# Open-source games for health, multiplayer and gamepads

## Co-creating fun care with children with asthma, young adults with cystic fibrosis, elders with COPD

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# Can we breathe freely?

Without air pollution,
our life expectancy would
increase by 34 months.[1]

With a commons-based
economy, each and every
human could afford medical
care (vs one in two today).[2]

How *not to produce* risks?

How to foster *mutual* care?

risks (on 10 people) [3]
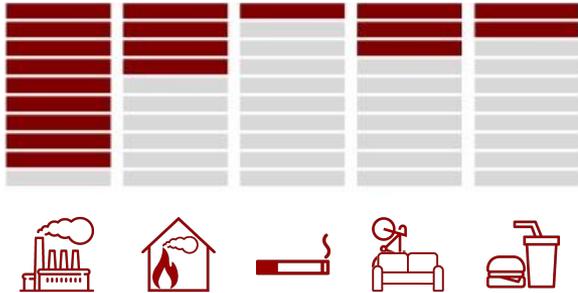
no access to care [3]

1. Lelieveld J et al. Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. Cardiovascular Research 2020. https://doi.org/10.1093/cvr/cvaa025
2. Balli F. Health technology and medical innovation: why open-source is vital. Geneva-Tsinghua Initiative SDG Summer School 2021. https://doi.org/10.5281/zenodo.5070342
3. Balli F et al. Mutual care taking: collectively creating our respiratory wellbeing with open sciences. GARD General Meeting 2021. https://doi.org/10.5281/zenodo.3451505

# We make Breathing Games.

We, people across regions and disciplines, get engaged to value pluralism and collective wisdom.

We embrace play as a natural way to experiment, socialize, learn.

We document and share our work so that everyone can freely use, study, improve, adapt it.
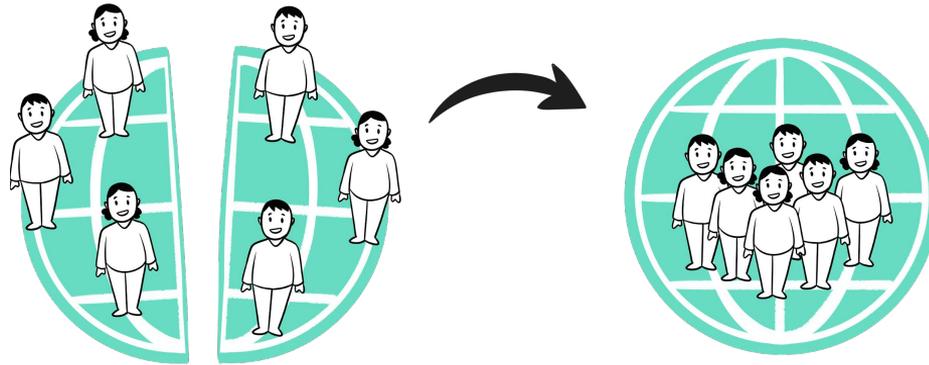
## Traditional medtech

Corporate experts

build

a technical tool

to manage a disease.

Sealed in a black box,

its price make it unaffordable to some.

#compliance

## Breathing Games

Volunteer, diverse contributors

co-create

an evolving, rewarding, immersive story

to promote holistic health.

Free to use, study, improve,

its gratuity helps develop solidarity.

#adhesion

**Games**

# Asthma Heroes

| | |
|---|---|
| Topics | Preventing asthma attacks, triggers, general knowledge |
| Audience | Children with asthma, 7-12 years old |
| Mode | 1 player, 90-minute, once |
| Story | Aliens transformed the planet and everyone is now asthmatic. You must gather information to cure asthma. |
| Languages | English 中文 Español العربية<br>Français Português Deutsch 日语<br>Türk 한국어 Tiếng Việt فارسى<br>Italiano |
| Disclaimer | Game created for research and health promotion. Not intended to diagnose, treat, or cure a disease. Not a medical device, does not replace prof. advice. |
| Device | Windows (ok), Mac OS (buggy), Linux (not tested) |
| Source code | AGPL 3 for Unity 2019.2.20 (closed engine) |
| Research | Pilot study, http://doi.org/10.2196/preprints.33389 |
| Website | www.breathinggames.net/jeux/asthma-heroes |
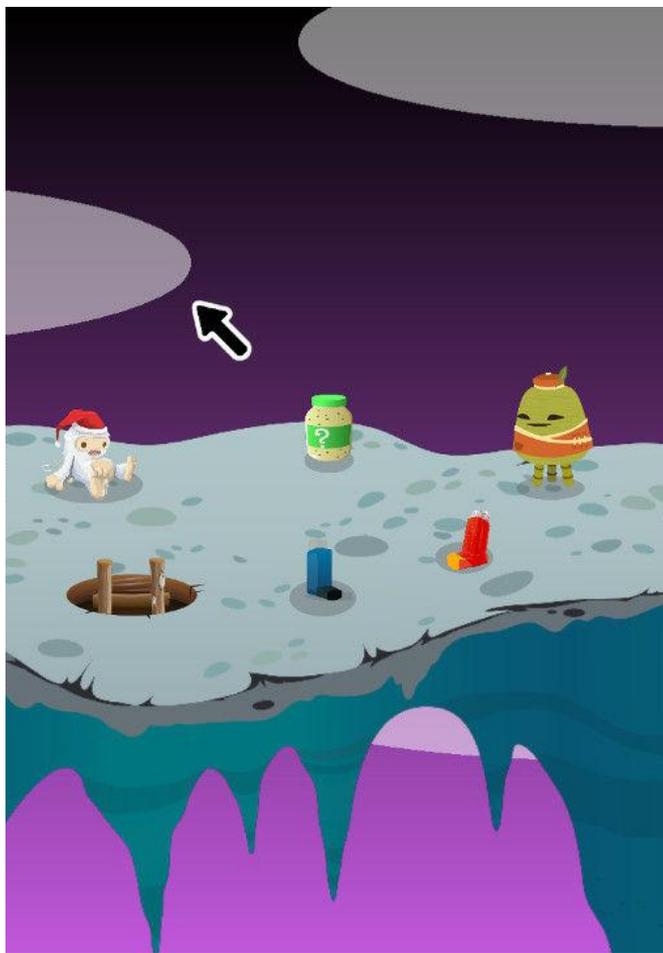
# Asthmonautes

| | |
|---|---|
| Aim | Preventing asthma attacks, triggers |
| Audience | Children with asthma, 11-16 years old |
| Mode | 1 player, 90-minute, once |
| Story | Three friends have asthma, and six know how to help them. Each time you help, you can access a new island. |
| Languages | English 中文 Español العربية<br>Français Русский Português Deutsch<br>日语 Türk 한국어 Tiếng Việt<br>فارسی Italiano |
| Disclaimer | Game created for research and health promotion. Not intended to diagnose, treat, or cure a disease. Not a medical device, does not replace prof. advice. |
| Device | Windows (ok), WebGL (buggy) |
| Source code | AGPL 3 for GameMaker (closed engine), Godot (archive) |
| Research | Pilot study, http://doi.org/10.2196/preprints.33389 |
| Website | www.breathinggames.net/jeux/asthmonautes |
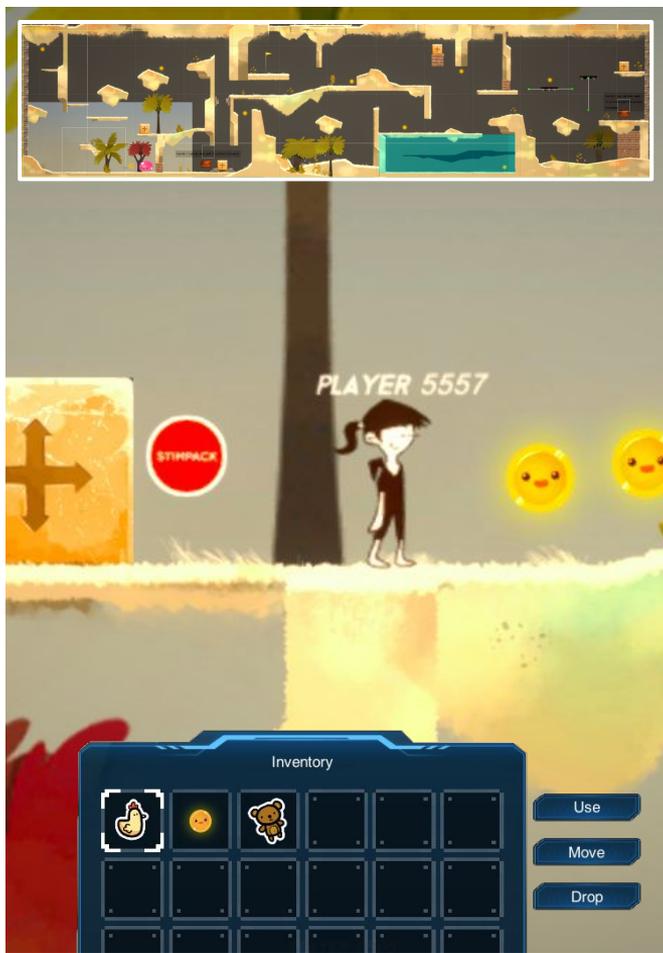
# Rise – multiplayer

| | |
|---|---|
| Aim | Inviting people to create a game level recounting *their* story, and transforming it into a collaborative challenge |
| Audience | All ages from 7 years old |
| Mode | 1 to 4 players online or on shared screen, time varies |
| Story | You go on a pilgrimage to the mountaintop with friends with different skills (double jump, gliding flight, speed boost, wall jump). On the way, the air becomes scarce and you have to cooperate to overcome challenges. |
| Languages | English |
| Disclaimer | Game created for research and health promotion. Not intended to diagnose, treat, or cure a disease. Not a medical device, does not replace prof. advice. |
| Device | Windows (ok) |
| Source code | GPL 3 for Unity 2019.2.20 + Photon (closed engines) |
| Research | To do |
| Website | www.breathinggames.net/jeux/rise |

# Controllers

# Spirotroller enhanced

| | |
|---|---|
| Data | Expiratory flow<br>3 push buttons |
| Output | Breath flow date via USB or Bluetooth |
| Description | 3D-printed personal device combining a venturi tube and a MP3V5010DP differential pressure sensor with amplifier, AdaFruit Feather 32U4 BlueFruit board, and battery. Certified Open Source Hardware Association. |
| Reprod cost. | 70 € electronic components + filament, bolts, etc. |
| Languages | English |
| Disclaimer | Controller created for research and health promotion. Not intended to diagnose, treat, or cure a disease. Not a medical device, does not replace prof. advice. |
| Licences | CERN OHL-S (designs), AGPL 3 (software) |
| Research | Cross sectional study with 158 children aged 8-15, PEF + FEV1 correlation, https://doi.org/10.2196/25052 |
| Website | www.breathinggames.net/spirotroller-enhanced |

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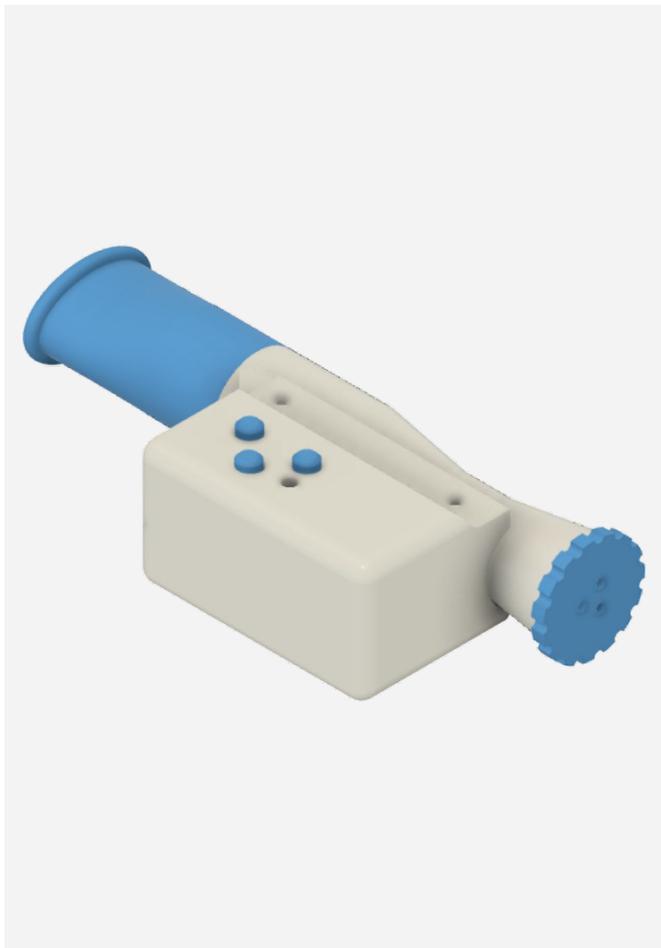
# Spirotroller gaming

| | |
|---|---|
| Data | Inspiratory and expiratory flow with optional resistor to adjust expiratory and inspiratory pressure<br>3 push buttons |
| Output | Flow, pressure, volume and breath direction via USB or Bluetooth BLE, gamepad emulation |
| Description | 3D-printed domestic device combining a venturi tube (antibacterial filament) and dual LPS33W absolute pressure sensors, ESP32 processor, and a battery. |
| Reprod cost. | 30 € electronic components + filament, bolts, etc. |
| Languages | English |
| Disclaimer | Controller created for research and health promotion.<br>Not intended to diagnose, treat, or cure a disease.<br>Not a medical device, does not replace prof. advice. |
| Licences | CERN OHL-S (designs), AGPL 3 (software) |
| Research | Integration to new and existing games in progress |
| Website | www.breathinggames.net/spirotroller-gaming |

# Breathing gamepad

| | |
|---|---|
| Data | Removable nose: Inspiratory and expiratory flow with optional resistor to adjust expiratory and inspiratory pressure, 2 joysticks, directional button, 8 push buttons |
| Output | Flow, pressure, volume and breath direction via USB or Bluetooth BLE, gamepad emulation |
| Description | 3D-printed domestic device combining a removable venturi tube (antibacterial filament) and dual LPS33W absolute pressure sensors, ESP32 processor, and a battery. Alternative Sensors and devices possible. |
| Reprod cost. | 50 € electronic components + filament, bolts, etc. |
| Languages | English |
| Disclaimer | Controller created for research and health promotion. Not intended to diagnose, treat, or cure a disease. Not a medical device, does not replace prof. advice. |
| Licenses | CERN OHL-S (designs), AGPL 3 (software) |
| Research | Integration to new and existing games in progress |
| Website | www.breathinggames.net/breathing-gamepad |

# Creation-as-research

# 5 asthmatic children and their parents tested four games

· games provide a space for parents and children
  learn and discuss by playing together

· real-life scenarios can improve knowledge transfer

· provides a positive role model in real-life
  as asthmatic characters overcome challenges

» Silva-Lavigne N, Valderrama A, Pelaez S, Bransi M, Balli F, Gervais Y, Gaudy T, Tse SM.
  Acceptability of serious games in pediatric asthma education and self-management.
  Preprint JMIR Pediatrics and Parenting 2021. http://doi.org/10.2196/preprints.33389

CHU Sainte-Justine Research Center
Mother and Child University Hospital Center

UNIVERSITÉ Concordia UNIVERSITY

Canadian Institutes of Health Research

breathing games.net™

# 158 children tested a game and controller in a spirometry lab

- PEF measured had good correlation with spirometry
  PEF (r=0.83, P<.001), $FEV_1$ (r=0.74, P<.001), $FEF_{25-75}$ (r=0.65, P<.001).

- PEF measured had expected bias (mean of –36.4 L/min).

- Participants' feedback strongly positive (78.3% – 123/157)
  reporting they would use the game if they had it at home.

» Chelabi K, Balli F, Bransi M, Gervais Y, Marthe C, Tse SM. Validation of a portable game controller to assess peak expiratory flow against conventional spirometry in children: cross-sectional study. JMIR Serious Games 2021. https://doi.org/10.2196/25052

# Young adults with cystic fibrosis co-designed games

- Two game jams with 10 young adults (16-24 yo),
  7 game designers, 4 illustrators, 5 engineers, 5 clinicians

- Projects: impact of daily choices on life quality,
  players cooperate to climb a mountain (scarce air)

- Positive feedback from all participants.



» Kirszenbaum M, Lustre A, de Beauvais N, Hauterive M, Wenk N, Gervais Y, Claricia M, Frangos M, Gomez V, Burgel, PR, Sermet-Gaudelus I, Valette J, Balli F. Favoriser le soin autonome : encourager les jeunes vivant avec la mucoviscidose à partager leur expérience à travers la création de jeux collaboratifs. RMEF 2021. https://doi.org/10.5281/zenodo.4730416

# Translation of two games for asthma in 12 languages

· English, Chinese, Spanish, Arabic, French, Portuguese, German, Japanese, Turkish, Korean, Vietnamese, Italian + Russian for Asthmonautes

· Reviewed by native physicians

· Corrections: language for children, global triggers, etc.



» Balli F, Jeanmaire G, Chelabi K, Kellner E, Gingras S, Gervais Y.
  Méthodes mixtes, jeux, matériel ouvert et traduction en santé.
  Colloque méthodes mixtes francophonie 2021. https://doi.org/10.5281/zenodo.4719734

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# Collaborations at GARD and beyond

- Italy: research planned after 20 children tested Asthma Heroes at the European researchers' night

- Syria: plan to make games accessible via Raspberry Pi in areas without Internet as pilot to support LMIC

- South Korea + Switzerland: plan to host co-creation events to combine games and air pollution sensors

# Advocating for health commons

- First event held to federate non-profit communities cocreating freely reproducible health technology

- Poster in English, French, Spanish, Portuguese, Russian, Chinese, Hindi, Bengali, Arabic

- GARD presentation on Respiratory health commons



**HEALTH TECHNOLOGY AS COMMONS: TRUSTABLE, AFFORDABLE, ADAPTABLE**

Geneva Health Forum 2020 · Open Village · www.openvillage.ch

6 in 10 humans still have no access to care, or do not adhere to it, despite rising investments.[1-3]
Alcohol-based hand rub[4] and WikiMed[5] illustrate how creating freely reproducible equipment and software with communities can: save millions of lives, increase integrity, cut costs by 90%.
Cooperation-driven care is the only way to realize the 2030 agenda in time: health for everyone.[6]
We present nine alternatives to the dominant proprietary excluding innovation model, to drive development towards a responsible, solidar society.

**Hand prosthesis to ease one's daily life**
A prosthetic hand usually costs 6-10 K€. Enable brings together over 30000 volunteers who design and distribute 3D-printed prostheses to vulnerable people.
www.enablingthefuture.org + www.gre-nable.fr + www.enablenepal.org

**Drugs produced with integrity**
India has a pioneer approach in pharmaceutics. Open Source Drug Discovery brings together 7900 people who collectively develop open-source, low-cost therapies for neglected

» Balli F, Matringe M, le Couedic C, Schull J, Gautam S, Jandard P, Kellner E, Anastasaki A, Serada K, Brahmachari SK, Winter L, Lonchampt P, Schoeller F, Krishnakumar A, Greshake B, Lhoste K, Parot C, Jeanmaire G. Health technology as commons: trustable, affordable, adaptable. Geneva Health Forum Open Village 2020. https://doi.org/10.5281/zenodo.4327587

# Next steps

Games: encourage people to co-create game levels for our online multiplayer

Controllers: further develop and validate the controllers

Creation-as-research: international study in various settings + advocacy for health democracy
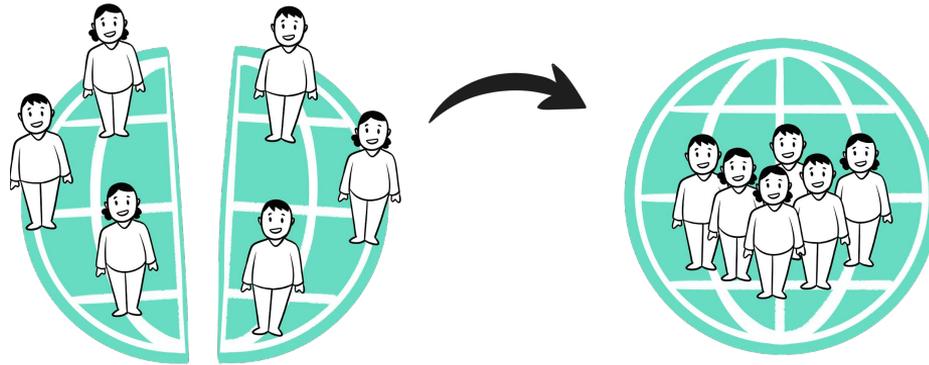
# Thank you

www.breathinggames.net          doi.org/10.5281/zenodo.5515638

breathinggames          breathinggames          /c/breathinggamesnet1

# Previous posters

Mutual care taking: collectively creating
our respiratory wellbeing with open sciences

GARD 2019 · https://doi.org/10.5281/zenodo.3451505



Next-gen advocacy for respiratory health:
fun, empowering, participatory, freely adaptable

GARD 2018 · https://doi.org/10.5281/zenodo.1344628



When populations care about their respiratory health:
a scalable bottom-up model to foster self-care for all

GARD 2017 · https://doi.org/10.5281/zenodo.1344084