Estimating the Economic Burden of Work Injuries and Illnesses in the European Union

Emile Tompa, MBA, PhD
Health and Labour Economist
Senior Scientist, Institute for Work & Health
Co-Director, Centre for Research on Work Disability Policy

Study Team
Emile Tompa, Amirabbas Mofidi, Swenneke van den Heuvel, Thijmen van Bree, Frithjof Michaelsen, Young Jung, Lukas Porsch, Martijn van Emmerik

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Emile Tompa, Amirabbas Mofidi, Young Jung

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Swenneke van den Heuvel, Thijmen van Bree, Martijn van Emmerik

VVA VALDANI VICARI & ASSOCIATI

Frithjof Michaelsen, Lukas Porsch

Overview of the Presentation

- Background and objective
- Method
  - Development of a conceptual model
  - Overarching study steps
  - High level assumptions
  - Data sources
- Results
  - Incidence of occupational injuries and disease
  - Economic burden by cost category, GDP, and cost per-case
  - Economic burden by stakeholder
  - Model Robustness
- Discussion and conclusion

Economic Burden/Cost of Illness Studies

- These studies measure total costs of a particular health condition (injury/illness/disease) to society, including treatment costs, other services provided, and lost output/productivity
- Some include the value of lost healthy time
- They do not measure the probability of success of treatment options or the opportunity costs of interventions that may avert the health conditions

Purpose of Economic Burden Studies

- Provide insights into the magnitudes of the cost of a health condition to society
- Can be used to monitor how burdens changed over time
- Can compare burdens for similar conditions in other jurisdictions
- Can compare burdens from different health conditions within a jurisdiction
- Case costing provides inputs in economic evaluation of prevention activities

Possible Policy Responses to Burden Information

- Increasing funding for intervention options known to reduce the burden
- Use case costing to evaluate the cost-benefit/effectiveness of interventions
- Investing in research to discover intervention options to reduce the burden when no effective alternatives currently exist

Methodological overview

- **Type of economic burden study undertaken**
  - Incidence costing study
  - Considers only new incidents in a particular year
  - Includes lifetime costs associated with each new incident incurred by all stakeholders
- **Key question addressed by this economic analysis**
  - What would be the saving to society (country x) if we did not have any work injuries or diseases in a particular year?

Economic burden = counterfactual scenario – current scenario

World as it was in a particular reference year

Alternative world that could have been

Difference in resources in relation to the health condition

Economics versus Accounting

- **How much would you pay to enjoy a day at a beautiful beach?**
- Accountant: counts prices paid – parking, sun screen, umbrella rental
- Economist: considers the value of a fun day at the beach (opportunity costs)

Reference Year

Countries in the study

Finland

Germany

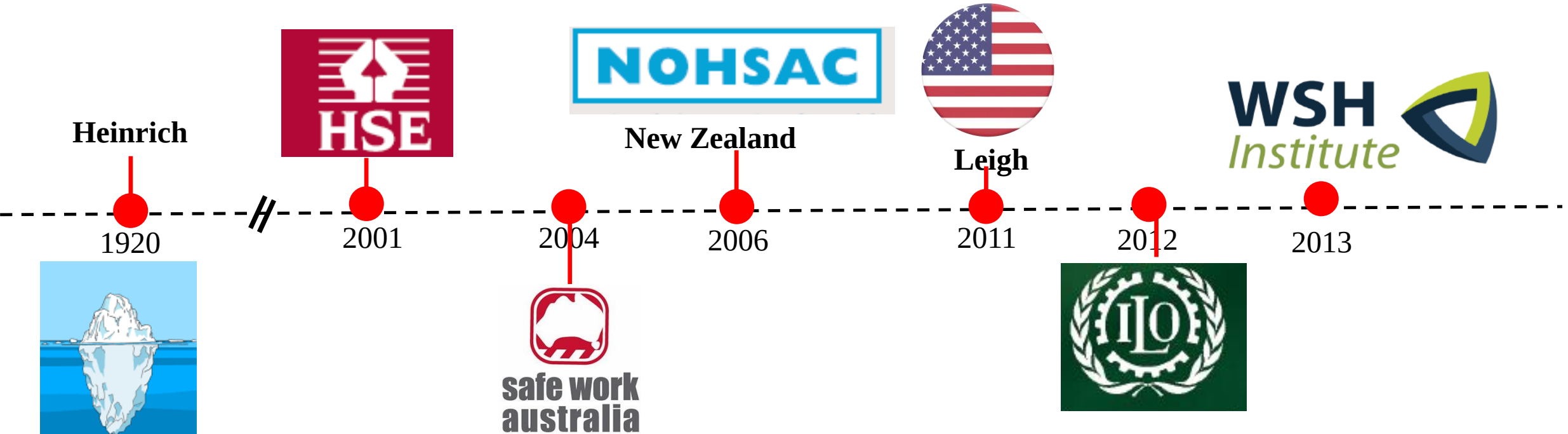
The Netherlands

Poland

Italy

Background

Ove the last few decades, there are several attempts to estimate the economic burden of occupational injuries and diseases around the world

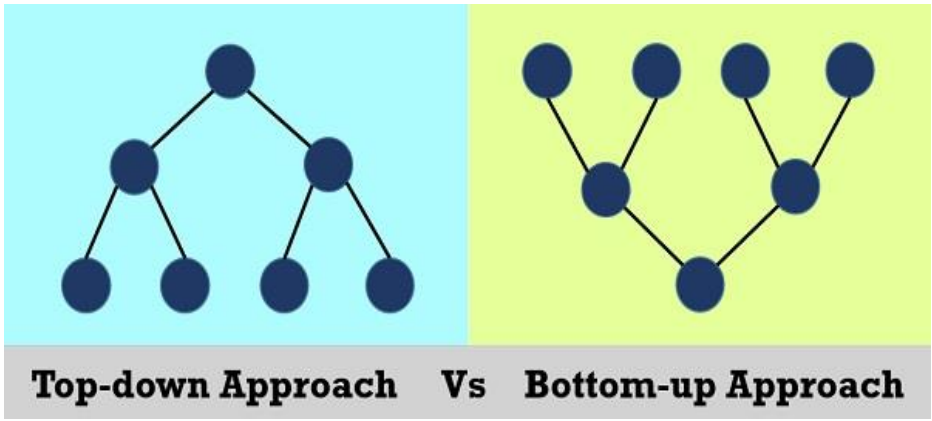


Where are we today?

Despite multiple published studies on the economic burden of work injuries and diseases around the world, identifying robust and comparable estimates of the total burden at the country level remains a complex mission, largely due to:

Lack of uniformity in national-level data collection

Lack of standardized economic burden estimation methodology



Lack of uniformity in national-level data collection

A key reason for less than optimal cross-country comparability is lack of uniformity in national-level data.

- **Inconsistency of definition of reportable work-related injury and disease cases** *(e.g. lost days more than 1 day, 3 days more than 3 days)*
- **Underreporting of work-related injuries** *(e.g. especially less severe cases)*
- **Underreporting of work-related diseases** *(e.g. especially cases with long latency)*
- **Under-coverage** *(e.g. non-coverage of certain economic sectors/ workforce subgroups)*
- **Inconsistency in data gathering formats** *(e.g. national level healthcare costs coding system)*
- **Different in jurisdictional system** *(e.g. share of employee, employer, insurance, public sector)*

Lack of standardized economic burden estimation methodology

The main differences in the methodology of economic burden of work injury and disease studies can be attributed to differences in:

1. The cost estimation model used, i.e. bottom-up versus top-down;
2. Case estimation approach, i.e., prevalence approach versus incidence approach, and adjustment for case underreporting; and
3. Costs subcategories considered are not same
    - Healthcare components
    - Output/productivity (multiple methods)
    - Health-related quality-of-life (e.g., decreases in social role engagement; pain, suffering and loss of enjoyment of life)

Development of our approach

Model synthesized from several studies:

a) **Tompa et al. (2017)** "*Economic burden of lung cancer and mesothelioma due to occupational and para-occupational asbestos exposure*"

b) **Leigh (2011)** "*Economic burden of occupation injuries and diseases in the US*"

c) **Safe Work (2017)** *"The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community"*

d) **HSE (2018)** *"Costs to Britain of workplace fatalities and self-reported injuries and ill health"*

High level assumptions and related factors

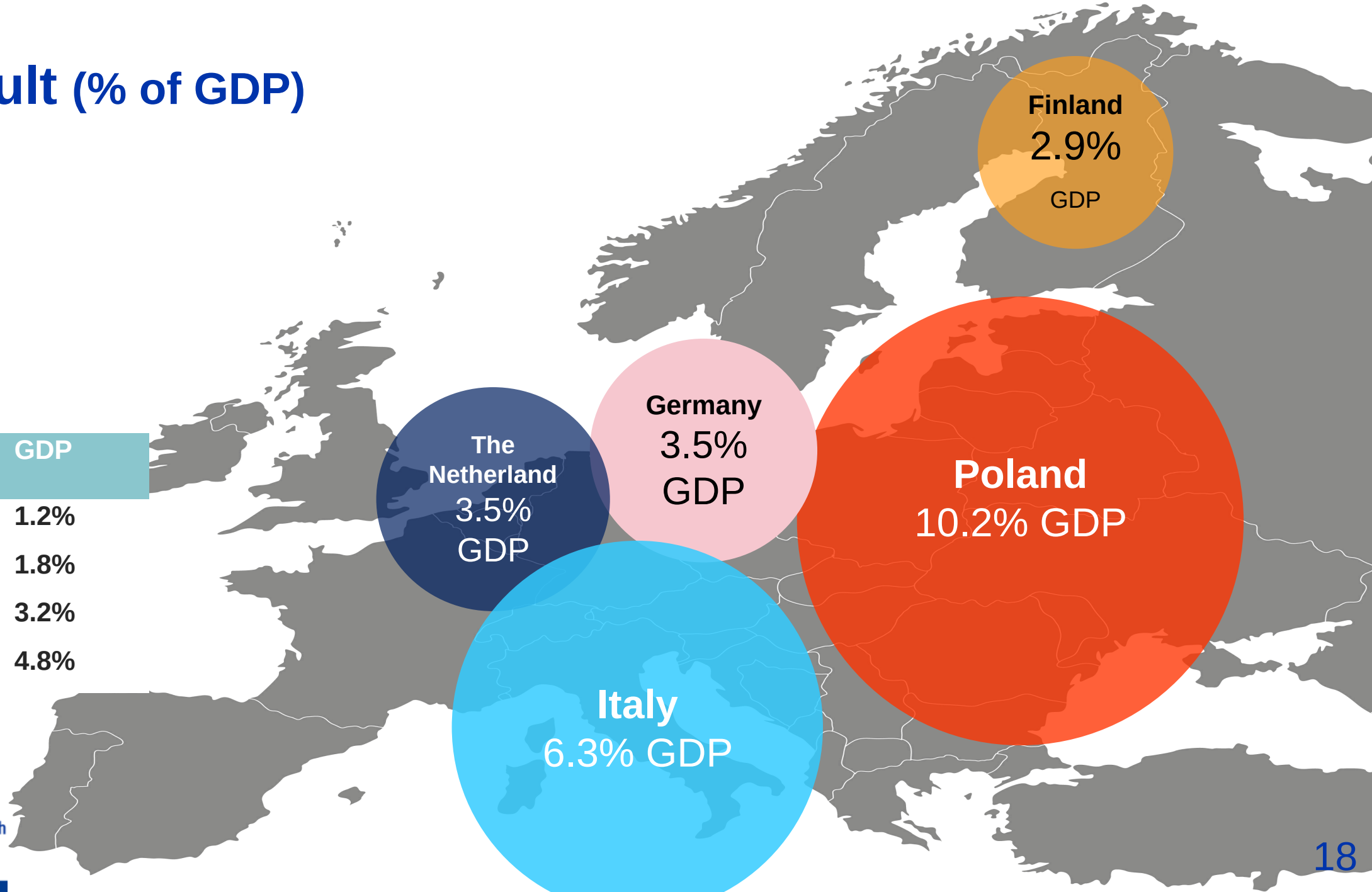
- Incidence costing approach (only newly diagnosed case in 2015)
- Bottom-up approach
- Three broad cost categories:
  - **Direct—healthcare**
  - **Indirect—productivity**
  - **Intangible—health-related quality of life (HRQL)**
- Considered lifetime costs for cases across all cost categories
- Effort to advance methods-included presenteeism, HRQL and out-of-pocket costs

What country has the lowest cost of work injuries and disease as a percentage of GDP?

a. Finland
b. Germany
c. The Netherlands
d. Poland
e. Italy

Result (% of GDP)

Country	GDP
UK	1.2%
US	1.8%
Singapore	3.2%
Australia	4.8%



European Agency for Safety and Health at Work

Economic model structure (cost by stakeholders)

	Worker, family and community	Employer	System/Public sector	Society
Direct cost	Share of formal healthcare cost[a] Informal caregiver costs Out-of-pocket costs	Share of formal healthcare costs[a]	Share of formal healthcare cost[a]	**Worker, family, and community + Employer + System/ Public sector**
Indirect cost	Share of wage losses not compensated[b] Fringe/Payroll benefit losses Home production losses	Share of wages replaced[b] Employer's adjustment costs Presenteeism	Share of wage replaced[b] Insurance administration costs	
Intangible cost	Monetary value of health-related quality of life losses			

Baseline work injury counts (2015)

	Employed population	No day lost		1-3 days lost		More than 3 days lost		Fatal cases[2]
Country		Percent[1]	Count[3]	Percent[1]	Count[3]	Percent[1]	Count[2]	
Finland	2,436,800	61	97,933	13	21,362	26	42,045	35
Germany	40,210,900	47	1,031,806	14	313,859	39	845,005	450
The Netherlands	8,318,700	47	88,928	14	27,051	39	72,829	35
Italy	22,464,800	13	50,538	11	42,673	76	295,156	543
Poland	16,083,900	10	9,363	6	6,216	84	81,850	301

[1] Eurostat (2018b). Labour Force Survey (LFS). Persons reporting an accident at work resulting in sick leave by period off work [hsw_ac3]
[2] Eurostat (2018a). Accidents at work statistics (ESAW). Fatal and non-fatal accidents at work, by sex, age groups, injury groups and NACE Rev. 2 economic sectors [hsw_mi07]
[3] Calculated number using the percentage based on [1],[2]

Adjusted estimates of work-related injuries

- For fatal injury cases, we assume no underreporting.
- To adjust the non-fatal injury case counts of Poland and Italy, we used the Germany ratio of fatal to non-fatal injuries (39) as a baseline ratio.
- We then ran a sensitivity analysis using the lowest (35) and highest (55) fatal to non-fatal injuries ratios, which were for The Netherland and Finland, respectively.
- We did not change the baseline injury count for Germany, The Netherlands and Finland.

Adjusted estimates of work injuries

Country	Employed population	Non-fatal cases (>1 day lost)[1]	Fatal cases[2]	Fatal to non-fatal ratio ×100,000	Adjustment ratio for non-fatal cases underreporting	Adjusted non-fatal cases
Finland	2,436,800	63,407	35	55	1 (+1.1, +1.2)	63,407 (69,748- 76,088)
Germany	40,210,900	1,158,865	450	39	1 (+1.1, +1.2)	1,158,865 (1,274,751-1,390,638)
The Netherlands	8,318,700	99,880	35	35	1 (+1.1, +1.2)	99,880 (109,867- 119,855)
Italy	22,464,800	337,829	543	161	3.7 (+2.9, +4.5)	1,257,987 (983,714-1,531,192)
Poland	16,083,900	88,066	301	342	7.9 (+6.2, +9.6)	697,337 (545,300-848,783)

[1] Count from Eurostat (2018a), Labour Force Survey (LFS). and distribution from Eurostat (2018b), Accidents at work statistics (ESAW).
[2] Eurostat (2018a), Labour Force Survey (LFS).

Estimation of work-related non-fatal disease incidence

Non-fatal disease: Compensated and non-compensated cases with the exceptions for cancers, circulatory diseases, respiratory diseases, and musculoskeletal diseases which were estimated using attributable fractions from the Burden of Disease study 2016 in the IHME (2016).

Fatal disease: Case counts from IHME 2015 and attributable fractions for fatal work-related diseases from IHME 2016. Not provide are attributable fractions for bladder cancer, digestive diseases, neurological diseases, mental disorders, genitourinary diseases, and musculoskeletal disorders.

Country	Finland		Germany		The Netherlands		Italy		Poland	
Scenario	Low	Baseline	Low	Baseline	Low	Baseline	Low	Baseline	Low	Baseline
Non-fatal	1,776	67,797	36,202	1,088,793	8,073	220,368	19,314	638,448	2,351	454,090
Fatal	-	629	-	13,923	-	3,261	-	10,526	-	4,663

***Low scenario**: Non-fatal disease only includes compensated cases, from national compensation system sources.*

Estimation of healthcare costs

- **Injuries with three or fewer days lost, c**onsidered a nominal healthcare cost of €100.
- **Injuries with more than three days lost**, began with data from the Italian National Ministry of Health and then estimated costs for the other four countries using adjustment ratio that we drew from International Comparisons of Health Prices and Volumes.
- **Work related diseases**, began with data from the Germany federal statistical office Destatis and estimated costs for the other four countries as above.
- **Out-of-pocket costs** estimated as a percentage of the cost of public healthcare services.
- **Informal caregiving**, assumed all cases with less than six months of lost time receive one-hour of care per day. For cases with more than six months of lost time, we did not consider informal caregiving after six months.

Estimation of output/productivity losses

- Used human capital approach (HCA) to estimate market output losses based on a counterfactual of average labour-market earnings of the working-age population, stratified by sex and age bracket.
- Cases with less than one day lost no productivity losses considered.
- Cases with less than 6 months lost assumed to return to work without a change in their long-run productivity.
- Cases with more than six months lost assumed to be permanently impaired. We assumed fraction of output losses (35% losses of wage) continued till age 65.
- Fatal cases, losses assumed for the remainder of a standard work life (age 65).

Estimation of home production losses

- Assumed workers off work not able to fulfil home production tasks.
- For permanent impairment and fatal cases, home production activities lost for the remainder of a standard life.
- Used data on time spent in home production activities.

Country	Time (hours per day)		Hourly wage	
	Men	Women	Men	Women
Finland	2.55[1]	3.68[1]	€12[6]	€12[6]
Germany	2.15[2]	3.36[2]	€19[7]	€14[7]
The Netherlands	1.95[3]	3.45[3]	€25[8]	€25[8]
Italy	2.18[4]	5.11[4]	€19[9]	€14[9]
Poland	2.65[5]	4.75[5]	€5[10]	€5[10]

[1] Statistics Finland (2010), [2]Destatis (2015b), [3] SCP (2012), [4] OECD (2016), [5] OECD (2016), [6] Statistics Finland (2018), [7] Destatis (2015b), [8] CBS/StatLine (2017), [9] Same as Germany, as National collective agreements (as of January 2016) for Personal and household services did not report the hour, [10] ZUS (2018)

Estimation of presenteeism

- Presenteeism costs considered for all non-fatal cases with one day to six months lost time and cases with more than six months lost time who returned to work.
- For injuries, presenteeism was assumed an issue only after return to work
- For diseases, presenteeism assumed an issue before and an absence.
- Value of presenteeism for injury cases is half that of disease cases.
- Presenteeism estimates based on the Schultz et al. (2009).

Estimation of employer adjustment costs

- Expenses related to replacing a worker absent due to work injury or disease.
- For fatal cases, assumed the adjustment costs of six months of wage and benefit.
- For non-fatal cases with more than three days lost, considered the two cost categories:
  - **Production disturbances** represent costs associated with work reorganisation and recruitment and training of temporary or permanent replacement staff.
  - **Administrative costs** were assumed to be incurred for time spent initiating and managing claims.

Estimation health-related quality of life losses (HRQL)

- For temporary and permanent disability we used multipliers based on severity.
- For fatal cases, assumed lost years had same values as the average for the population, stratified by sex and age.
- HRQL losses estimated with Quality-Adjusted Life Years (QALYs) and monetized using a price weight of €41,100 (£30,000) per QALY (NICE).

Injury severity (days lost)	< 3	4- 14	15- 90	90- 180	180- 365	Never return
Proxy (lost QALY multiplier)[1]	Minor(1)	F (0.002)	W (0.01)	X (0.03)	S (0.1)	S (0.19)
Disease severity (days lost)	**< 3**	**4- 30**	**30- 90**		**> 90**	**Never return**
Proxy (lost QALY multiplier)[1]	Minor(1)	F(0.002)	W (0.01)		2×W (0.02)	S (0.19)

[1] Adopted from HSE (2011).

Results (case counts of work injuries and diseases in 2015)

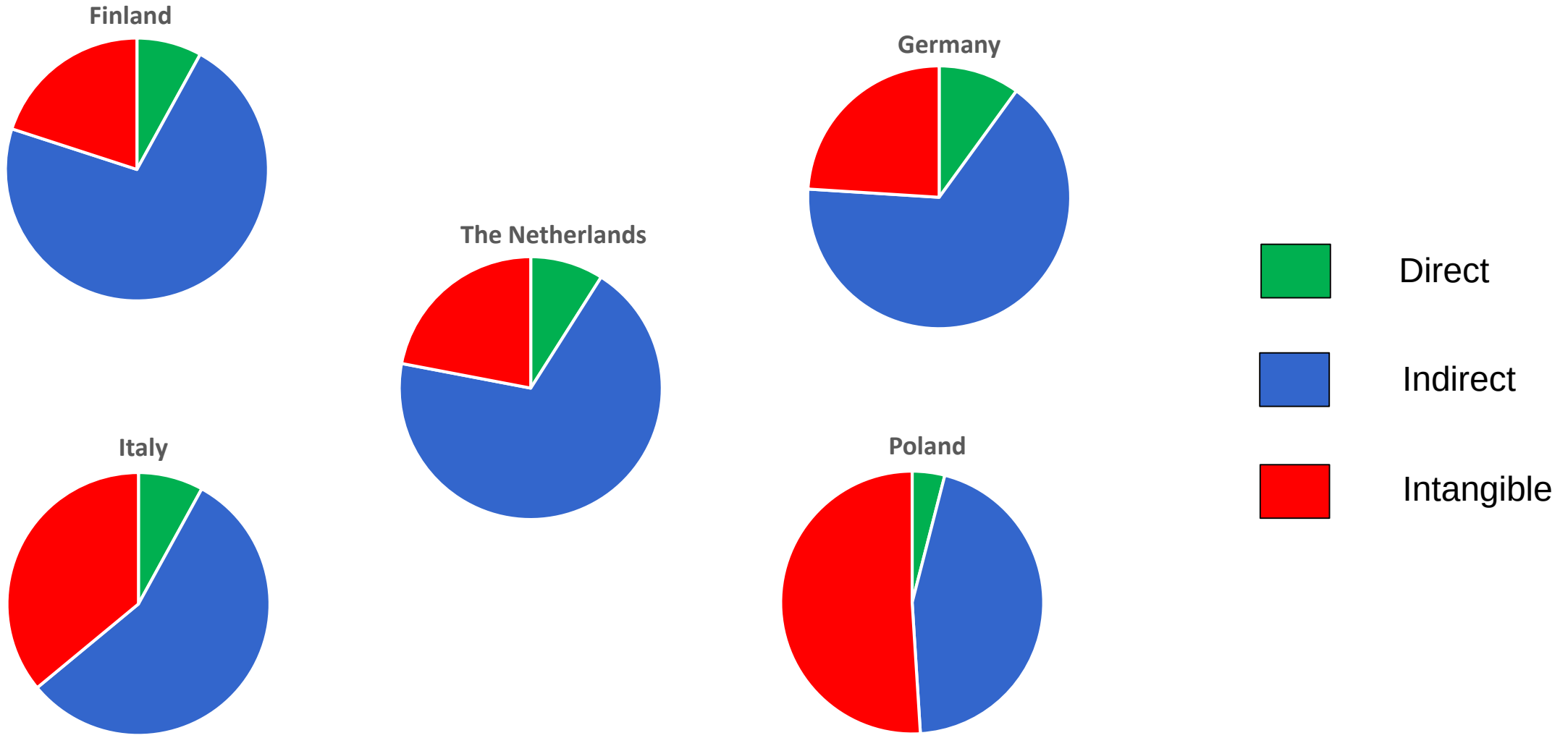
Countries	work injuries		work diseases	
	Non-fatal	Fatal	Non-fatal	Fatal
Finland	63,407 (2,602)	35 (1.4)	67,795 (2,782)	628 (25.8)
Germany	1,158,865 (2,882)	450 (1.1)	1,088,793 (2,708)	13,924 (34.6)
The Netherlands	99,880 (1,201)	35 (0.4)	220,368 (2,649)	3,262 (39.2)
Italy	1,257,987 (5,600)	543 (2.4)	638,448 (2,842)	10,524 (46.8)
Poland	697,337 (4,336)	301 (1.9)	454,090 (2,823)	4,663 (29.0)

Note. *Number in parenthesis represents incidence per 100,000 employed population (We only included Non-fatal cases with at least 1 workday lost).*

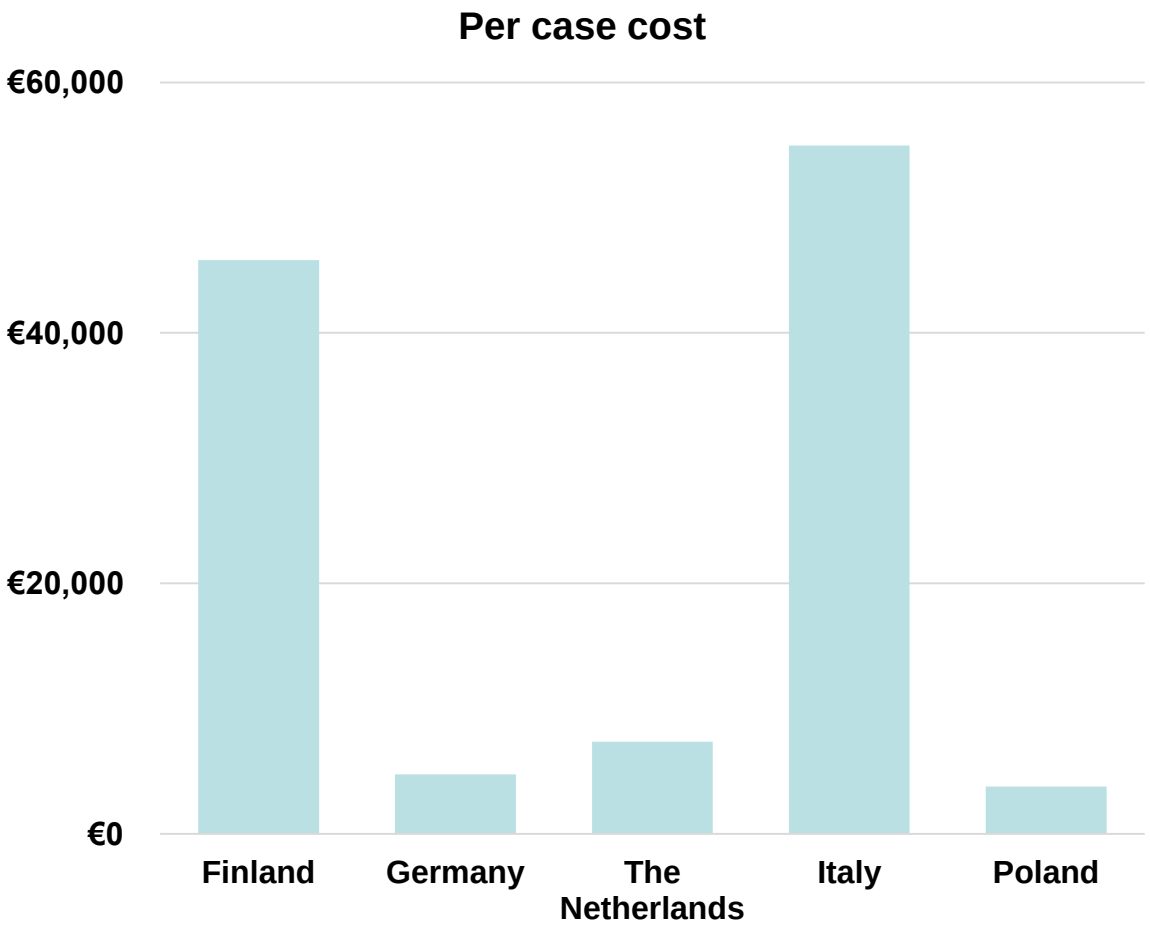
Result (summary)

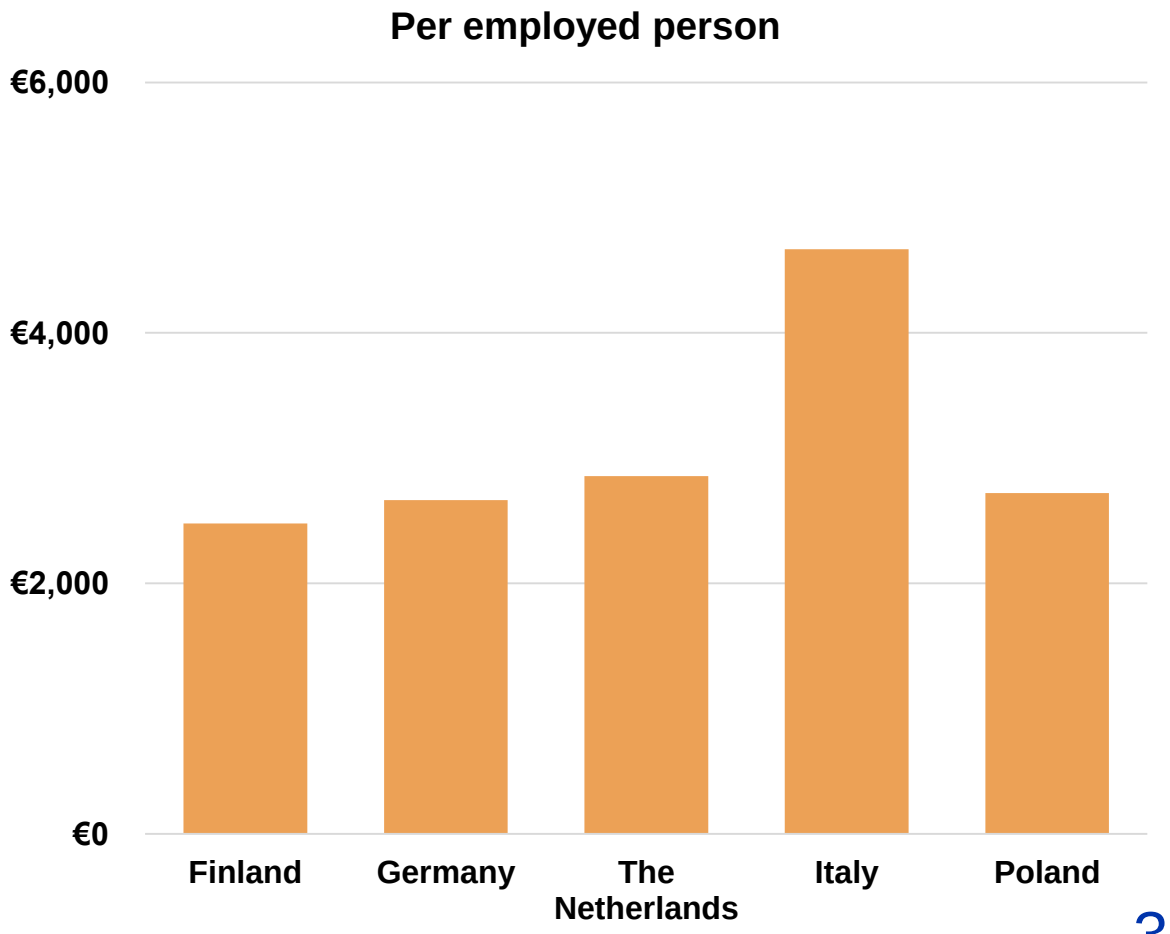
Country		Finland	Germany	The Netherlands	Italy	Poland
Cases		131,867	2,262,031	323,544	1,907,504	1,156,394
Direct costs	Millions €	€ 484	€ 10,914	€ 2,137	€ 8,491	€ 1,882
Indirect costs	Millions €	€ 4,362	€ 70,658	€ 16,468	€ 58,961	€ 19,588
Intangible costs	Millions €	€ 1,196	€ 25,557	€ 5,147	€ 37,392	€ 22,311
Total economic burden	Millions of €	€ 6,042	€ 107,129	€ 23,751	€ 104,844	€ 43,781
Percentage of GDP		2.9%	3.5%	3.5%	6.3%	10.2%
Per case cost	€	€ 45,816	€ 47,360	€ 73,410	€ 54,964	€ 37,860
Per employed person	€	€ 2,479	€ 2,664	€ 2,855	€ 4,667	€ 2,722

Result (cost by category—direct, indirect and intangible)



Result (cost per case)

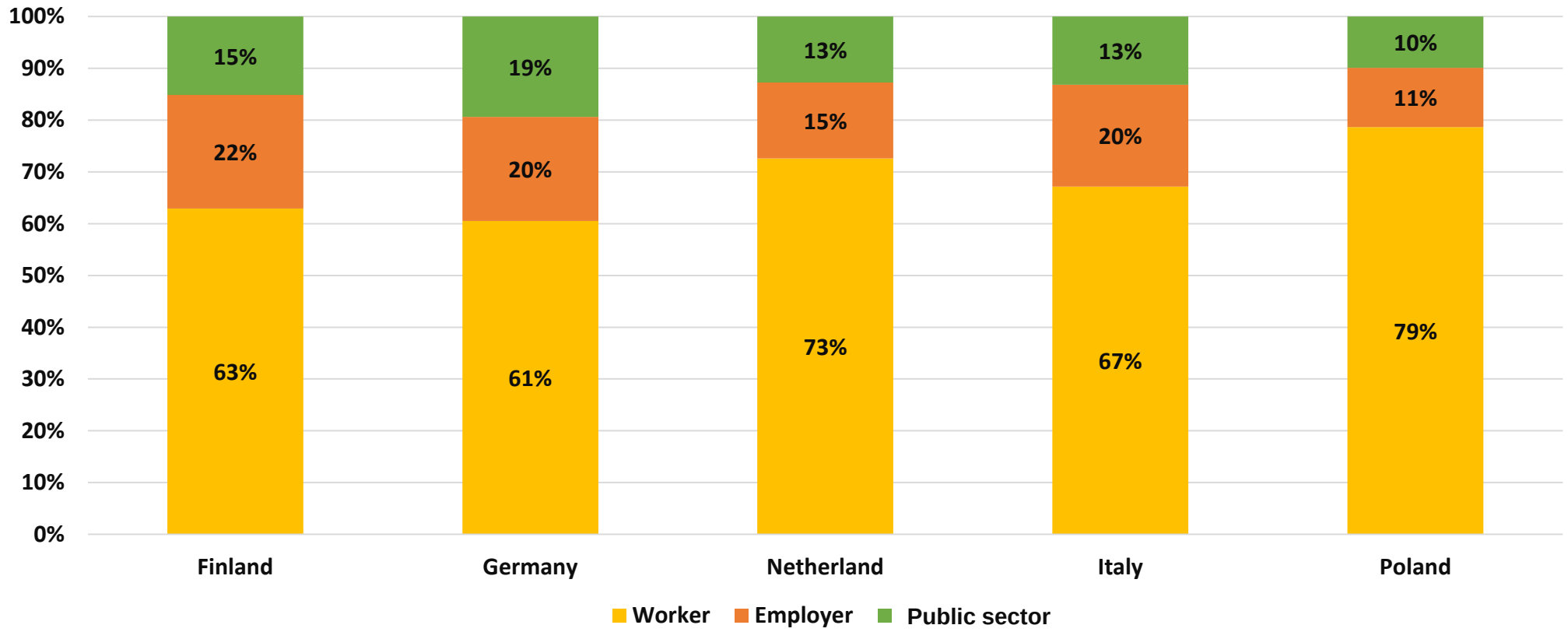




In what country do workers pay the highest proportion of the total cost?

a. Finland
b. Germany
c. The Netherlands
d. Poland
e. Italy

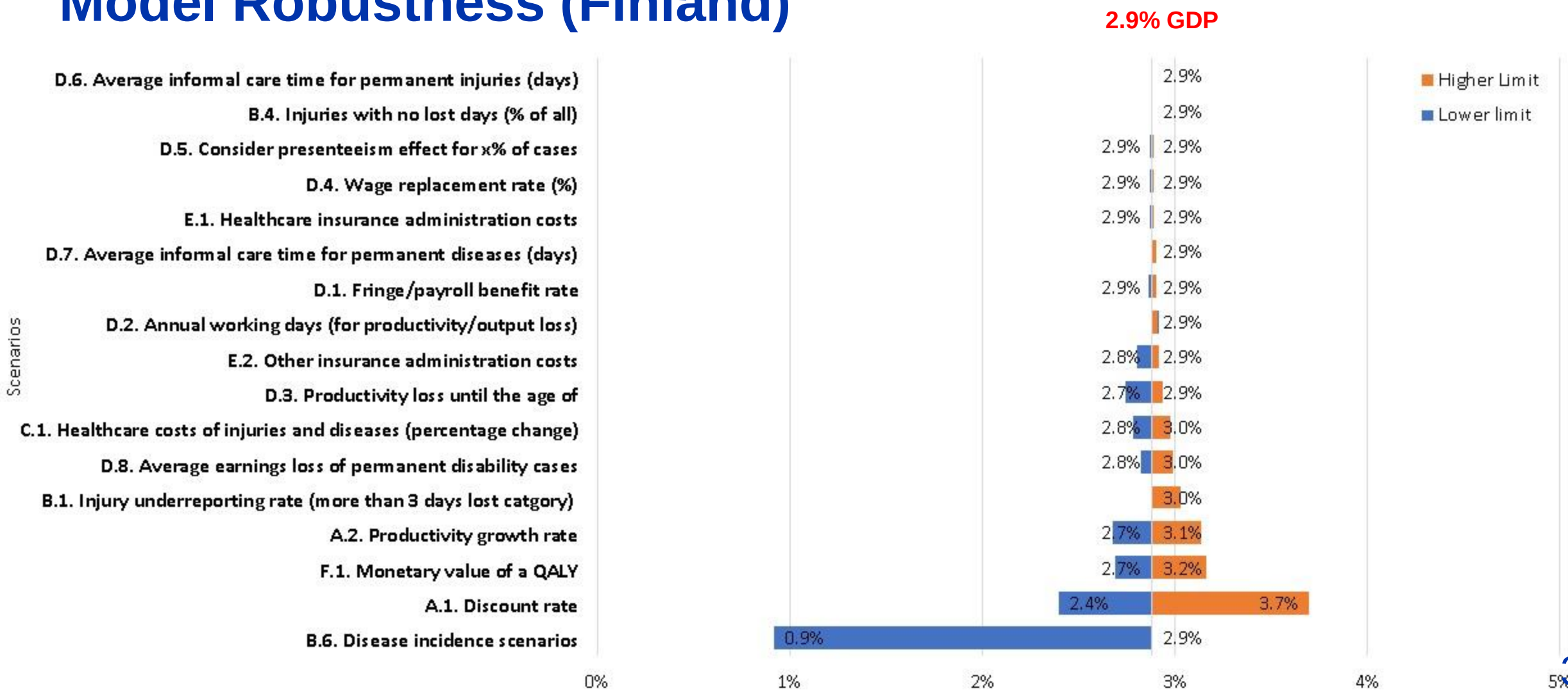
Result (cost by stakeholders—worker, employer, public sector)



Model Robustness

- Given the number of data elements and variety of assumptions needed, the burden estimates were sensitive to the values used for key parameters.
- Several one-way sensitivity analyses were undertaken for key parameters with uncertain values.
- The lower and higher bounds of the economic burden were estimated as a percentage of GDP.

Model Robustness (Finland)



Model Robustness

- Assumptions about the incidence counts of work injuries and diseases cases are the most influential parameters on the economic burden.
- Diseases with longer latency periods are often not reported and fatal work diseases are often excluded.
- The sensitivity analysis results provide insights into the possible range of true values of the burdens and also identify input data that warrant refinement in data collection systems.

Discussion

What are the reasons of the variation in GDP percentage?

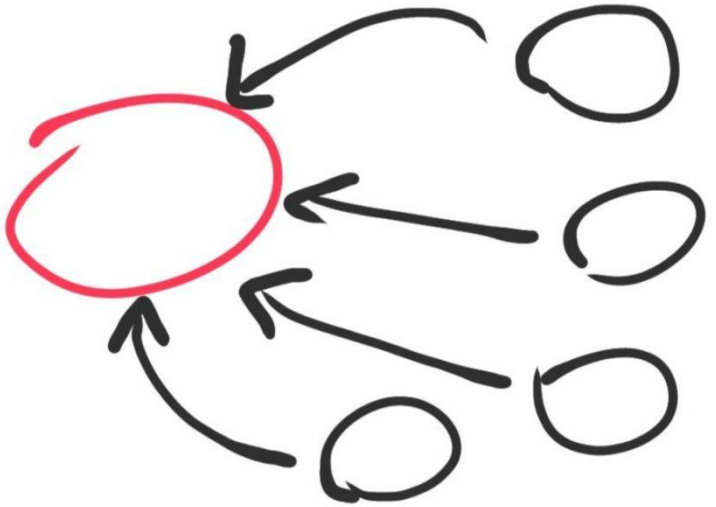
- **Differences in national characteristics**
  - ✓ Sector structure
  - ✓ Practices in particular sectors
  - ✓ Countries economic situation and labour-market earnings
- **Uncertainty of input parameters**
  - ✓ Underreporting of the incidence of work-related injuries and disease
  - ✓ Costing uncertainties (e.g., healthcare, permanent disabled productivity losses)
  - ✓ Different data sources and related accounting processes

Conclusions

- Study focuses on both conceptual and applied aspects of estimating the economic burden of occupational injuries and diseases at the national level

- We advance the method on several fronts—our efforts can give insight to administrators, data collectors and academics of where further fieldwork might be undertaken

- Our case costs and total economic burden estimates provide a basis for undertaking economic evaluations of prevention efforts and can serve as a template for monitoring and evaluation at the country level



Next Steps

- The framework can be used to evaluate the economic burden of work injuries and diseases over time within countries and at a point in time in different countries in the EU and beyond.
- Avenue by which to evaluate progress in reducing burdens within countries and a better understanding of the cross-country differences in the total burden and the cost components contributing to the burden.

Publications

https://osha.europa.eu/en/tools-and-publications/publications/value-occupational-safety-and-health-and-societal-costs-work/view

Heinrich 1920

HSE 2001

NOHSAC New Zealand 2004

safe work australia 2006

Leigh 2011

ILO 2012

WSH Institute 2013

Institute for Work & Health 2019

Questions?
Insights?

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Emile Tompa
Senior Scientist, Institute for Work & Health
Co-director, Centre for Research on Work Disability Policy
etompa@iwh.on.ca
www.crwdp.ca

Overarching study steps

Estimation of new cases

Definition of cost categories

Price weights

Total (sub) category costs for a strata =

# of new cases
x
per case costs for cases

Data sources for case counts

- **Non-fatal work-related injuries[1]**
- **Fatal work-related injuries[1]**
- **Non-fatal work-related diseases[2,3]**

  Different data sources, different scenarios of the case count. Baseline scenario:
  - Count of compensated (accepted, recognized) and non-compensated non-fatal cases for most types of diseases[2]; with the following exceptions:
  - for cancers, circulatory diseases, respiratory diseases, and musculoskeletal diseases we estimated case counts and used attributable fractions to estimate the work-related cases[3]
- **Fatal work-related diseases[3]**

European Statistics on Accidents at Work (ESAW)

Labour Force Survey (LFS)

Institute for Health Metrics and Evaluation

Sources:

[1] ESAW 2015 (non-fatal cases of Poland and Italy are adjusted based on the fatal to non-fatal ratio). To estimate the number of non-fatal cases with 1-3 workdays lost, the severity distribution in the LFS 2013 was applied

[2] National sources: Finland - Finnish Institute of Occupational Health (2012); Germany - DGUV Statistics (2013); The Netherlands - NCvB statistiek, Nationale Registratie Beroepsziekten (2015); Italy - Banche dati static, occupational injury and disease (2015); Poland: Choroby Zawodowe W Polsce W (2014)

[3] IHME 2015

Data details for price weights

Direct costs

- Healthcare costs (public sector/insurer)
- Overhead costs (public sector/insurer)
- Informal care giving (family/community)
- Out of pocket costs healthcare products (worker/family)

Indirect costs

- Market output losses including payroll/fringe benefits
  - Absenteeism and presenteeism
  - Employer adjustment costs
- Insurance administration costs
- Home production losses

Intangible costs

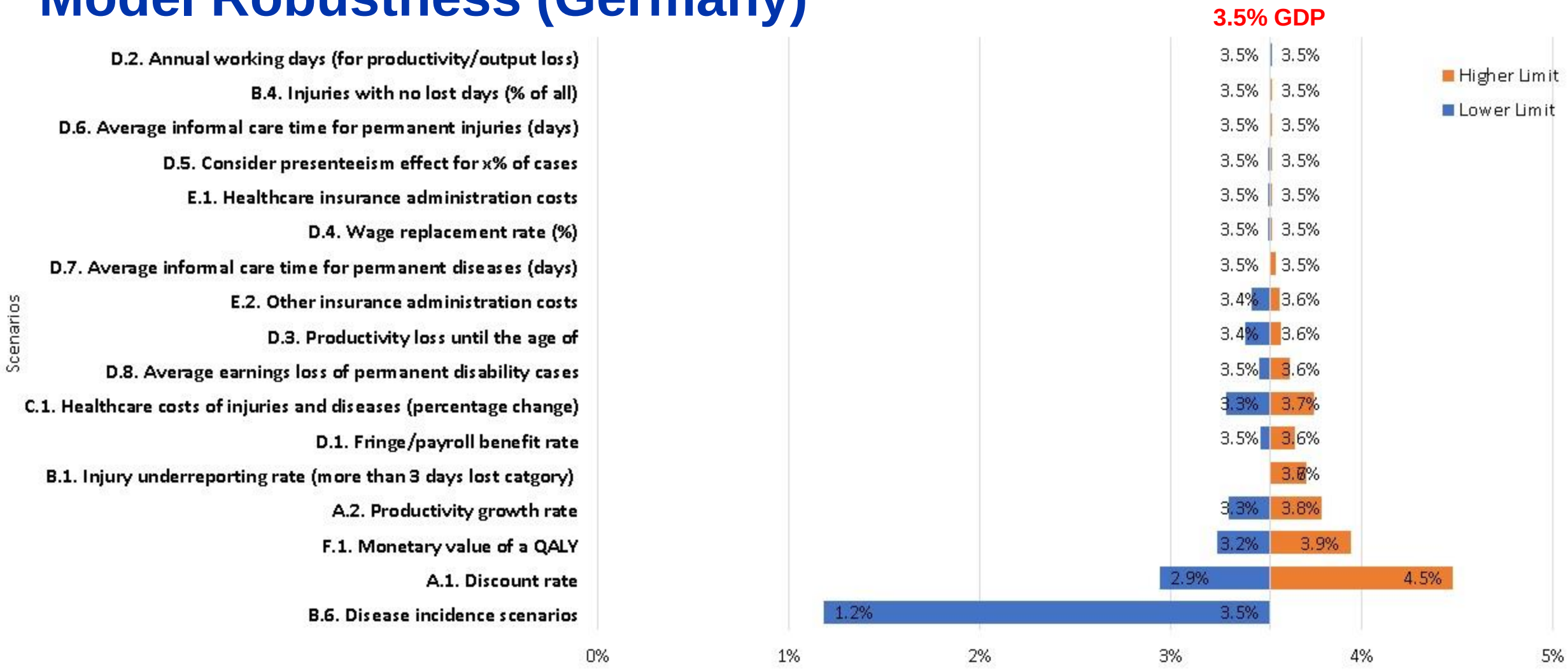
- Monetary value of Quality Adjusted Life Years (QALYs)

Estimation of work-related non-fatal disease incidence

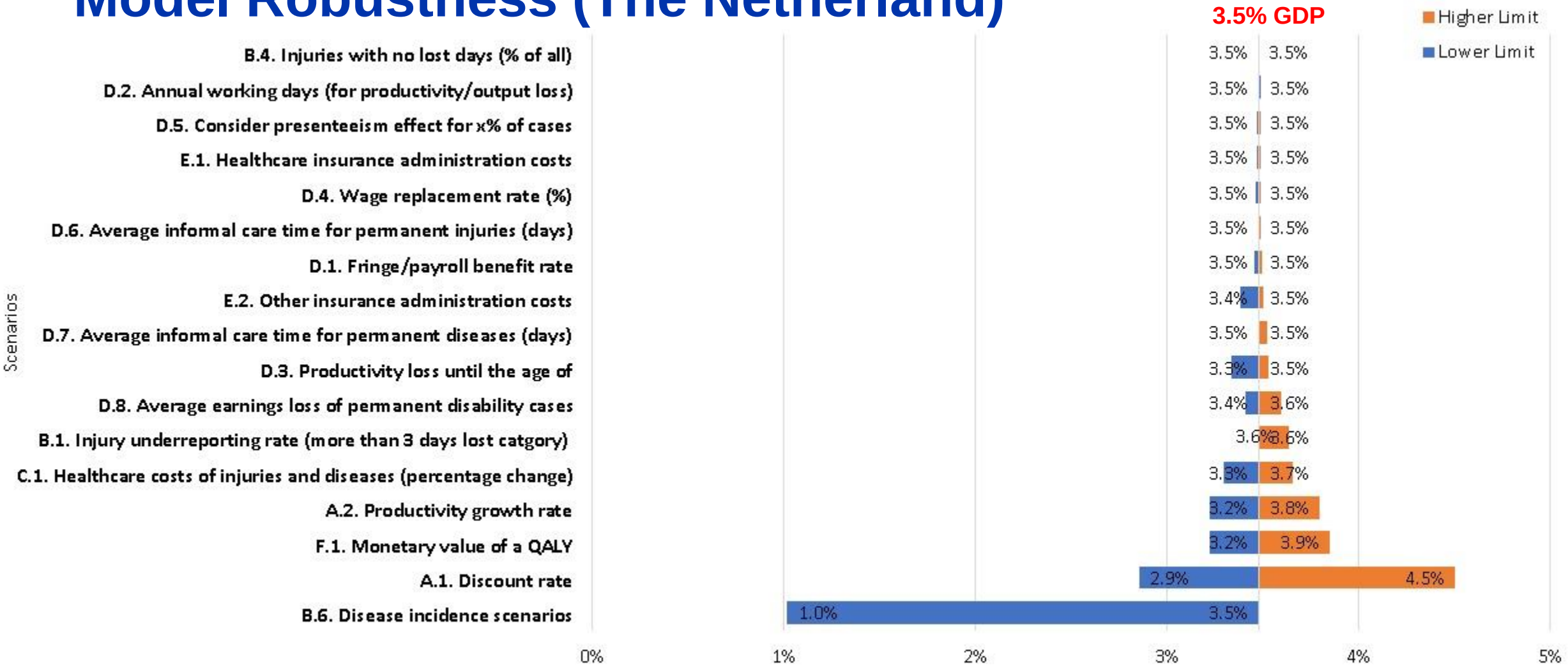
Country	Finland		Germany		The Netherlands		Italy		Poland	
Scenario	Low	Baseline	Low	Baseline	Low	Baseline	Low	Baseline	Low	Baseline
Non-fatal	1,776[1]	67,797[1,6]	36,202[2]	1,088,793[2,6]	8,073[3]	220,368[3,6]	19,314[4]	638,448[4,6]	2,351[5]	454,090[5,6]
Fatal	-	629[6]	-	13,923[6]	-	3,261[6]	-	10,526[6]	-	4,663[6]

Low scenario
-For non-fatal disease; i.e. only includes compensated cases.
Baseline scenario:
-Non-fatal disease; i.e. compensated and non-compensated cases with the exceptions for cancers, circulatory diseases, respiratory diseases, and musculoskeletal diseases that were estimated using attributable fractions from the Burden of Disease study 2016 in the IHME (2016).
-Fatal disease, we estimated case counts from IHME 2015 data using attributable fractions for fatal work-related diseases from IHME 2016. However, IHME 2016 does not provide attributable fractions for bladder cancer, digestive diseases, neurological diseases, mental disorders, genitourinary diseases, and musculoskeletal disorders.
[1] Työterveyslaitos (2012), [2] DGUV Statistics (2013), [3] NCvB statistiek (2015), [4] Banca Dati Statistica (2015), [5] Szeszenia-Dabrowska et al. (2016), [6] IHME (2016).

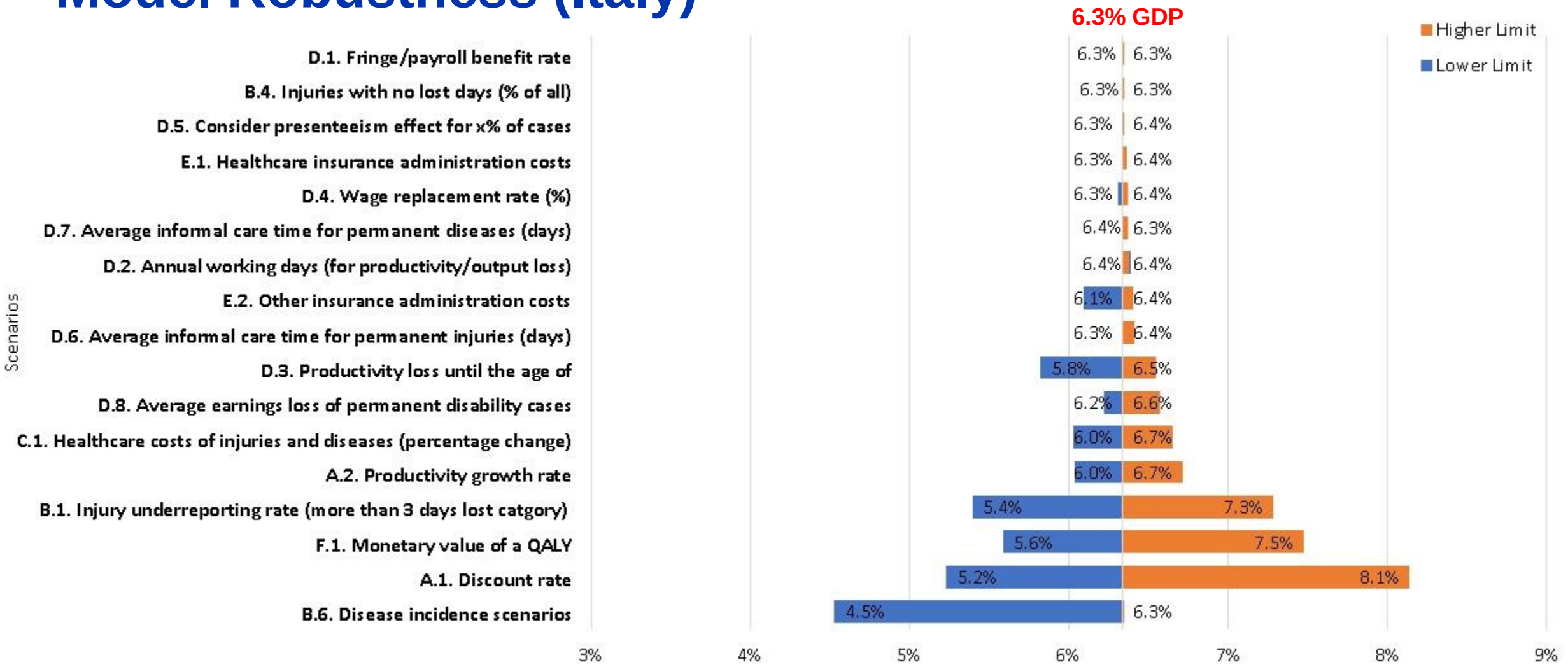
Model Robustness (Germany)



Model Robustness (The Netherland)



Model Robustness (Italy)



Model Robustness (Poland)