



P3.057 Smog, Cancer and Costs: Why Air Quality Matters for Lung Cancer Prevention in Poland



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INTRODUCTION

Outdoor air pollution and particulate matter are classified by IARC as Group 1 human carcinogens. In Poland exposure is dominated by coal combustion — household solid-fuel heating and coal-based electricity generation ($\approx 80\%$ of national output).

PM_{2.5} crosses the alveolar barrier into the systemic circulation; the documented consequences extend beyond the airway to cardiovascular, metabolic, neurological and oncological disease.

Lung cancer is the leading cause of cancer death worldwide. Its latency of up to 20 years means that present-day incidence reflects the exposure of previous decades — and that today's emissions determine the burden of the 2040s.

For thoracic oncology the effect is twofold: pollution raises incidence, and by driving COPD it erodes the respiratory reserve that determines operability and post-resection risk.

Aim

To quantify air pollution in Poland against WHO, EU and national standards, and to relate it to population health, projected lung cancer incidence and economic burden.

METHODS

Design

Retrospective analysis of publicly available national surveillance, registry and social-insurance data. No individual patient data were used; ethics approval was not required.

Data sources

- Air quality** — Chief Inspectorate of Environmental Protection (GIOS): hourly PM_{2.5} and NO₂ and 24-h PM₁₀ from all national monitoring stations, 2015–2019. Completeness 92.1% / 95.3% / 95.1%.
- Standards** — WHO Air Quality Guidelines 2005; Directive 2008/50/EC; Polish Regulation of the Minister of the Environment, 24 August 2012.
- Lung cancer** — Polish National Cancer Registry (ICD-10 C33+C34), observed 2009–2018; Ministry of Health Maps of Health Needs projections for 2020, 2025 and 2030.
- Emission abatement** — Central Statistical Office, Statistical Yearbook of Industry.
- Sickness absence** — Statistical Yearbook of Social Insurance (ZUS), 2015–2017.

Exposure translation

Annual particulate concentrations were converted into the equivalent number of passively smoked cigarettes per resident per day using the published van der Zee formula, applied to the whole population including newborns.

Limitations

Ecological design: no individual-level exposure and no causal inference. Abatement statistics cover industrial sources only and omit household emissions. Absence data are aggregate day counts and cannot be expressed per worker. Registry and projection series are produced by different methods and are not directly comparable.

DISCUSSION AND CONCLUSION

Compliance is not safety

Poland met EU and national limit values for PM_{2.5}, PM₁₀ and NO₂ throughout 2015–2019, yet particulate concentrations stayed roughly twice the WHO guideline and short-term PM₁₀ peaks breached the permitted 35 days in four of five years. Legal compliance and a health-protective level of exposure are not the same thing.

The exposure is not marginal

Expressed in a familiar metric, ambient particulate exposure corresponds to roughly seven to nine passively smoked cigarettes per resident per day — on the order of 30 pack-years across a lifetime — in a population in which most people never smoke actively.

Prevention has to be systemic

Individual exposure to ambient air is largely non-modifiable, so primary prevention depends on national policy: replacing household solid-fuel heating and coal-based generation. Because carcinogenesis is slow, those benefits will be measured in decades.

Conclusion

Air pollution in Poland remains a substantial health and socio-economic burden despite formal compliance with EU and national standards. Strengthening primary prevention — particularly reduction of household and coal-related emissions — is justified on both health and economic grounds. Until those measures take effect, risk-adapted low-dose CT screening is the available lever for reducing the near-term burden.

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Artificial Intelligence (AI) Use Disclosure

Disclosure for this poster: Claude (Anthropic) was used as a supportive tool to draft and edit the poster text in English, to lay out the poster and to render the figures from data supplied by the authors. No content was generated from AI knowledge: all data, analyses, interpretation and conclusions are the authors' own. The authors reviewed and verified every element and take full responsibility for the content.

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RESULTS

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the WHO 2005 guideline
mean PM_{2.5}, 2015–2019

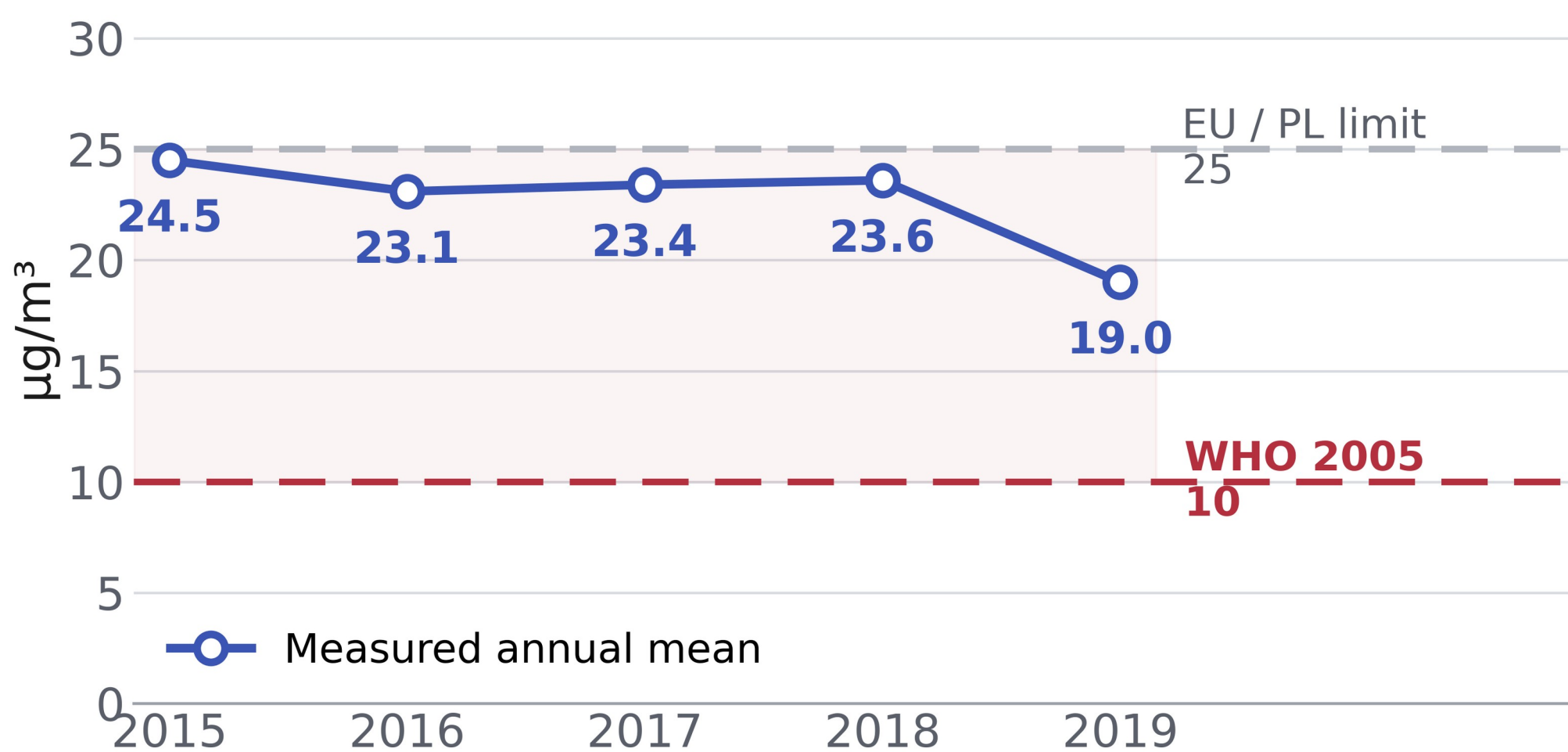
≈ 8

equivalent passively smoked cigarettes
per resident, per day

33,800

lung cancer cases projected
for Poland in 2030

PM_{2.5} annual mean, Poland



PM₁₀ annual mean, Poland

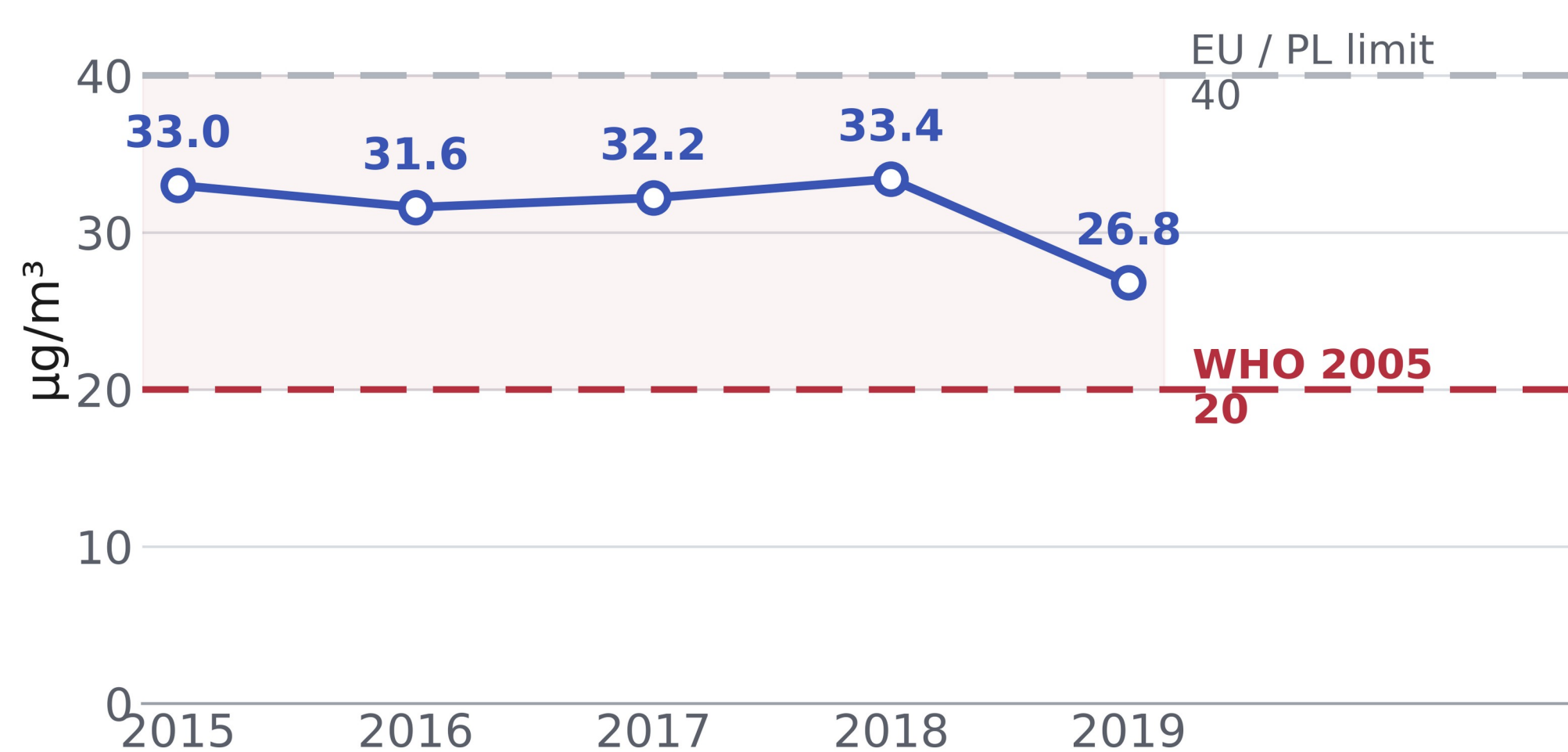


Figure 1. Annual mean particulate concentrations against the WHO 2005 guideline and the EU / Polish limit value. Both fractions remained within the legal limit and above the WHO guideline throughout; the shaded band is the interval between the two thresholds.

Days exceeding the PM₁₀ 24-h limit (50 µg/m³), station average

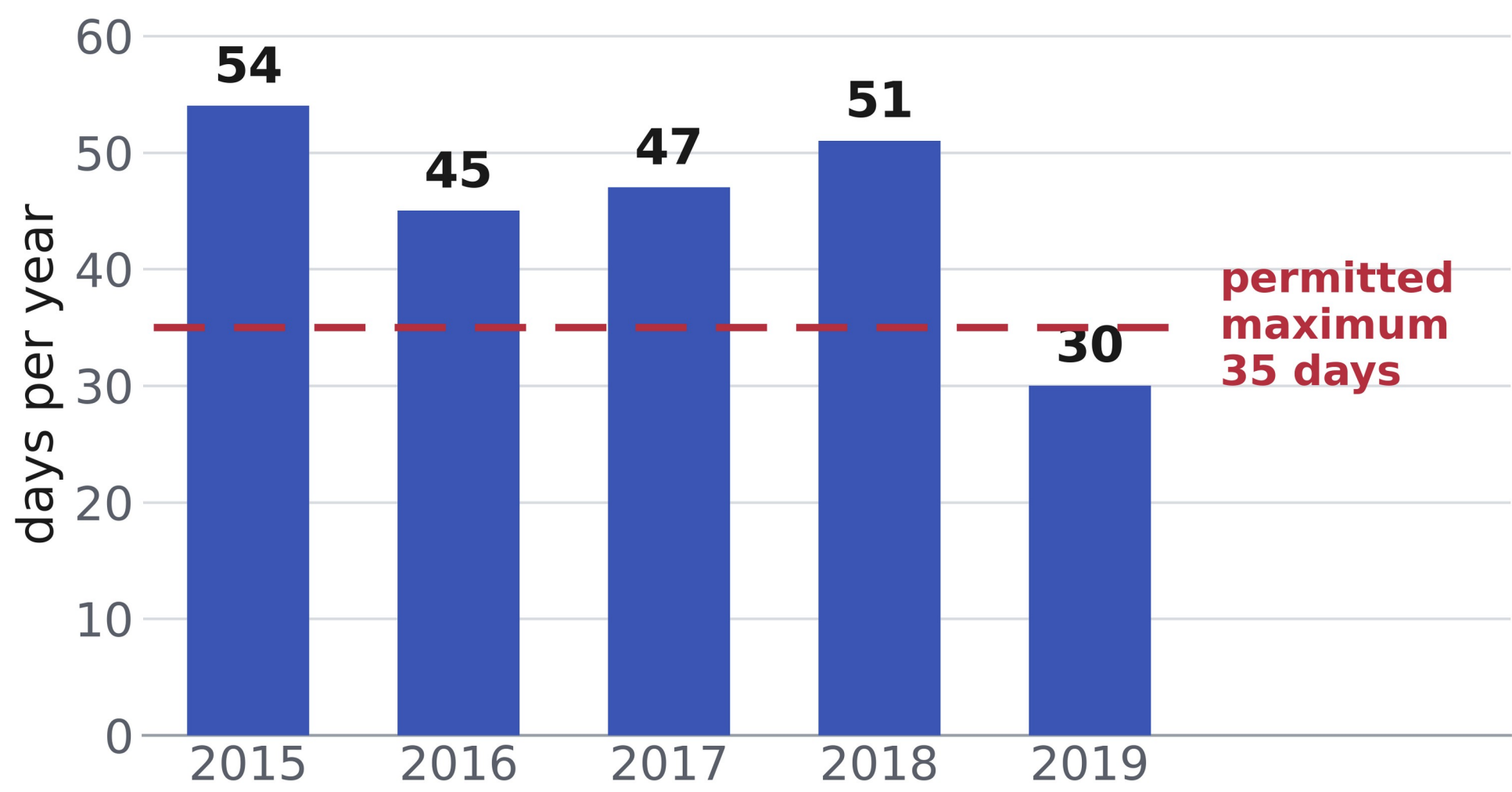


Figure 2. Short-term PM₁₀ peaks exceeded the permitted 35 days in four of five years.

Equivalent passively smoked cigarettes per resident, per day

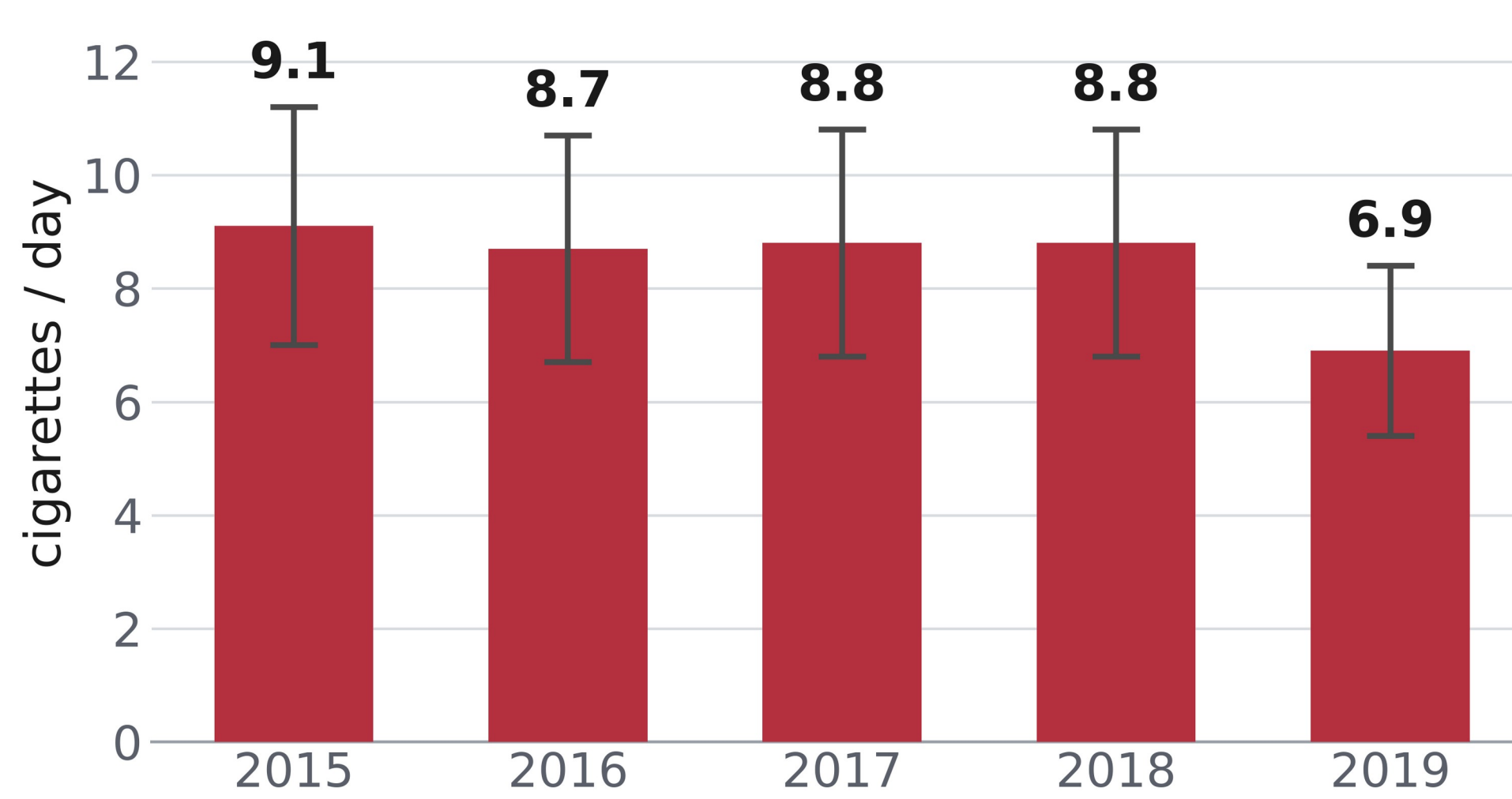


Figure 3. Particulate exposure expressed as passively smoked cigarettes; bars are means with the published uncertainty.

Lung cancer (ICD-10 C33+C34), Poland

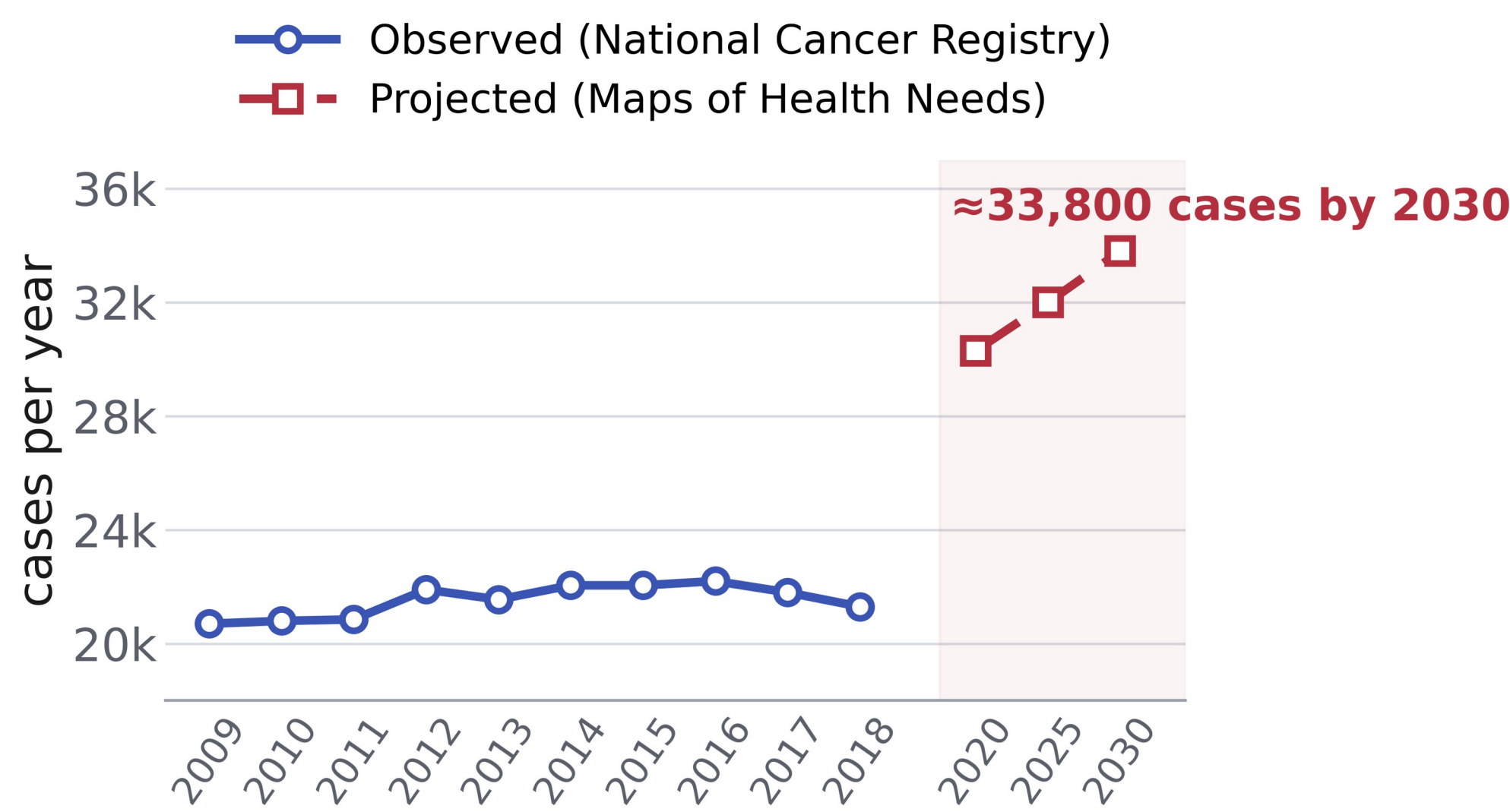


Figure 4. Registry counts and Ministry of Health projections.

Certified sickness absence (ZUS)

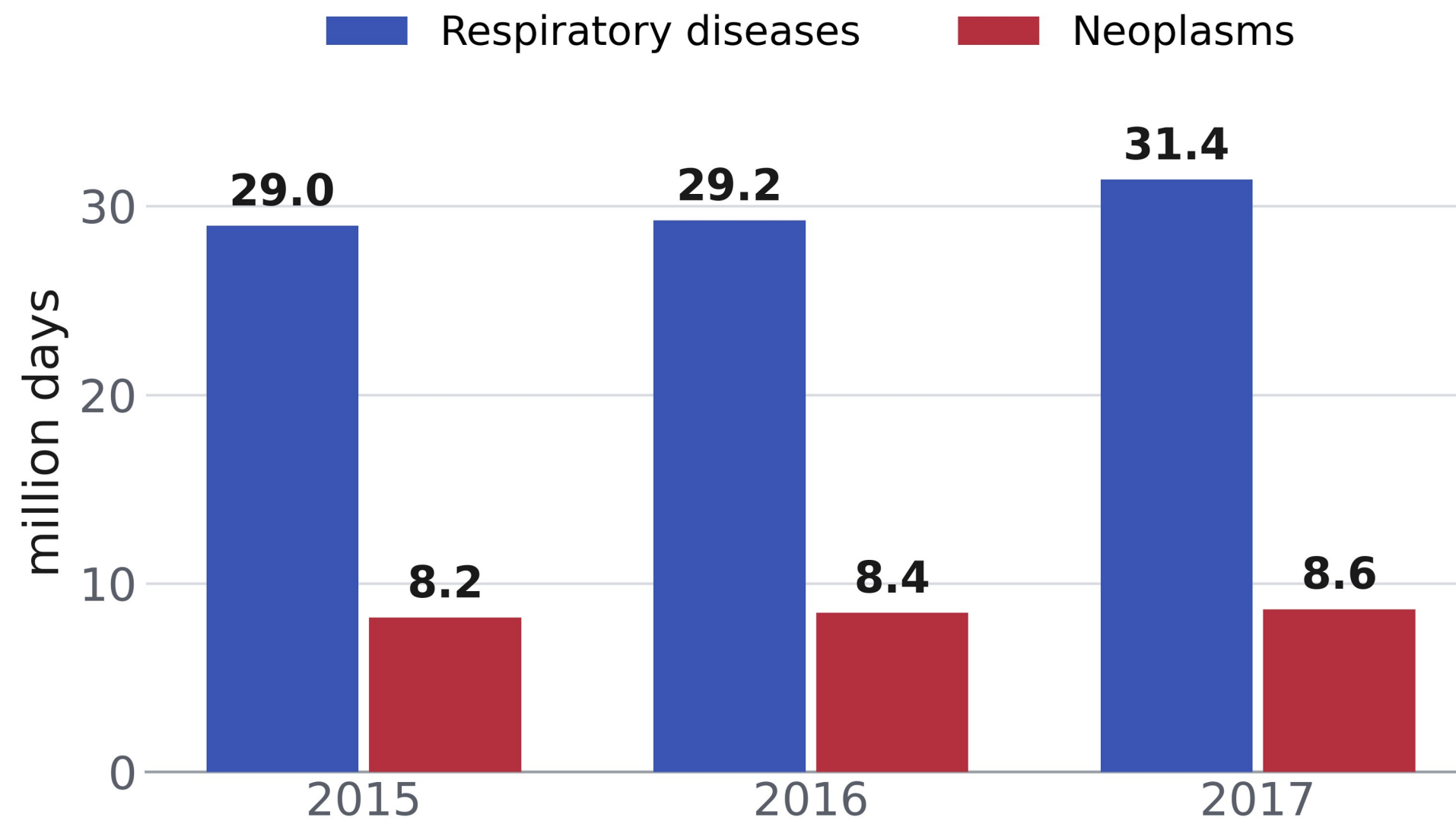


Figure 5. Certified sick-leave days rose in both categories.