



Annual ERA-ENVHEALTH Open Conference

*Forest Fires – Climate change and
Health impacts*



Tackling the increasing threat of Smoke Health Impacts from Forest fires and Climate Change

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Wildfires have increased in the past decades:

- Climate change and global warming
- Heatwaves, prolonged **drought** periods, **low precipitation** levels
- Wildfires, **more frequent, more severe, larger-scale events**

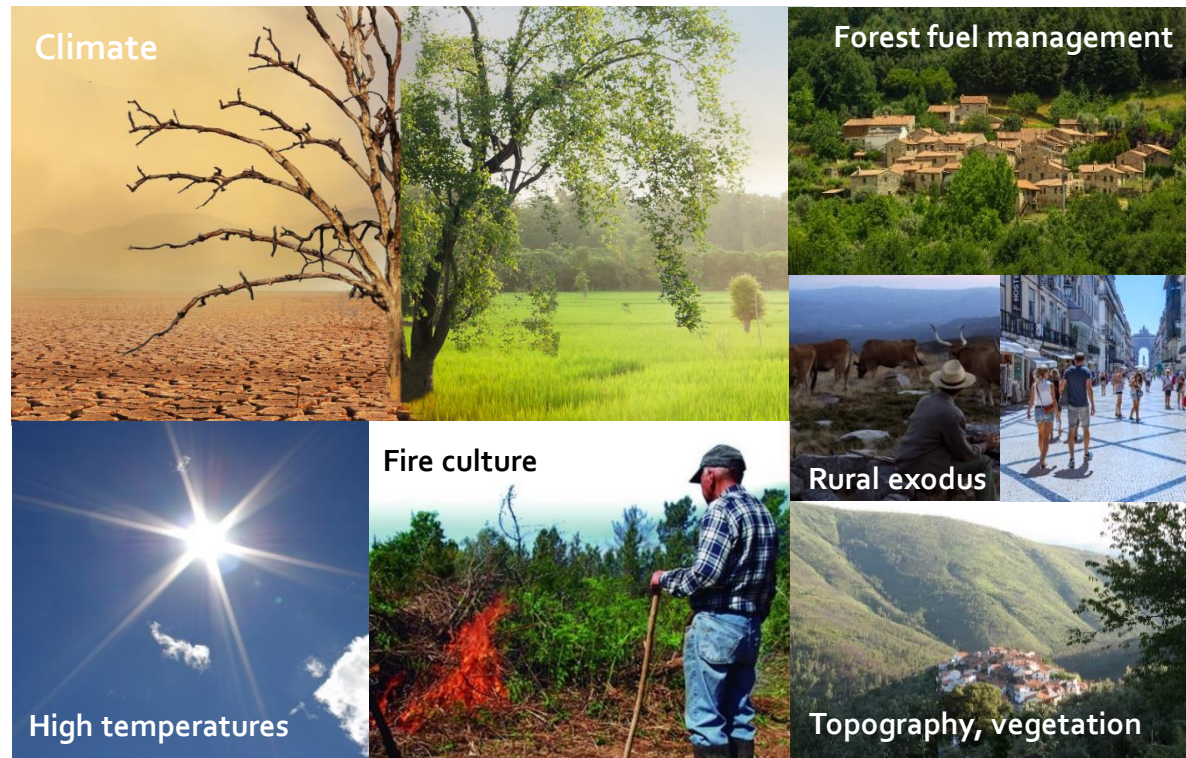


Wildfires around the globe:

- **Globally:** USA, Canada, Australia, Africa,..
- **Europe** (65,000 wildfires/year) - Mediterranean countries
- **Portugal**, within the most affected countries

WILDFIRES IN PORTUGAL

Mainland Portugal has very diverse landscapes, very susceptible to *wildland / rural / forest fires* due to several factors such:



WILDFIRE SMOKE: ADVERSE HEALTH EFFECTS



Wildfires can cause significant impacts on **people**, particularly on vulnerable and highly exposed groups

Short-term:

- Eye irritation
- Respiratory irritation
- Breath difficulty
- Headaches
- Dizziness



Long-term:

- Respiratory diseases
- Cardiovascular conditions
- Cancer

FIREFIGHTERS' OCCUPATIONAL EXPOSURE

- High exposures to pollutants in different occupational settings



In the field



On the return to fire station



At the fire station

- Very hostile and unpredictable conditions
- High physical and psychological demands in hostile environments
 - High temperatures
 - Trekking, chainsaw work, brush removal
 - Carry heavy equipment/tools (e.g., rakes, axe, shovels, fire hoses)
 - High stress levels

- Long & multiple shifts (days, weeks)



Portuguese Wildland Firefighters, after an exhausting **24 hours of tackling the flames** in the wildfire of Pedrógão Grande, 2017

FIREFIGHTERS' OCCUPATIONAL EXPOSURE



Inhalation

From breathing contaminants



Ingestion

From touching contaminated gear and not washing hands properly



Absorption

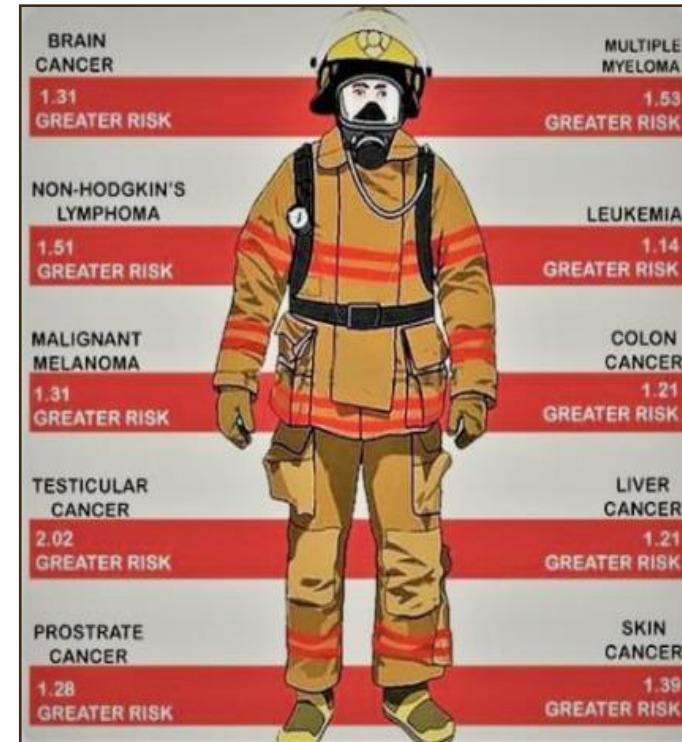
From contaminants going through, around, or under gear and contacting the skin

Short-term health effects:

- Eye and respiratory irritation
- Dizziness
- Headaches
- Nausea
- Shortness of breath
- Cough



Long-term health effects:



Cancer



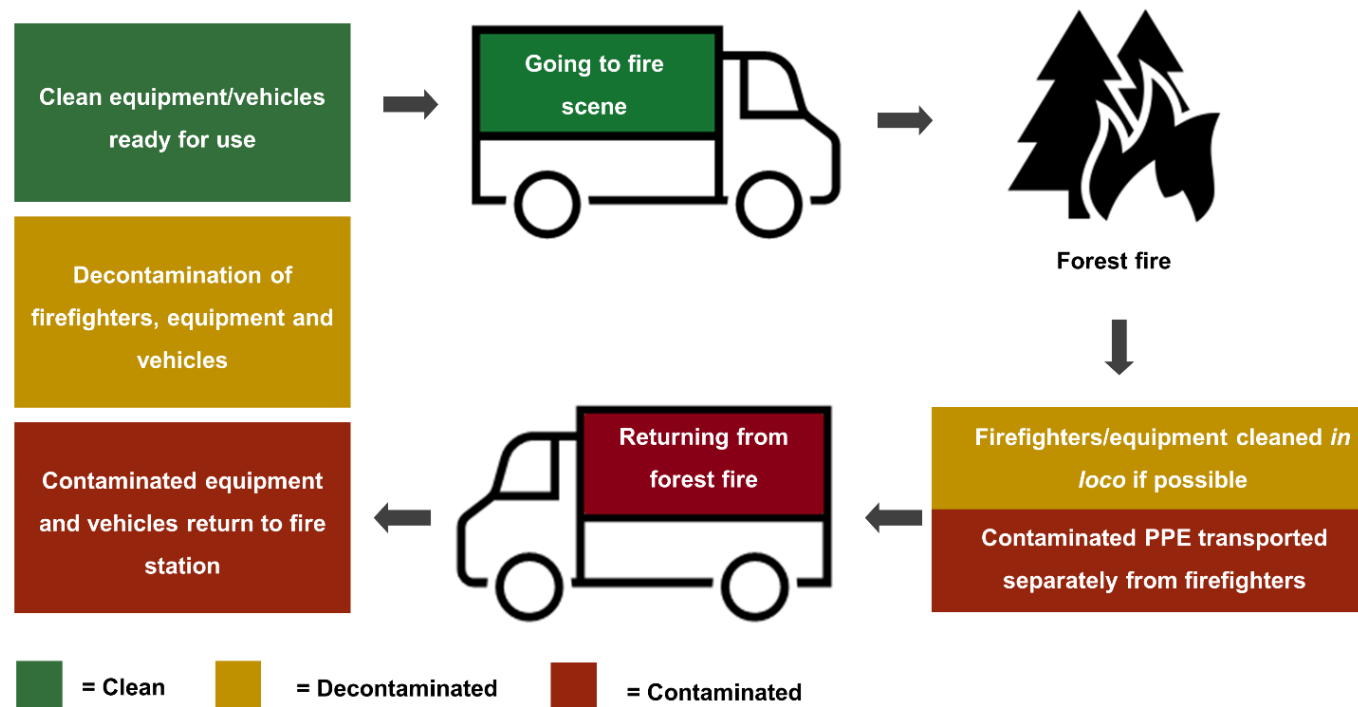




Mitigation Measures & Recommendations

DECONTAMINATION PROCEDURES

(De)contamination cycle: The decontamination procedure is a **sequential set of steps** that must be followed to ensure a successful decontamination process.



Esteves, F., et al (2023). *Wildland firefighters: a crucial weapon for forest fire management. Which health risks do they face?* In "Fire Hazards: Socio-economic and regional issues". To be published by Springer

DECONTAMINATION PROCEDURES

Before return to fire station:

- Get clean *in loco*, if it is feasible
- If not possible, use **wipes** and/or water and soap to clean skin exposed areas (neck, face, hands)



At the fire station:

- **Personal decontamination (shower)** should be the top priority upon returning to the fire station to remove contaminants from the skin
- **Designation zones at the fire station:** It is crucial to control the spread of harmful pollutants at fire station through the designation of “**contamination zones**” (e.g., laundry, primarily operational areas, truck bay) and “**clean zones**” (e.g., recreational rooms, bedrooms)



IMPORTANT RECOMMENDATIONS



Regular physical activity



Good sleep hygiene



Healthy eating behaviours



Avoid risk behaviours
(e.g., alcohol, tobacco)



Awareness campaigns



Keep PPE in good condition



(Regular cleaning and inspection of PPE, repairing or replacing)



Health surveillance



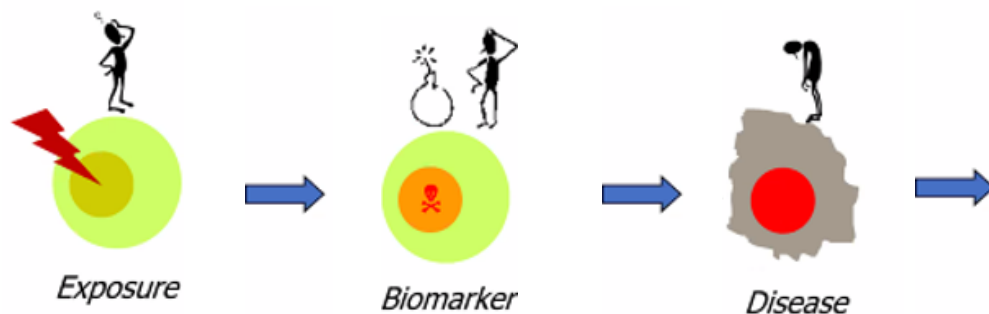
BIOMONITORING APPROACH, WHAT FOR?



In June 2022, occupational exposure as a firefighter was classified **carcinogenic to humans** (Group 1)

Firefighters are still among the **least studied occupations** in terms of **health risks**

Very few studies considering **biological impact** of **wildfires exposure**



Biomonitoring:

- **Identify** potential signals of **exposure** to hazardous agents
- Provides a **more accurate representation** of the substances that **workers are exposed to**
- Can **detect exposures** to harmful substances **at an early stage**, even before clinical symptoms or health effects become apparent
- Provides **information on modes of action and** understanding on **potential long-term health effects**
- **Gives important information** for the development of **health and safety policies**



- Characterize the occupational exposure and identify potential health risks
- Knowledge of the biological mechanisms of action of woodsmoke exposure
- Identify a set of appropriate (bio)markers for health surveillance
- Contribute to the establishment of recommendations and good practices to improve firefighters' working conditions

OUR STUDY – DESIGN



~200 Healthy Wildland Firefighters from 14 fire stations: Active firefighters; >1year/service

Phase I: Pre-fire Season

Phase II: Fire Season



- **Comprehensive Questionnaire** (e.g., demographic, lifestyle)
- **Air monitoring** (e.g., PMs)
- **Biomonitoring** (Blood, serum, urine, buccal cells):
 - **Biomarkers of exposure** (e.g., PAHs)
 - **Biomarkers of effect:**
 - DNA damage and oxidative DNA damage (comet assay)
 - Chromosomal instability (micronucleus test (MN))
 - Inflammation and immunologic parameters (e.g., IL6, IL8)

- **Short QA** (e.g., data on fire occurrence, exposure time and acute health symptoms)
- **Biomonitoring** (Blood, serum, urine, buccal cells):
 - **Biomarkers of exposure** (e.g., PAHs)
 - **Biomarkers of effect:**
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OUR STUDY - FIELDWORK

Detailed characterization via questionnaires:

- Personal information (e.g., age, gender,...)
- Occupational characterization (e.g., PPE use, occupational history,...)
- Lifestyle (e.g., diet, physical exercise,...) & health data (e.g., medication, diseases,...)



Air sampling:



14 Fire stations



Outdoor/Indoor air monitoring
(e.g., PM_{2.5} and PM₁₀)



Biological sampling:

Buccal cells => MN assay



Urine => e.g. PAHs



Blood => e.g., DNA damage



Transported in a cooler



Laboratorial analysis



OUR STUDY – SOME FINDINGS SO FAR

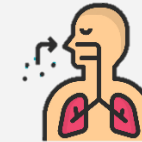


Firefighters' Occupational Exposure Before the Wildfire Season in Non-Fire Settings:



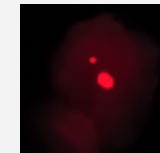
Estimated Inhaled Dose PM₁₀ & PM_{2.5} in Fire Stations:

$$Dose (D) = (BR/BW) \times C \times t$$



Impact of Inhaled PM₁₀ & PM_{2.5} in % MN of exfoliated buccal cells:

- **No association** between estimated inhaled doses to PM in fire stations and MN assay in buccal cells



Overall low PM levels:

Indoor PM_{2.5} & PM₁₀

- PM₁₀ = 10.5 µg m⁻³
- PM_{2.5} = 8.5 µg m⁻³

Outdoor PM_{2.5} & PM₁₀

- PM₁₀ = 21.1 µg m⁻³
- PM_{2.5} = 4.5 µg m⁻³

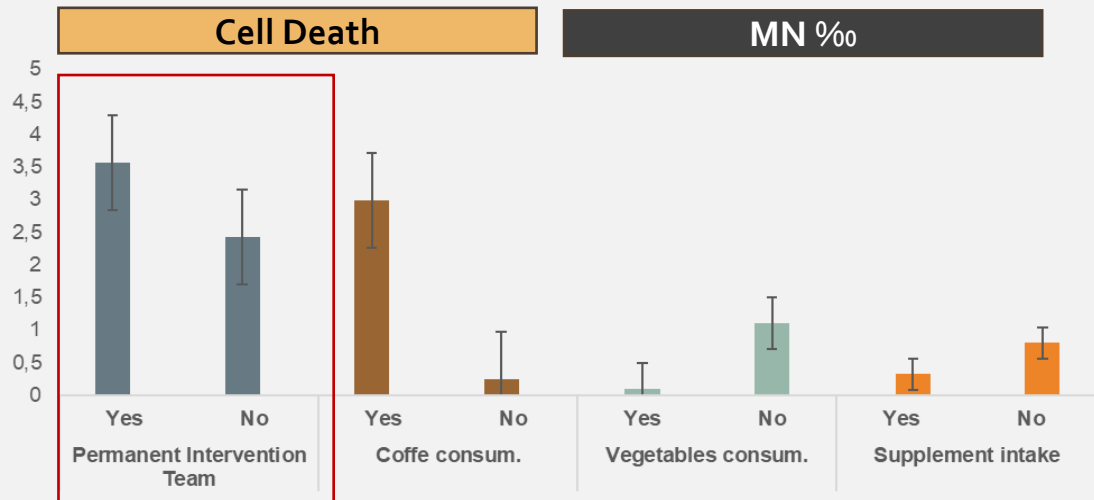
Wildland firefighters in Pre-fire Season of 2021 = 172 firefighters (82% males; mean age 38 ± 11 years)

OUR STUDY – SOME FINDINGS SO FAR



Firefighters' Occupational Exposure Before the Wildfire Season, in Non-Fire Settings:

Permanent Intervention Teams (n=46) presented increased buccal cell death % than those reporting to be volunteers.



Permanent Intervention Teams (full-time firefighters)



Wildland firefighters in Pre-fire Season of 2021 = 172 firefighters (82% males; mean age 38 ± 11 years)

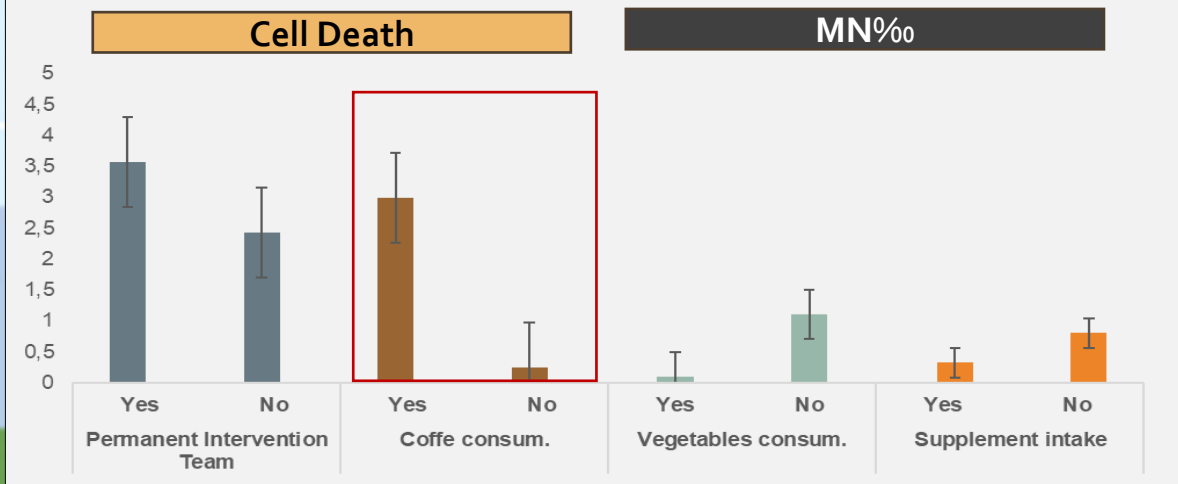
OUR STUDY – SOME FINDINGS SO FAR



Firefighters' Occupational Exposure Before the Wildfire Season, in Non-Fire Settings:



❖ **Coffee intake (n=147):** presented increased buccal cell death % than those reporting not to drink coffee.

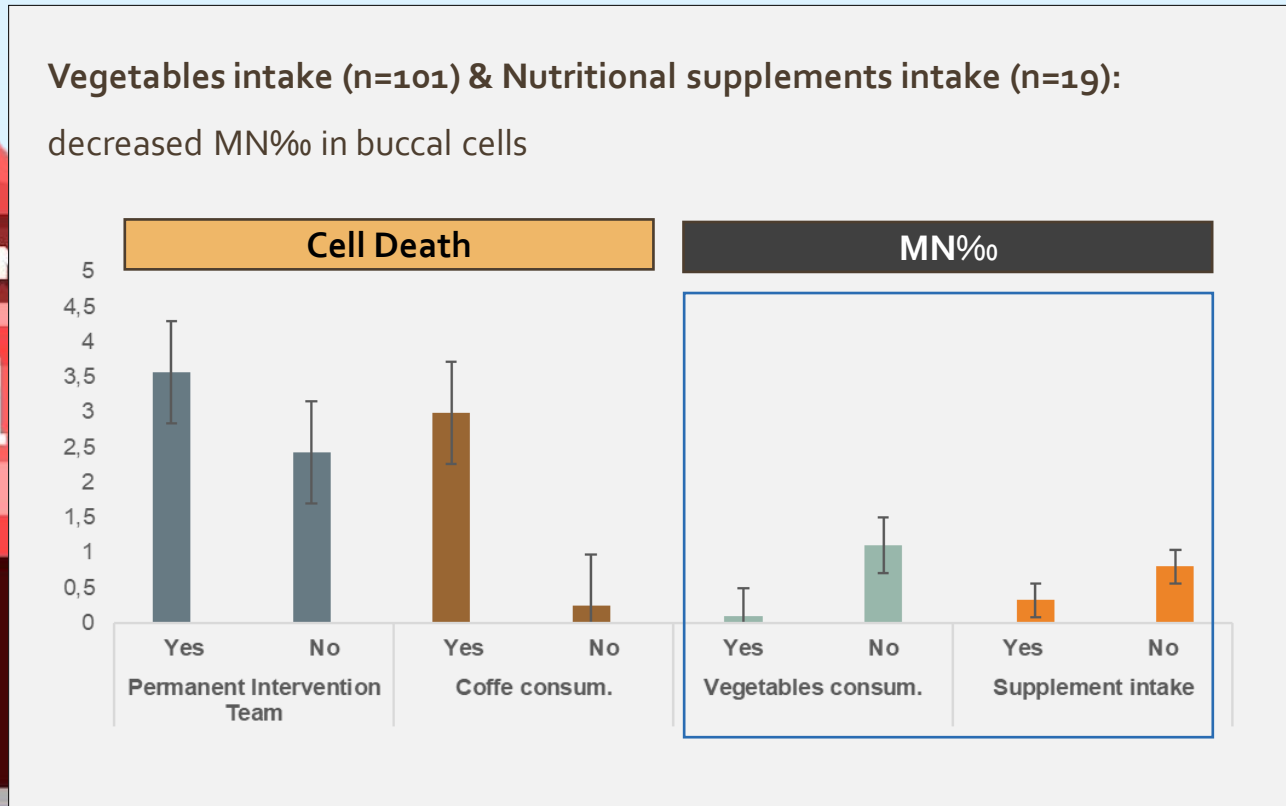


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OUR STUDY – SOME FINDINGS SO FAR



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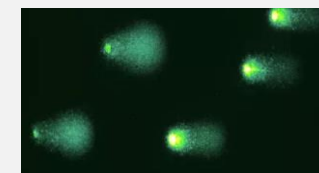
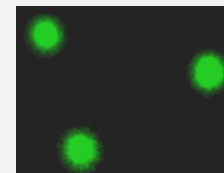
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OUR STUDY – SOME FINDINGS SO FAR

Firefighters' Occupational Exposure Before the Wildfire Season, in Non-Fire Settings:



Firefighters **exposed to Environmental Tobacco Smoke** (n=70) presented higher **DNA strand breaks** ($p < 0.05$) in peripheral blood than those non exposed



Wildland firefighters in Pre-fire Season of 2021 = 172 firefighters (82% males; mean age 38 ± 11 years)



- Our results provide data on the characterization of wildland firefighters' occupational exposure while working in fire stations before a wildfire season;
- This data will be **integrated** together with other **biological** and **environmental findings** collected over **different time points** of a wildfire season.

ACKNOWLEDGMENTS



- **Firefighters that are participating in this study**
- **BioFirEx** (PCIF/SSO/0017/2018) - A panel of (bio)markers for the surveillance of firefighter's health and safety
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- EPIUnit - Institute of Public Health, University of Porto, Porto, Portugal (**ISPUP**)
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- Faculty of Medicine, University of Porto (**FMUP**)



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We Need Wildland Firefighters, Wildland Firefighters Need Us!

THANK YOU FOR YOUR ATENTION!

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