (27)

##### **The environmental impact:**

- The environmental impact is difficult to estimate since the device is not yet manufactured in its final version and the specific materials used are still unknown. However, it is important to consider the fact that the glove does not use any source of energy. (27)

##### **The approval status:**

- The business model of the company Steadiwear, which designed the Steadiglove, is not known at the moment since the glove is not yet available.

## **TYZE**

### **An online networking platform to support care for the elderly**

#### **The challenge:**

The population is aging and institutional health services are struggling to meet the growing needs for monitoring and support of patients and the elderly. Several studies demonstrate the importance of a support network: people recover more quickly, become healthier, and use health services more efficiently. (30-32) More than 80% of Canadians offer free assistance to family or community members. In addition, 40% of Canadians expressed concern about the needs of others, despite their own problems. (30, 33)



#### **The innovation:**

Tyze is an online networking platform that enables those caring for an elderly person to communicate and to organize their support activities. The platform can be used to archive documents, share news and photos, and synchronize a calendar between caregivers, family, friends, and the community surrounding the person in need of support. Tyze is also a recognized social enterprise with a "B Corporation" certification. This certification means that certified for-profit corporations are obliged to consider the impact of their decisions on their employees, suppliers, community, customers, and the environment. (28, 34)

## **What We Know**

#### **How it works:**

- Tyze is an online platform and therefore requires the use of electronic hardware such as a computer, smartphone, or tablet. (28)
- Tyze can be used by both individuals and healthcare institutions. The company can adapt its platform on demand to meet specific needs. (28)
- By facilitating the establishment of a support network, Tyze technology addresses the challenges of healthcare systems rather than the global burden of disease. (30-32)

#### **The cost:**

- Tyze technology was purchased by Saint Elizabeth Healthcare, Canada's largest non-profit nursing service providers. Tyze is offered free of charge to all Saint Elizabeth Healthcare clients and their network members. (29)

#### **The environmental impact:**

- The environmental impact of using Tyze is minimal, as it is an online platform. In addition, the "B Corporation" certification ensures that the company cares about the environment in the development of its products. The total impact can therefore be evaluated based on the other devices used. (34)



## EASYSON

### *An affordable and invisible hearing aid*

#### **The challenge:**

Hearing aids are underused for a number of reasons, including high costs, discomfort, aesthetics, and the number of appointments required with specialists. Hearing problems have many causes, including sensory organ diseases, ranked 8th in the list of causes leading to the global burden of disease, and hearing loss related to aging, ranked 23<sup>rd</sup>. (3)



#### **The innovation:**

EasySon hearing aids respond to all of these problems by offering a low-cost, invisible, ready-to-hear device that addresses several types of hearing problems and requires only one medical appointment. Unisson, which offers EasySon hearing aids, is a for-profit French company with the legal form of a limited liability company. (37)

#### **What We Know**

##### **How it works:**

- The EasySon device measures only 5 mm and slips completely into the ear canal. It is therefore virtually invisible and allows users to wear it discreetly. (35)
- EasySon devices can be used by people with up to 60% hearing loss (mild to moderate), as well as several problems such as presbycusis (mostly due to aging). They may not be suitable for some people. (35)
- EasySon hearing aids are only available following an in-person appointment at the Unisson clinics in Paris and Lyon. (35)

##### **The cost:**

- In France, where EasySon devices are available, patients are reimbursed in part by social security (€119.83 per ear) and then insured under insurance policies (average of €330). Most patients receive total reimbursement. (35)
- The EasySon service is unlimited and includes routine check-ups, audiograms as needed for equipment fittings, and cleanings. It is not necessary to make an appointment, which adds to its accessibility. (36)

##### **The environmental impact:**

- The environmental impact of EasySon hearing aids is difficult to assess as the exact composition of the devices remains unknown. The prostheses use disposable batteries with an autonomy of 80 h. (35)

**NOTES**

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