

Gregory MS

Annual

Review

2023



<https://gregory-ms.com/>

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Foreword

by António Lopes

As we reflect on the milestones achieved by the team in the past year, it fills us with immense pride and gratitude to witness the work we have made in the field of multiple sclerosis (MS) research. Our annual report for 2023 serves as a testament to our unwavering commitment to advancing the understanding and treatment of this complex disease.

At the heart of our accomplishments is the little bot that started it all, Gregory-MS, which we have developed to revolutionise the way scientific information is processed and utilised. This machine learning-based bot has efficiently been sifting through an overwhelming volume of scientific publications and clinical trials to pinpoint their relevance in the context of MS research for the last three years.

That work was just the start and allowed us to reach other milestones throughout 2023, such as an observatory we have established dedicated to gathering and curating pertinent information on multiple sclerosis, providing invaluable resources to researchers and healthcare professionals. Furthermore, our partnership with NovaSBE and the Project-based Learning initiative has paved the way for master students to collaborate with us in enhancing the capabilities of Gregory-MS, promising further advancements in 2024.

The integration of data from the World Health Organization has fortified our ability to track clinical trials globally, enhancing our understanding of the landscape of research and treatment options for multiple sclerosis. Moreover, our presence in various media platforms has facilitated critical conversations and awareness about the importance of advancing MS research.

Looking forward, our aspirations for 2024 are no less ambitious. We aim to continue our trajectory of innovation and collaboration, harnessing the power of technology and strategic partnerships to drive meaningful progress in the realm of MS research.

As we embark on this journey, we extend our sincere gratitude to each and every one of you who have supported us in our mission. Together, we stand poised to make a profound and lasting impact on the lives of those affected by multiple sclerosis. Our accomplishments in 2023 have set the stage for an even more remarkable year ahead.



Photo © [Maria Abranches](#)

Summary

The Gregory MS Annual Review 2023 showcases a year of significant advancements, collaborations, and contributions to the world of MS research and beyond. We've made a better distinction between what is Gregory AI, Gregory MS, and the Human Singularity Network as a way to show our strong commitment to harnessing technology for the betterment of human health and knowledge.

Gregory AI and Gregory MS: Pushing Research Forward

Gregory AI, is an open-source software, and **Gregory MS**, is a specific application for MS research. During this year we took steps to show the difference between the two, and created the website [Gregory-AI.com](https://www.gregory-ai.com). Gregory AI is the version you want if you are looking to implement it as a research assistant for your field of interest.

We hope this will help show that our software can be used for other diseases and topics of research.

Human Singularity Network: Facilitating Sustainability

We established the Human Singularity Network as a non-profit organisation and that has been an important step towards making these projects more sustainable and transparent. This move has also allowed for better collaboration with institutions sharing a similar vision of leveraging technology for social and human betterment. Information on this non profit can be found at <https://human-singularity.org/>.

Development Milestones

Gregory AI experienced substantial enhancements in 2023, including licensing changes, machine learning improvements, data management upgrades, and user interface enhancements.

Academic Contributions and Collaborations

The paper "[A machine learning approach for mapping and accelerating multiple sclerosis research](#)," co-authored by António Lopes and Bruno Amaral, marks our contribution to academia. In it, we provide details on how we use Gregory to process data from public sources into usable information for MS stakeholders.

Nova SBE is collaborating with us, using Gregory MS for their project-based learning in the Master's of Business Analytics. With their help we hope to improve the Machine Learning algorithm that we use to identify papers with significant patient outcomes.

Observatory: A New Approach to MS Research

[The MS Observatory](#) is an interactive chart and detailed insights into various medicines and research areas related to MS, enhancing the understanding and accessibility of this field.

Researcher Insights and Global Outreach

The analysis of the MS research landscape has provided valuable insights into the most prolific authors and the challenges of mapping research contributions by country. Despite limitations in data availability, efforts have been made to understand global research efforts in MS.

Advancements in Clinical Trials

Significant progress has been made in integrating data from the **World Health Organization** (WHO) on clinical trials, addressing the challenge of numerous identifier numbers in the field. This has paved the way for us to one day track each individual clinical trial.

Financial Overview and Team Contributions

The financial section shows modest donations but highlights the backing provided by the Lisbon Collective for Gregory MS. The diverse and skilled team members, including António Lopes, Bruno Amaral, Inês Carvalho, and Margarida Gomes, play integral roles in driving the project's success.

Gregory AI, Gregory MS, and the Human Singularity Network

Gregory AI

In 2022 we started using “**Gregory AI**” to refer to the Open Source and Generic software that can be trained around any kind of research. We have used “**Gregory MS**” to refer to the website and specific use of the software to speed up research around Multiple Sclerosis.

Both of them are open source and offer free access, specially Gregory MS who is actively distributing information on the website, via email, on Blue Sky (<https://bsky.app/profile/gregory-ms.com>) and Med-Mastodon (<https://med-mastodon.com/@gregoryMS>). Gregory MS also offers everyone a free API at <https://api.gregory-ms.com/>.

The Human Singularity Network, at <https://human-singularity.org/>, is a non profit created to make Gregory AI and Gregory MS more independent and sustainable.

While Gregory AI doesn't have running costs, and only needs people to keep developing it, the Multiple Sclerosis use case needs a server to run, a domain, an email service, someone to manage the site, and other costs.

These costs were initially covered by Bruno Amaral's funds, and later covered by the company he founded, [The Lisbon Collective](#). Donations were gathered through the Ko-Fi.com service and the company would cover any transaction costs, as well as any extra funding needed.

With the creation of the Human Singularity Network we are now able to process donations and pay for costs in a more transparent way. <https://human-singularity.org/transparency/>

The Lisbon Collective is a digital consultancy studio that among other things helps clients implement Gregory AI. When this happens, only the consultancy hours are billed to the client since the software is under a Creative Commons License — Attribution 4.0 International — CC BY 4.0.

Creating the non profit organisation also sets the foundations necessary for us to collaborate and interact with other institutions who share our mission of supporting projects where technology is put towards social and human ideas.

Development and New Features

António Lopes and Bruno Amaral are still the main contributors to the project and the code is available at <https://github.com/brunoamaral/gregory>

During 2023 there was a total of 5 releases up until the 5th of December. The details are available on the releases page. <https://github.com/brunoamaral/gregory/releases>

In a nutshell, **Gregory AI** went through these improvements and changes.

1. Licensing and Legal Changes:

- Change to Creative Commons – Attribution 4.0 International license (v16).

2. Machine Learning and Data Science Enhancements:

- Addition of fields for saving Machine Learning predictions by the Linear SVC Support Vector Classifier (v16).
- Implementation of the LSVC machine learning model (v16).

3. Data Import and Management:

- Introduction of a Django command for importing data from the World Health Organization (WHO) (v16).
- Updates to the Clinical Trials table to align with WHO standards (v16).

4. API and Backend Improvements:

- Several API changes and new endpoints, especially for chart building and observatory page enhancements (v15).
- Authentication options using Django Rest Framework and djangorestframework-simplejwt (v15).
- New API endpoint for adding articles via HTTP POST requests (v13).

5. User Interface and User Experience:

- Improvements to source management with new fetch options and description fields (v15).
- RSS feed addition for each author (v14).

6. Infrastructure and Technical Updates:

- Upgrade of Django and Python versions (v15.5 and v14).
- Implementation of a new summarizer for abstracts (v14).

7. Clinical Trials Specific Features:

- Functionality to check for duplicate clinical trials and maintain a history of changes (v15).
- Focus on fetching Eduract and NCT numbers for clinical trials to avoid duplicate content (v13.12).

8. General Maintenance and Minor Enhancements:

- Various minor fixes, code cleanups, and enhancements across different releases.

Contributing to Academia

António Lopes and Bruno Amaral believe in giving back, and to do that they wrote and sent for approval a paper on **“A machine learning approach for mapping and accelerating multiple sclerosis research”**.

The paper was accepted and is available on open access at [Procedia Computer Science](https://www.procedia.com/ProcediaComputerScience).

<https://www.sciencedirect.com/science/article/pii/S1877050923004106>

Abstract

The medical field, as many others, is overwhelmed with the amount of research-related information available, such as journal papers, conference proceedings and clinical trials. The task of parsing through all this information to keep up to date with the most recent research findings on their area of expertise is especially difficult for practitioners who must also focus on their clinical duties. Recommender systems can help make decisions and provide relevant information on specific matters, such as for these clinical practitioners looking into which research to prioritize. In this paper, we describe the early work on a machine learning approach, which through an intelligent reinforcement learning approach, maps and recommends research information (papers and clinical trials) specifically for multiple sclerosis research. We tested and evaluated several different machine learning algorithms and present which one is the most promising in developing a complete and efficient model for recommending relevant multiple sclerosis research.

With feedback from the reviewers, we applied a change to improve the algorithm that we are using right now.

Publishing costs associated with this paper are not in the scope of the Gregory MS project and were covered by the authors.

Improving our algorithm with Nova SBE

The team is always on the lookout for ways to improve our summarisation and machine learning algorithm. This year, Nova SBE as joined us in that effort. Gregory MS will be the case study for their Masters' in of Business Analytics as project based learning.



NOVA SCHOOL OF
BUSINESS & ECONOMICS

The project is already underway in the 23/24 school year, with the guidance of Patrícia Xufre and Tiago Godinho.

We would like to thank Leid Zejnilovic, and Lénia Mestrinho for opening this door. It is a pleasure to be working with the team of the Nova SBE Data Science Knowledge Center. Patrícia Xufre and Tiago Godinho have been mentoring the project, and their students have been doing a great job in exploring the database. Francisco Lopes Natário Pinto Gomes, Julia Emma Maria Antonioli, Kuba Maciej Bialczyk, Martim Alves Ernesto Esteves, Nicolò Mazzoleni; did more than just explore a dataset. Their questions and rhythm in taking on this project is invaluable.

The Observatory pages, a closer view on MS research

There are several medicines available for MS, Disease Modifying Therapies (DMT's). There is a also a good range of research areas connected to it. Diet and gut microbiota's impact, Bruton's tyrosine kinase (BTK) inhibitors, use of stem cells, and a few others.

Gregory can help us get a better idea of how much research is done for a certain medicine or area of research. We added that information as an [Observatory](#). This interactive chart allows users to select and zoom in on the timeline of published research in a given category.

For each category, the user can drill down to collect a list of the related clinical papers.

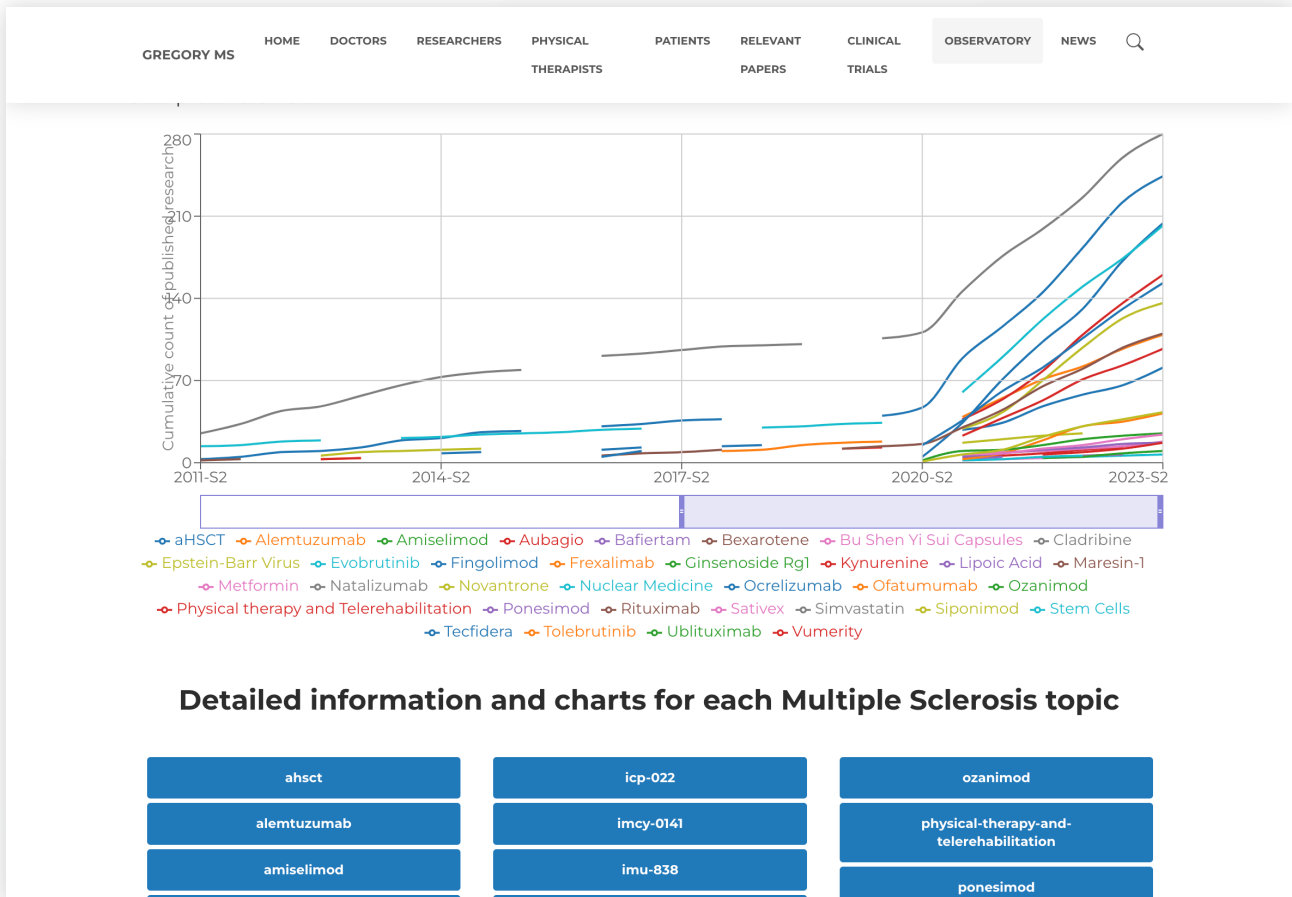


Fig 1. Screenshot of the observatory chart available at <https://gregory-ms.com/observatory>

We included the option to download a list of all the articles so that researching it can be easier and more open.

The choice of categories didn't follow any specific methodology, we simply picked popular medicines, and areas of research.

What we have learned about the researchers

This year we took a deep dive into who publishes research around MS. This meant a clean up of the database and several improvements to how we gather and process author information. Right now, we check the data we receive from crossref.org, using the DOI number of each paper, and check orcid.org for more information about that author.

The ORCID number of each author is used to avoid duplicates, but this method is not full proof as some authors are not on that database.

In December 2023 we had a total of **114 145** authors on our database, and we were able to identify the ones with more published papers.

Top 20 Authors With Published Research

#	Full Name	ORCID	Total Papers 2023
1	Massimo Filippi	http://orcid.org/0000-0002-5485-0479	53
2	Jens Kuhle	http://orcid.org/0000-0002-6963-8892	50
3	Friedemann Paul	https://orcid.org/0000-0002-6378-0070	40
4	Ruth Ann Marrie	http://orcid.org/0000-0002-1855-5595	34
5	Xavier Montalban	http://orcid.org/0000-0002-0098-9918	34
6	Helmut Butzkueven	http://orcid.org/0000-0003-3940-8727	31
7	Ludwig Kappos	http://orcid.org/0000-0003-4175-5509	31
8	Francesco Patti	http://orcid.org/0000-0002-6923-0846	30
9	Tanuja Chitnis	http://orcid.org/0000-0002-9897-4422	29
10	Jeannette Lechner-Scott	http://orcid.org/0000-0002-3850-447X	28
11	Maria A Rocca	http://orcid.org/0000-0003-2358-4320	27
12	Robert W. Motl	http://orcid.org/0000-0003-0112-2803	26
13	Tjalf Ziemssen	http://orcid.org/0000-0001-8799-8202	26
14	Gavin Giovannoni	http://orcid.org/0000-0001-9995-1700	25
15	Bianca Weinstock-Guttman	http://orcid.org/0000-0001-6732-151X	24
16	Frederik Barkhof	http://orcid.org/0000-0003-3543-3706	24
17	Alexandre Prat	http://orcid.org/0000-0001-6188-0580	23
18	Bernhard Hemmer	http://orcid.org/0000-0001-5985-6784	23
19	Anneke van der Walt	http://orcid.org/0000-0002-4278-7003	22
20	Heinz Wiendl	http://orcid.org/0000-0003-4310-3432	22

Table 1. **Source:** <https://metabase.gregory-ms.com/public/dashboard/9f103ca9-82a6-4846-bcd3-37932b9c8547>

MS research per country

With the list of 112 thousand authors at hand maybe we could finally understand which countries are publishing more research. This turned out to be an impossible task.

First, what does research per country mean? It should be a direct relation between the sponsors of the research published, but that doesn't take into account where the study was conducted, and the author's affiliation.

Public databases do not seem to have reliable data about affiliations, and Gregory is not saving that information for now.

We tried to take a shortcut and see which countries the authors have mentioned on their ORCID pages. Only 16.38% of all authors in our database have been found on ORCID, this could be for reasons other than their self-registration such as misspelling of first and last name. Of these, only 3.23% have added country information to their profile.

Authors in Gregory's database and on ORCID

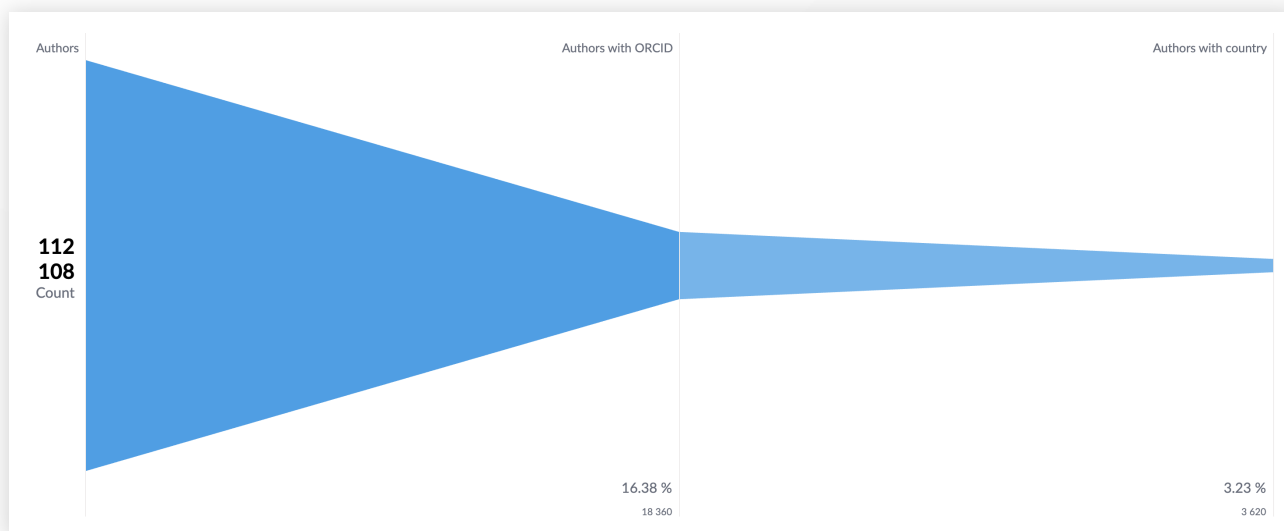


Fig. 2. Percentage of authors registered on ORCID and percent of which indicate a country on their record. **Source:** <https://metabase.gregory-ms.com/public/question/0724fafb-92f4-4784-bdab-60c4de3712b6>

With these caveats, we are still able to see a distribution of the published research per country, and the number of authors in each country.

Published papers per country

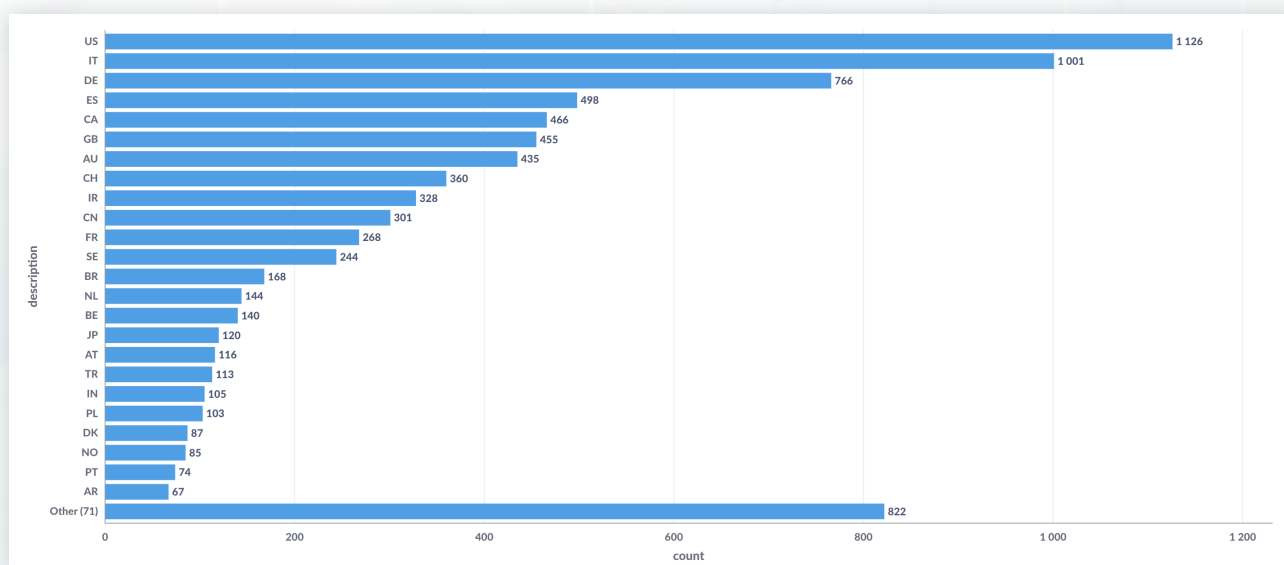


Fig. 3. Published papers per country **Source:** <https://metabase.gregory-ms.com/public/question/6113f22f-fb8f-4336-811b-954838112415>

Authors per Country

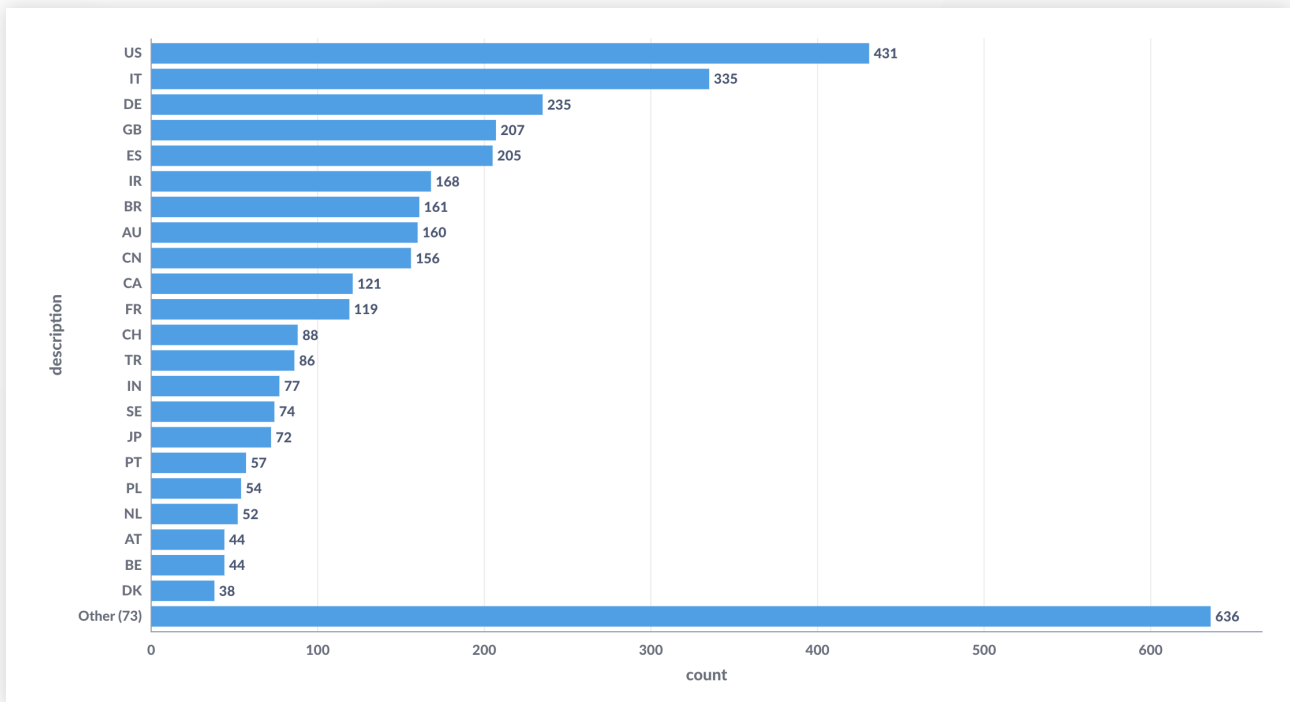


Fig. 4. Authors per country. **Source:** <https://metabase.gregory-ms.com/public/question/b231b7db-4cf5-422b-b182-fc28417edf7d>

[There is also a full dashboard available with the author data updated in real time.](#)

Improvements to clinical trials

This was the year where we found a way to include [data on Clinical Trials by the World Health Organization](#). In doing that we took a dive into the problem of too many identifier numbers in this ecosystem. For our goal, we found 20 different kinds of identifier number.

- | | | | |
|-----------|------------|-----------|-----------|
| 1. ACTRN | 6. EUCTR | 11. JPRN | 16. PACTR |
| 2. CHICTR | 7. EUDRACT | 12. LBCTR | 17. PER |
| 3. CTIS | 8. IRCT | 13. NCT | 18. RBR |
| 4. DRKS | 9. ISRCTN | 14. NL | 19. RPCEC |
| 5. EUCT | 10. ITMCTR | 15. NTR | 20. TCTR |

The WHO intends to implement a **Universal Trial Number** and we will be alert to include that information on our database.

We feel that we have reached a point where we can rely on the sources of data we have, and are able to move on to other improvements. One of those improvements could be tracking the changes on each of them in order to notify interested parties.

Gregory MS in the Media

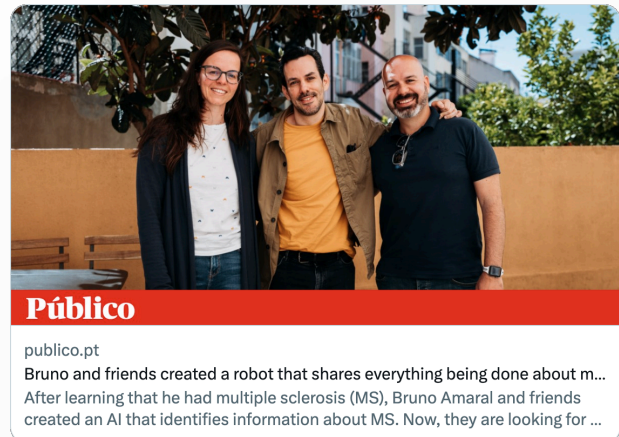
This year we were able to obtain some news coverage in nation-wide media outlets and others specific to the Health sector.

[This information will be kept in the new Media page of the Gregory MS website.](#)

[Bruno e os amigos criaram um robô que diz o que se está a fazer sobre esclerose múltipla](#)

08 May 2023

Bruno Amaral has created Gregory MS, an artificial intelligence tool that provides information on scientific research about multiple sclerosis. The project was developed in a café in Lisbon where Amaral often works.



[Isto faz-se por cá - Episódio 18](#)

26 May 2023

This episode features Gregory MS, a digital assistant designed to inform about scientific research on multiple sclerosis. The program highlights innovative projects developed in Portugal.

<https://www.rtp.pt/play/p6403/e694619/isto-faz-se-por-ca>



Gregory “facilita o trabalho de todas as pessoas que têm que investigar determinadas doenças”

02 April 2023

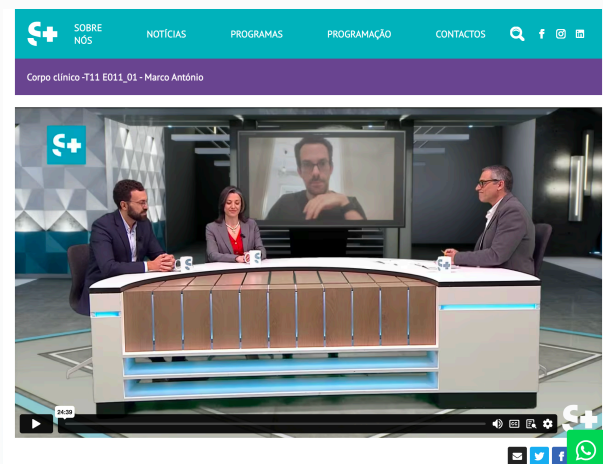


Corpo Clínico T11 E011

15 June 2023

Part 01: <https://www.saudemais.tv/video/282371-corpo-clinico-t11-e011-01-marco-antonio>

Part 02: <https://www.saudemais.tv/video/282370-corpo-clinico-t11-e011-02-marco-antonio>



Social Media, what changed

Getting in touch with neurology professionals, MS patients, and researchers is important to us, and we use all channels we can. This year we had to make some adjustments to this plan.

Gregory MS was posting found articles on Twitter up until the time that the company decided to change the terms of service and access to the API. For that reason we have stopped managing the account, leaving behind a last tweet for users to follow us on Blue Sky or Mastodon.

Thanks to the open API available on Mastodon and Blue Sky, we were able to quickly adapt the code and automate posting relevant articles and clinical trials.

Key numbers for 2023

Gregory MS database

22 557

Articles

1 211

Relevant
Articles

114 145

Authors

4 510

Clinical Trials

94

Subscribers

Website

4 894

Visitors

(+1.83k)

12 470

Page views

(+6.39k)

79%

Bounce Rate

(-1%)

50s

Avg. Visit Time

(-6s)

Social Media

268

Followers
on X

92

Followers on
Mastodon

59

Followers on
BlueSky

Software

5

Software
Releases

30

Commits
to code

4

Contributors
to code

Budget

19€

Donations

334,25€

Expenses

Report and Accounts for Gregory MS

We don't make an effort to motivate donations and this year that shows. On the other hand we took the necessary steps to establish a non profit organization, the Human Singularity Network, to allow us for a more transparent management of donations and expenses in the coming year.

In 2023, Gregory MS spent 321.52 euro in hosting expenses which were covered by the Lisbon Collective.

Donations

For 2023 we received a total of 19€ in donations, not counting Stripe's processing fee. Two of the 4 donations received were made by the Lisbon Collective while testing the Stripe payment form.

From	Received in euro	Date and Time (UTC)
Raquel	€3,00	May 8, 2023 9:28 AM
S. Luz	€10,00	August 30, 2023 1:36 PM
Bruno Amaral	€3,00	October 18, 2023 3:53 PM
Lisbon Collective	€3,00	October 18, 2023 5:58 PM
Total	€19,00	

Table 2. Donations received in 2023.

Source data:

Ko-Fi: Transaction_All.csv 1.7KB

Stripe: unified_payments.csv 0.5k8

Expenses

Apart from hosting costs, this year we also required some funds to setup the non profit organisation and consolidate the project's resources. Specifically we needed to purchase an official dossier for the meeting minutes and pay for the domain name human-singularity.org. These expenses were covered from Bruno Amaral's funds.

Table below shows the invoices for hosting and domain. USD and EUR column reflect how much of that invoice refers to Gregory-MS.

Invoices and Expenses

Invoice	USD	EUR
DigitalOcean Invoice 2023 Dec (719484-473034690).pdf	US\$30,81	€28,65
DigitalOcean Invoice 2023 Nov (719484-470594591).pdf	US\$31,45	€29,25
DigitalOcean Invoice 2023 Oct (719484-468789257).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Sep (719484-466552027).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Aug (719484-464550872).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Jul (719484-462361602).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Jun (719484-460631718).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 May (719484-458613011).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Apr (719484-457316300).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Mar (719484-455405803).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Feb (719484-453305351).pdf	US\$28,80	€26,78
DigitalOcean Invoice 2023 Jan (719484-452139830).pdf	US\$28,80	€26,78
Cloudflare 328335471.pdf	US\$9,15	€8,51
TOTAL	US\$359,41	€334,25

Table 3. Domain and hosting expenses for [Gregory-MS.com](https://www.gregory-ms.com)

The Team

The team began with Bruno and António. Soon after, Margarida joined and raised the bar for what we communicate. In the beginning of 2023, Inês Carvalho found us and volunteered to help the project grow.

António Lopes

António is a programmer who has dedicated most of his professional life to researching, designing and developing systems in all kinds of environments, from desktop and mobile, to physical computing. He's been involved in researching and working with Artificial Intelligence since the year 2000, and in the past couple of years has focused his attention on AI usage and development. After knowing Bruno for over a decade, they started working together on a way to automate Gregory and turn it into a tool anyone could use.

Find out more of what António has been working on at antoniolopes.info and on LinkedIn

<https://www.linkedin.com/in/alopes/>



Bruno Amaral

Bruno is a Digital Strategist who works bridging the gap between tech and communication.

He founded and works at the Lisbon Collective, and is a teacher, both in Lisbon University's Masters Course of Communication and Digital Strategy, and Public Relations at the School of Communication and Media Studies, also in Lisbon.

Bruno was diagnosed with Multiple Sclerosis in 2019 and is using tech to help improve quality of life for himself and others suffering with MS.

You can see what Bruno has been working on at brunoamaral.eu and on LinkedIn

<https://www.linkedin.com/in/brunoamaral/>



Photo © [Maria Abranches](#)

Inês Carvalho

Inês is a recent addition to the Public Relations (PR) field of communication.

She graduated in PR and Business Communication and as already created an online store for indoor plants and worked in marketing for one of Portugal's largest supplement brands.

In her free time, Inês is learning German and learning nutrition. She recently joined Lares Online as a Strategic Content Manager.

She joined the team after meeting Bruno in the School of Communication and Media Studies. With a keen interest in Artificial Intelligence and a desire to create positive change, Inês eagerly contributes her unique blend of skills, creativity, and passion to make a lasting impact on the projects she undertakes.

Check out what Inês is doing on her LinkedIn profile <https://www.linkedin.com/in/ipcarvalho/>



Margarida Gomes

Margarida is a designer and the newest member of the Gregory team. She studied Industrial Design at IADE — Creative University, but nowadays she applies those same design principles to different areas of the discipline, including graphic design for social media.


Margarida is passionate about arts and crafts, and also travel, as she's been a solo traveler since 2014.

Check out more of Margarida's work on her LinkedIn profile <https://www.linkedin.com/in/margaridagomesfreelancer/>



Photo © [Maria Abranches](#)



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