Project HealthCare

GOVERNMENT-CENTRIC FISCAL ANALYTICAL FRAMEWORK FOR EVALUATING BURDEN OF DISEASE:

DIABETES MELLITUS

Slovak Republic

February 4th, 2026

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Expert review:

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The document "Government-centric fiscal analytical framework for evaluating burden of disease: Diabetes mellitus" offers a unique, consolidated manuscript of an issue that has often been addressed only partially. It draws on multi-source analytical datasets. May be the data validity can be a concern (e.g., only ~70–80% of physicians report to NCZI), but this is partly offset by the overall robustness of the data and supplementation with other sources (health insurances, ministry of health etc.). These data are valuable for clinicians, health insurers/payers, the regulator (Ministry of Health of the Slovak Republic), and professional societies. A major strength is the emphasis on indirect costs, which are frequently overlooked yet often form the larger part of the burden. With diabetes prevalence rising, both direct and indirect costs increase - underscoring the need for rigorous, predictive analysis to support health-policy and financing decisions. Impacts should be strictly separated for type 1 vs. type 2 diabetes because their cost drivers differ. The material suggests patient counts have not increased substantially (and even decline in the data—likely a reporting artifact), yet total costs have doubled. For type 1, growth is largely driven by new technologies: they represent a major cost item, and conditions for their use still lag behind other countries, but they can significantly improve quality of life and reduce indirect costs. For type 2, costs are driven by new drug molecules/classes whose value lies in reducing or delaying complications and comorbidities.

Care for people with diabetes is delivered mainly in the outpatient sector, so spending rises there and clinics must sustainably fund operations. Declines in inpatient care may reflect technologies and therapies that reduce the need for hospitalization. However, the analysis may undercount inpatient costs for treating complications/comorbidities because these are often recorded under other diagnostic groups rather than diabetes, where poorly controlled diabetes remains a key upstream driver. The central policy message should be the continued rise of indirect costs and the argument that higher investment now can yield broader savings later. Cutting direct costs in the short-term risks increasing indirect costs and ultimately raising future direct costs for managing complications. One next step is to correlate these findings with similar analyses in cardiovascular (e.g., heart failure, coronary disease) and renal disease to better quantify the downstream impact of inadequately treated diabetes.

January 18th, 2026

Expert Review:

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This expert review assesses Prof. Robert Babela's work on a government-centric fiscal analytical framework for evaluating the burden of diabetes in Slovakia. The analysis stands out for its methodological rigor and originality, offering a comprehensive perspective that extends well beyond traditional health-economic evaluations. By systematically linking diabetes epidemiology with public finances, labor market outcomes, and the sustainability of public budgets, the study provides a holistic view of the disease's true economic impact. A key scientific contribution is the shift from focusing solely on direct healthcare costs to considering the full fiscal consequences over a patient's lifetime. The findings reveal that direct healthcare expenditures account for only 10-15% of the total burden, while the majority of costs arise from lost productivity (due to disability and absenteeism), reduced tax revenues, and increased social transfers, particularly the growing need for care services. The study quantifies lost productivity at up to €1.416 billion, with the total fiscal impact estimated at €2.1 billion annually and projected to rise to €3 billion. These figures underscore the significant macroeconomic challenge diabetes poses to public finance sustainability. Methodologically, the work employs national data, distinguishes between diabetes types, and utilizes advanced modeling techniques such as discounted cash flows, scenario analysis, and Monte Carlo simulations. Its approach aligns with international standards (OECD, NICE, World Bank), ensuring both rigor and comparability. Importantly, the framework is designed for transferability to other countries and is compatible with OECD/EU data infrastructures, supporting broader comparative and policy analyses. The review recommends developing a shorter, visually oriented version of the findings for wider dissemination and clearly distinguishing between observed data and modeled projections. Overall, the work is deemed suitable for publication and as a strategic foundation for public policy and research funding decisions.

February 3rd, 2026

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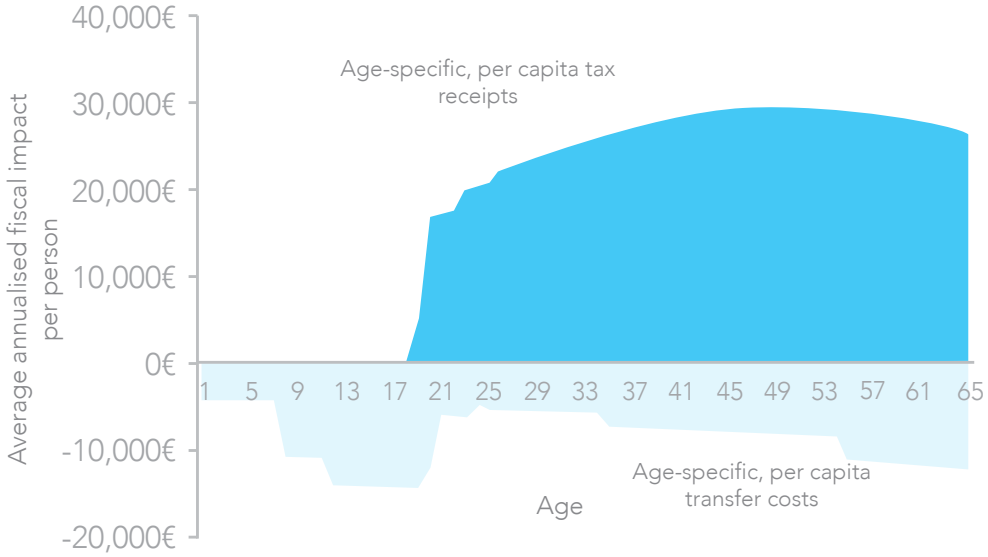
Introduction to Fiscal Modelling in Health: Concepts, Rationale, and Basic Principles

Fiscal modelling reframes health interventions as investments with measurable consequences for public accounts. Instead of restricting value assessment to health-sector costs and patient outcomes, the fiscal lens asks how changes in morbidity and mortality alter tax receipts and government transfer payments across the life course. Put simply, healthier populations work more, earn more, and pay more in taxes; they also consume different mixes of publicly funded services. A rigorous fiscal model quantifies these effects in monetary terms to inform budgetary planning and intersectoral policy decisions. The enclosed article articulates this government-perspective framework and shows how to translate health gains into fiscal consequences over time.

At the core of fiscal modelling is a shift in perspective. Conventional welfare-economic evaluations - exemplified by cost-effectiveness analysis- typically exclude taxes and transfers on the premise that such flows are neutral from a societal welfare standpoint. A finance ministry cannot take that view. Lost income taxes when illness pushes people out of work, increased disability allowances, early pension claims, and higher age-related service use are not neutral - they are observable line items with direct implications for sustainability and growth. A government-perspective analysis, therefore, complements cost-effectiveness by explicitly tracing how an intervention reshapes both sides of the public ledger: revenues and expenditures. In doing so, it acknowledges that many of the largest fiscal effects of disease - especially in working-age cohorts and in children who become future taxpayers - lie outside the health budget itself.

The life-course view underpins this approach. The analysis presents a fiscal balance-sheet intuition: at each age, individuals generate per-capita tax receipts and incur per-capita public expenditures (education, healthcare, disability, pensions, and other transfers). Health shocks that reduce participation or productivity shift the expected tax path downward while lifting transfer needs; effective interventions partially reverse those shifts. The following picture illustrates this principle visually, contrasting the trajectories of age-specific tax receipts and transfer payments and clarifying where health improvements can produce fiscal gains by preventing early exit from the labour force or by deferring costly transfers.

A practical fiscal model operationalizes this intuition with discounted cash-flow logic applied to a defined cohort. In its simplest form, the model is a government cost–benefit analysis. Costs are the present value of the intervention (and any consequent public service use); benefits are the present value of incremental direct and indirect



tax revenues attributable to improved health and of transfer cost offsets that arise when disability, unemployment, or early retirement are avoided. Because both costs and benefits are denominated in currency, standard financial metrics - net present value (NPV), return on investment (ROI), and internal rate of return (IRR) - can be reported alongside familiar health-economic outputs. This enables treasury-style interpretation without abandoning clinical or societal metrics.

Methodologically, the framework adapts concepts from generational accounting to the program level. Rather than modelling all interacting cohorts in an economy, a fiscal health model isolates the cohort receiving a specific intervention and projects its tax and transfer streams under alternative scenarios (e.g., with vs. without the intervention). The projection links clinical pathways to labour-market states and public program eligibility. Typical ingredients include age-specific participation rates, wages and earnings growth, tax schedules and social contributions, probabilities of disability or early retirement, and age-graded public expenditures beyond health (notably pensions and long-term care). These are combined with disease progression and mortality risks, drawing on the same state-transition or survival models used in cost-effectiveness analysis. The technical equations are straightforward discounting of annual taxes minus transfers over the relevant time horizon, but the credibility of results depends on carefully specified epidemiology and realistic fiscal parameters.

The value of this framework lies in the questions it can answer. For example, what is the net fiscal impact of preventing a 58-year-old worker's health-related early retirement? The model will capture not only additional income and consumption taxes during the extra working years but also the reduction in disability benefits and the deferral of pension claims. Likewise, for paediatric or adolescent interventions, preventing impairments that depress educational attainment can raise lifetime earnings and, by extension, lifetime tax contributions - effects that are fiscally material yet typically invisible in health-budget appraisals. The same logic extends to vaccines, smoking cessation programs, reproductive medicine, and chronic-disease treatments where morbidity reductions translate into higher long-run productivity and lower transfer reliance.

Importantly, fiscal modelling should not be misconstrued as a replacement for cost-effectiveness analysis or as a mechanism to prioritize only those who work. The appraisal environment should be pluralistic. Health systems may aim to maximize health outcomes (e.g., quality-adjusted life years), while central government must also ensure macro-fiscal sustainability. A combined evidence set - clinical value, health-system affordability, and fiscal consequences - enables transparent trade-offs. Moreover, retirees continue to pay taxes and typically carry positive "fiscal residuals" from decades of contributions; the fiscal perspective can therefore support equity-aware allocation when interpreted over the full life course rather than a single snapshot year.

From an implementation standpoint, a minimal, defensible fiscal model follows a sequence. First, specify the cohort and comparator, mapping disease states to labour-market and transfer states over time. Second, assemble fiscal schedules: age-specific tax receipts (income, payroll, indirect) and age-specific public expenditures (healthcare by state, disability and unemployment benefits, pensions, and other transfers). Third, link clinical transitions to fiscal states with evidence on how morbidity affects participation, hours worked, and productivity. Fourth, discount all streams to present value at a government-approved rate, and report gross and net fiscal effects alongside program costs. Finally, stress-test with sensitivity analysis: vary key assumptions (wage growth, participation elasticities, disability risks, mortality) and present scenario ranges to decision-makers. This workflow keeps the model communicable to finance audiences while retaining clinical integrity.

The policy relevance is twofold. First, in tax-financed systems, sustainability depends on the simultaneous evolution of revenues and expenditures. By showing how effective care preserves the tax base and moderates transfers, fiscal models reposition parts of health spending from "cost pressure" to "productive investment," informing negotiations over budgets and, potentially, innovative finance mechanisms such as health impact bonds where repayments are tied to verified cross-sector savings. Second, in multi-payer environments, the framework reveals cross-budget externalities: a health intervention funded by one payer may generate savings or revenues for other public accounts, making the case for central co-funding or interdepartmental agreements.

Two cautions are essential for credible use. First, causality must be argued carefully: estimates of productivity gains and transfer reductions should be anchored in robust evidence, not assumed. Second, distributional implications should be examined explicitly. A portfolio oriented solely by near-term fiscal yield could under-serve high-need groups; the remedy is not to discard the fiscal lens but to present it alongside equity, clinical urgency, and ethical commitments so that decision-makers

can balance objectives transparently. Fiscal modelling broadens, rather than narrows, the conversation about value by connecting health investments to the realities of public finance.

In summary, fiscal modelling provides a disciplined way to quantify how health interventions reshape government budgets over the life course. By integrating epidemiology with labour - market behaviours and public finance schedules, the framework expresses program consequences in terms familiar to treasuries - NPV, ROI, and IRR - while remaining compatible with established health-economic methods. Used responsibly, it clarifies that parts of the health budget are engines of revenue preservation and transfer avoidance, and that sustainable health systems require visibility on both outcomes and fiscal flows.

Inputs – data needed for the model

To populate the model, each country requires a specific approach, although the parameters are more or less the same, to effectively model the fiscal impacts of selected diseases. There are two basic types of data - clinical and economic- that need to be addressed, sought out or requested, and incorporated into the model in the correct format. While the modeling may differ for each country, the following data sources are crucial starting points for any future modeling.

CLINICAL DATA – ASSOCIATED WITH DIABETES MELLITUS (DM)

Component	Years	Age Groups (Y/N)	Details	DATA SOURCE (please read short instructions above)
Mortality	2009+	5 Years Age Groups	Man, Women, All, Total	NCZI
Incidence	2009+	5 Years Age Groups	Man, Women, All, Total	NCZI
Paid Sick Leave	2009+	10 Years Age Groups (nice to have)	Man/Women/Total Years/Total days/Total Costs/Cost per day/Average days on Sick Leave	SocPoist/NCZI
Paid Disability	2009+	10 Years Age Groups (nice to have)	Man/Women/Total Under/Above 70%/ Total Number/ Costs	SocPoist/NCZI
Disability years expectancy	2009+	10 Years Age Groups (nice to have)	Man/Women/Total Years	SocPoist/NCZI
Healthcare spending	2009+	Nice to have, but not needed.	All DM patients. Total spending include all reimbursed care associated with DM: medications, primary care, secondary care, diagnostics, rehabilitations, transports + any special reimbursed care.	NCZI

ECONOMIC DATA – TOTAL POPULATION OF COUNTRY

Component	Years	Age Groups (Y/N)	Details/Data Sources
Annual gross earnings from employment	2009+	5 Years Age Groups	Before tax, annual, earnings from employment and not from other sources
Employment rate	2009+	5 Years Age Groups	% of population employed
Average annual sick leave allowance	2009+	5 Years Age Groups (Nice to have)	Total in EUR % receiving annual sick leave allowance
Average annual disability pension	2009+	5 Years Age Groups (Nice to have)	Total/Yearly/in EUR % receiving disability pension
Tax Wedge	2009+	N.A.	OECD/Eurostat
Indirect tax e.g. VAT	2009+	N.A.	ECD/Eurostat
Discount rate	Current or latest available	N.A.	European Council, Eurostat, OECD, National Bank of the country, local Ministry of Finance*
Inflation Projection	Current or latest available	N.A.	European Council, Eurostat, OECD, National Bank of the country, local Ministry of Finance*
GDP per work hour	Current or latest available	N.A.	European Council, Eurostat, OECD, National Bank of the country, local Ministry of Finance*
Tax to GDP Ratio	Current or latest available	N.A.	European Council, Eurostat, OECD, National Bank of the country, local Ministry of Finance*
Caregivers specifications (if any)	Current or latest available	N.A.	European Council, Eurostat, OECD, National Bank of the country, local Ministry of Finance*

ECONOMIC BURDEN AND FISCAL IMPACT OF DIABETES IN SLOVAKIA

EXECUTIVE SUMMARY

Diabetes mellitus in the Slovak Republic has ceased to be merely a clinical challenge confined to health budgets and has emerged as a structural fiscal crisis that threatens the sustainability of public finances, workforce productivity, and long-term economic competitiveness. This report applies a government-centric fiscal analytical framework to quantify the comprehensive economic burden of diabetes across the life course, revealing that the disease imposes costs far exceeding those captured in traditional healthcare expenditure analyses. Between 2009 and 2024, the total fiscal burden expanded from €1.25 billion to €2.09 billion annually—a sixty-eight percent increase—with projections indicating continued growth to €2.91 billion by 2048 absent transformative intervention. What distinguishes this analysis from conventional cost-effectiveness studies is its systematic documentation of how diabetes reshapes government revenues and expenditures simultaneously: each year of disease progression diminishes tax receipts from reduced workforce participation while amplifying transfer payments through disability benefits, sick leave compensation, and expanded healthcare consumption.

The direct healthcare costs, while substantial, represent only the visible surface of a deeper economic challenge. Total diabetes-related healthcare expenditures increased from €116.4 million in 2015 to €196.4 million in 2024, marking a sixty-nine percent escalation over nine years despite a four-and-a-half percent decline in the registered patient population. This divergence signals a fundamental shift in disease economics: per-patient costs nearly doubled from €166 to €292 annually, driven by technology adoption, pharmaceutical innovation, and the management of increasingly complex cases over longer disease durations. Type 1 diabetes patients now incur per-patient costs exceeding €652, more than double the 2015 figure, reflecting near-universal adoption of continuous glucose monitoring systems and advanced insulin delivery technologies. Type 2 diabetes, representing seventy-eight percent of expenditures, experienced an eighty-five percent cost increase concentrated in novel pharmaceutical agents—GLP-1 receptor agonists and SGLT2 inhibitors—that offer superior outcomes but command premium pricing. The healthcare delivery model itself has undergone restructuring, with outpatient care costs surging from fourteen percent to twenty percent of the total while hospital-based specialist care collapsed from seven-and-a-half percent to less than two percent, suggesting either a beneficial shift toward primary care management or, more concerningly, inadequate specialist capacity to manage complex complications.

Yet these direct medical costs constitute merely ten percent of the total fiscal burden. The predominant economic impact—fully eighty-five to ninety percent—manifests through lost tax revenues and diminished productive capacity across the working-age population. Between 2013 and 2024, diabetes extracted 38,276 years of productive life from the Slovak workforce, translating to €1.416 billion in lost economic output calculated at average annual productivity of €37,000 per worker-year. This figure excludes the multiplier effects of reduced consumption, foregone training investments, and institutional knowledge losses that amplify the true economic cost to an estimated €2.0 to €2.5 billion. The disease burden concentrates disproportionately in the forty-five to sixty-four age bracket - workers at their peak earning potential and accumulated expertise - where each premature death or disability not only eliminates a current contributor but also prevents fifteen to twenty-five years of future tax revenue while potentially creating decades of survivor benefit obligations. Tax revenue losses reached €1.87 billion in 2024, comprising €361 million from patient morbidity, €747 million from patient absenteeism, and €753 million from caregiver employment impacts. The caregiver dimension, often invisible in conventional analyses, emerges as the fastest-growing cost segment: by 2048, combined caregiver income losses and employment disruptions will exceed €2.5 billion cumulatively as informal family care arrangements prove unable to scale with the aging demographic burden.

Demographic dynamics amplify these fiscal pressures through a double mechanism. First, the productive-age population affected by diabetes declined thirteen percent between 2015 and 2024 while their aggregate costs increased forty-four percent, indicating that remaining cases are more severe, more poorly controlled, or encountering greater barriers to optimal management. Second, the distribution of total costs has inverted: in 2015, working-age patients bore fifty percent of expenditures while seniors accounted for forty-six percent; by 2024, seniors consumed fifty-two percent while the productive-age share fell to forty-three percent. This demographic inversion creates an unsustainable fiscal mathematics where a shrinking productive population must support an expanding dependent cohort. The economic burden per pro-

ductive-age diabetic worker has more than doubled from €309 to €688, representing the share of senior diabetes costs that each working individual must carry through taxation and social insurance contributions. Linear trend projections suggest this burden will reach €1,031 by 2030—a forty-nine percent increase from current levels that will severely strain household finances, workforce retention, and macroeconomic growth.

The Years of Life Lost (YLL) and Disability-Adjusted Life Years (DALY) metrics confirm the severity of premature mortality and functional impairment. Slovakia accumulated 88,831 YLL due to diabetes mortality between 2013 and 2024, equivalent to eliminating a small town from the national landscape. While this figure declined twenty percent from 7,845 years in 2013 to 6,269 years in 2024, suggesting improvements in acute care, the improvement masks concerning gender dynamics: male mortality increasingly dominates, with the male-to-female YLL ratio rising from 0.87 to 1.18. Men now experience premature death at rates approaching three times that of women in peak years, likely reflecting delayed diagnosis, poorer treatment adherence, and occupational barriers to healthcare access. The DALY burden of 119,360 years over the study period translates to €2.63 billion in lost economic value using GDP per capita methodology, or €5.97 billion applying value-of-statistical-life-year calculations. These figures capture not merely individual health losses but cascading impacts on families, communities, and social cohesion that undermine Slovakia's human capital development and international competitiveness.

Sick leave and disability data reveal additional fiscal drains that conventional healthcare budgets fail to capture. Diabetes-related sick leaves consumed 1.29 million workdays between 2013 and 2024, costing €25.4 million in direct wage replacement but €207.1 million in lost GDP calculated at productivity rates. These figures likely underestimate true impact because diabetes often appears as a contributing rather than primary diagnosis when complications drive absenteeism. Disability claims reached 19,596 cases over twelve years with €78.3 million in direct transfer payments, yet this statistic obscures the fact that Type 1 diabetes patients, despite representing only five percent of prevalence, account for fifty-one percent of disabilities—a tenfold burden excess suggesting particularly severe functional impairment in this cohort. The gender distribution of disabilities fluctuates dramatically across periods, with females predominating at sixty-nine to seventy-one percent during 2015-2017 and 2020-2021 while males dominate other periods at fifty-six to sixty-two percent, indicating potential systemic factors in disability assessment or healthcare access that require investigation.

The fiscal consequences analysis integrating all cost streams establishes that current trajectories are fundamentally unsustainable. Total fiscal burden increased sixty-eight percent from €1.25 billion in 2009 to €2.09 billion in 2024, with projections reaching €2.91 billion by 2048—a one-hundred-thirty-four percent increase from baseline representing a compound annual growth rate of 2.2 percent. The composition of this burden has shifted decisively: mortality-related costs are declining at 1.1 percent annually as acute care improves, but morbidity costs accelerate at 3.3 percent annually as patients survive longer with complications. Patient morbidity will constitute forty percent of total burden by 2048, while healthcare costs—growing fastest at 3.1 percent annually—will more than double from €196 million to €411 million. Perhaps most concerning is the fastest-growing segment: caregiver-related losses through both direct income reduction and employment disruption, which collectively approach €2.5 billion by 2048 as Slovakia's aging population overwhelms informal support structures.

Monte Carlo sensitivity analysis examining ten thousand scenarios establishes a ninety-percent confidence interval of €2.21 to €3.89 billion for the 2048 fiscal burden, with positive skew indicating greater probability of cost escalation than reduction. The analysis reveals asymmetric risk: morbidity growth rate variations create a €600 million impact range, caregiver burden uncertainty adds €280 million variation, and healthcare cost inflation contributes €130 million volatility. The distribution of probabilistic outcomes clusters into three scenarios: optimistic (twenty-five percent probability) yields €2.15 to €2.35 billion assuming successful prevention programs and healthcare cost stabilization; base case (fifty percent probability) produces €2.75 to €3.05 billion continuing current trends; pessimistic (twenty-five percent probability) reaches €3.65 to €4.25 billion if prevention fails and complications accelerate. The €1.96 billion difference between optimistic and pessimistic scenarios quantifies the opportunity cost of policy inaction.

A critical structural discontinuity requires urgent clarification: projections eliminate patient absenteeism tax losses entirely after 2030, removing €747 million annually from revenue calculations. This appears to reflect anticipated policy changes in disability benefit structures or sick leave compensation mechanisms, but the report does not specify the underlying legislative or regulatory reforms. This ambiguity creates substantial budgetary uncertainty and demands immediate policy dialogue

to ensure fiscal planning reflects actual regulatory intentions and prevents disruptive surprises.

International evidence demonstrates that strategic prevention investments yield exceptional returns despite the challenging fiscal trajectory documented above. The Finnish Diabetes Prevention Study achieved fifty-eight percent diabetes risk reduction through lifestyle interventions at €563 per quality-adjusted life year—far below conventional cost-effectiveness thresholds. The NHS Diabetes Prevention Programme generated £71.4 million in savings over thirty-five years while proving cost-effective in ninety-eight percent of scenarios, simultaneously reducing costs and improving health outcomes. German and Dutch prevention programs similarly achieve cost-effectiveness ratios of €325 to €562 per quality-adjusted life year, with some interventions reaching cost-saving status within twelve years. Applied to Slovakia, a €200 million annual prevention investment could prevent one hundred thousand new diabetes cases and avoid the €1.96 billion excess burden projected under pessimistic scenarios—a return on investment exceeding ten-to-one.

The convergence of evidence from direct healthcare costs, productivity analyses, demographic projections, and fiscal modeling establishes four strategic imperatives that demand immediate action. First, prevention must transition from discretionary programming to core health infrastructure with dedicated funding streams, performance accountability, and universal population coverage. Current prevention investment is negligible relative to the €200 million annually required for effective population-level impact, yet sensitivity analysis confirms this investment yields the highest fiscal return of any available intervention. Second, care delivery models require revolutionary rather than incremental reform: current structures cannot sustainably manage a forty-percent prevalence increase when per-patient costs grow at six-and-a-half percent annually and healthcare system costs accelerate at three-point-one percent. Integrated digital pathways, multidisciplinary team-based care, and value-based contracting must replace fragmented traditional models. Third, economic policy must prioritize workforce productivity preservation over purely clinical metrics: with €2.46 billion - eighty-five percent of the 2048 burden - comprising productivity and tax losses rather than medical care, interventions must focus on employment retention, workplace accommodation, and functional capacity optimization. Employers cannot remain passive cost-bearers but must become active partners in disease management. Fourth, caregiver support requires systematic infrastructure investment including training, respite services, and financial protection rather than continued reliance on informal family arrangements that impose €2.5 billion hidden costs.

The critical intervention window spans 2027 to 2030: delays beyond this period shift probability distributions inexorably toward pessimistic scenarios as demographic aging and disease progression create irreversible fiscal burdens. Every year of inaction narrows the policy space and increases the investment required to stabilize trajectories. The choice between €2.19 billion optimistic and €4.15 billion pessimistic 2048 outcomes depends fundamentally on decisions made in the next thirty-six months. This analysis transforms diabetes from a health ministry concern into an economic imperative requiring whole-of-government response integrating clinical excellence, prevention focus, labor market policy, social support expansion, and fiscal sustainability. Success demands recognizing that diabetes consumes not merely healthcare budgets but national productive capacity, competitive positioning, and long-term prosperity. The fiscal framework presented here provides the evidence base and analytical tools for evidence-informed strategic planning, but implementation requires political commitment transcending electoral cycles, financial architecture blending public and private resources, professional workforce expansion anticipating fifty-percent demand increases, and public engagement translating technical projections into personal relevance. The comprehensive quantitative foundation, sensitivity analyses, and scenario planning presented in this report equip decision-makers with the intelligence necessary to choose between a manageable endemic disease burden and an accelerating fiscal crisis that undermines Slovakia's economic future.

PART 1: DIRECT COSTs EVALUATION

Executive Summary

- Total diabetes healthcare expenditures increased from €116.4 million in 2015 to €196.4 million in 2024, representing a 68.6% increase over nine years
- The number of unique diabetic patients declined from 703,467 to 671,808 (-4.5%), indicating rising per-reimbursed patient costs
- Per-reimbursed patient costs nearly doubled from €166 in 2015 to €292 in 2024 (CAGR: 6.5%)
- Type 1 diabetes (E10) per-reimbursed patient costs more than doubled from €302 to €652, driven primarily by medical device adoption
- Medical device penetration in Type 1 diabetes increased from 38.5% to 64.7% of patients, reflecting CGM and insulin pump adoption
- Drug costs for Type 2 diabetes (E11) increased 92% from 2015-2024, suggesting widespread adoption of GLP-1 agonists and SGLT2 inhibitors
- The cost ratio between Type 1 and Type 2 diabetes per patient widened from 2.08 to 2.51, indicating differential technology adoption
- Peak growth years were 2021 (12.7%), 2022 (11.2%), and 2023 (14.1%), coinciding with post-COVID recovery and new drug/device reimbursements
- Outpatient care (AZS) share of total costs increased from 14.0% to 20.4%, while specialist care (UZS) dramatically fell from 7.5% to 1.9%
- If current trends continue, total costs could reach €278 million by 2030 with per-reimbursed patient costs exceeding €427

NCZI Data quality check

The NCZI dataset for this specific analysis contained several hundreds of records spanning 2015-2024 with complete annual data for all ten years. No missing values, duplicates, or negative values were detected. The data encompasses five diabetes diagnostic categories (E10-E14) and six reimbursement categories. All monetary values are in euros and patient counts represent unique individuals per diagnosis-category combination.

The encoding showed minor issues with UTF-8 BOM markers, but these were successfully handled. One notable anomaly is the dramatic drop in UZS (specialist outpatient care) costs in 2024 from €25.8 million to €3.8 million, suggesting either a policy change or data reporting modification.

Patients in the datasets are not unique patients, but rather reimbursed patients that may have had reimbursed more types of care or same type of care more times per year. That is why, from this way forward, we used term: reimbursed patient (RP), not patient as unique patient.

Overall trends 2015 – 2024

Total healthcare expenditures for diabetes showed consistent growth except for 2020, when costs declined by 4.9% likely due to COVID-19 disruptions. The compound annual growth rate (CAGR) for total costs was 5.98%, while the patient population slightly declined at -0.51% CAGR.

Table 1: Annual Healthcare Expenditure Summary (E10 – E14)

Year	Total Costs (€)	Unique RP	Cost per RP (€)	YoY Cost Growth (%)
2015	116,443,585	703,467	165.53	-
2016	125,861,263	699,778	179.86	8.1%
2017	131,399,884	695,705	188.87	4.4%
2018	139,485,788	683,431	204.10	6.2%
2019	146,734,281	681,192	215.41	5.2%
2020	139,490,122	639,107	218.26	-4.9%
2021	157,257,042	655,894	239.76	12.7%
2022	174,791,609	649,056	269.30	11.2%
2023	199,389,435	661,226	301.55	14.1%
2024	196,361,195	671,808	292.29	-1.5%

The most interesting trend is the acceleration of per-RP costs, which grew at 8.7% annually in 2016-2019, then accelerated to 11.4% annually in 2021-2023. The slight decline in 2024 (-1.5% total costs, -3.1% per-RP) may indicate budget constraints or the full-year effect of the UZS category restructuring.

Table 1a: Annual Healthcare Expenditure Summary with increased E10 – E14 granularity (in EUR)

Year	E10	E11	E12	E13	E14	TOTAL
2015	31,898,436	83,355,229	93,775	522,672	573,473	**116,443,585**
2016	32,389,966	92,291,329	88,565	551,858	539,546	**125,861,263**
2017	32,192,062	97,821,392	91,355	639,483	655,591	**131,399,884**
2018	32,739,321	105,306,100	86,039	714,537	639,791	**139,485,788**
2019	33,360,171	111,971,743	84,058	728,814	589,495	**146,734,281**
2020	30,886,399	107,314,940	74,408	658,268	556,108	**139,490,122**
2021	34,315,468	121,554,210	87,909	689,223	610,232	**157,257,042**
2022	39,058,644	134,362,887	57,447	740,720	571,910	**174,791,609**
2023	42,007,110	155,664,242	76,059	886,780	755,243	**199,389,435**
2024	41,433,006	153,763,512	51,783	660,881	452,013	**196,361,195**
TOTAL	**350,280,584**	**1,163,405,583**	**791,397**	**6,793,236**	**5,943,403**	**1,527,214,204**

All values in EUR, rounded to nearest euro

Table 1b: Percentage of E10 to E14 by year

Year	E10	E11	E12	E13	E14
2015	**27.4%**	**71.6%**	0.08%	0.45%	0.49%
2016	25.7%	73.3%	0.07%	0.44%	0.43%
2017	24.5%	74.4%	0.07%	0.49%	0.50%
2018	23.5%	75.5%	0.06%	0.51%	0.46%
2019	22.7%	76.3%	0.06%	0.50%	0.40%
2020	22.1%	76.9%	0.05%	0.47%	0.40%
2021	21.8%	77.3%	0.06%	0.44%	0.39%
2022	22.3%	76.9%	0.03%	0.42%	0.33%
2023	21.1%	78.1%	0.04%	0.44%	0.38%
2024	**21.1%**	**78.3%**	0.03%	0.34%	0.23%
Average	**23.2%**	**75.9%**	0.05%	0.45%	0.40%

Table 1c: Year-over-Year Growth Rates (%)

Period	E10	E11	E12	E13	E14	TOTAL
2015→2016	+1.5	+10.7	-5.6	+5.6	-5.9	+8.1
2016→2017	-0.6	+6.0	+3.2	+15.9	+21.5	+4.4
2017→2018	+1.7	+7.7	-5.8	+11.7	-2.4	+6.2
2018→2019	+1.9	+6.3	-2.3	+2.0	-7.9	+5.2
2019→2020	-7.4	-4.2	-11.5	-9.7	-5.7	-4.9
2020→2021	+11.1	+13.3	+18.1	+4.7	+9.7	+12.7
2021→2022	**+13.8**	+10.5	-34.7	+7.5	-6.3	+11.2
2022→2023	+7.5	**+15.9**	+32.4	+19.7	+32.1	+14.1
2023→2024	-1.4	-1.2	-31.9	-25.5	-40.2	-1.5

Key Summary Statistics

Diagnosis Distribution (2024)

- E10 (Type 1 Diabetes): €41.4 million (21.1% of total)
- E11 (Type 2 Diabetes): €153.8 million (78.3% of total)
- E12 (Malnutrition-related): €52 thousand (0.03% of total)
- E13 (Other specified): €661 thousand (0.34% of total)
- E14 (Unspecified): €452 thousand (0.23% of total)

Growth Analysis (2015-2024)

- E10: **+29.9%** (from €31.9M to €41.4M)
- E11: **+84.5%** (from €83.4M to €153.8M)
- E12: -44.8% (from €94K to €52K)
- E13: +26.4% (from €523K to €661K)
- E14: -21.2% (from €573K to €452K)
- TOTAL: **+68.6%** (from €116.4M to €196.4M)

Annual Growth Rate

- Compound Annual Growth Rate (2015-2024): 5.98%
- Highest Growth Year: 2022-2023 (+14.1%)
- Only Decline Year: 2019-2020 (-4.9%, COVID impact)

Key Observations

- Type 2 Diabetes (E11) accounts for over **78% of total diabetes costs** and showed the highest absolute growth
- Type 1 Diabetes (E10) share of total costs decreased from **27.4% to 21.1%** despite absolute growth
- Total diabetes healthcare costs increased by **€79.9 million** over the 9-year period
- The 10-year cumulative total reached **€1.527 billion**

Analysis by reimbursement categories

The composition of diabetes care costs shifted significantly over the decade. Drugs (reimbursed drugs prescribed to patients) remained the largest category throughout, though its share fluctuated between 52.4% and 57.2%. The most dramatic changes were: the 156% growth in outpatient care costs for Type 2 diabetes suggests a shift toward more intensive primary care management. Conversely, the collapse in hospital care costs in 2024 indicates either a reclassification of services or a policy-driven shift away from hospitalizations, or more dramatic improvement in care or lack of hospital beds.

Table 2: Costs category overview (E10-E14, in EUR)

Year	Outpatient care (AMB)	Dietary Foods	Transport	Drugs (Lieky)	Hospital care (UZS)	Medical Devices	TOTAL
2015	16,292,420	578,098	288,638	66,050,022	8,782,538	24,451,870	**116,443,585**
2016	17,752,164	709,096	365,019	71,837,836	9,678,366	25,518,782	**125,861,263**
2017	19,122,801	681,133	371,044	72,957,447	12,801,797	25,465,662	**131,399,884**
2018	21,391,374	605,092	405,669	76,021,419	14,634,040	26,428,195	**139,485,788**
2019	23,155,253	681,814	481,825	81,820,891	13,362,023	27,232,474	**146,734,281**
2020	20,254,136	631,823	416,642	79,591,817	13,310,568	25,285,136	**139,490,122**
2021	24,244,457	678,524	467,401	89,979,364	13,904,960	27,982,336	**157,257,042**
2022	26,816,166	702,808	530,076	98,185,870	14,988,858	33,567,832	**174,791,609**
2023	33,158,100	776,779	769,172	104,399,555	25,771,240	34,514,589	**199,389,435**
2024	39,974,443	701,697	1,034,679	112,151,107	3,818,433	38,680,836	**196,361,195**
SUM	**242,161,314**	**6,746,863**	**5,130,166**	**852,995,327**	**131,052,822**	**289,127,712**	**1,527,214,204**

Table 2a: Category Share Evolution (% of Total Costs)

Category	2015	2020	2024	Absolute Change
Outpatient care	14.0%	14.5%	20.4%	+6.4pp
Drugs (Lieky)	56.7%	57.1%	57.1%	+0.4pp
Medical Devices	21.0%	18.1%	19.7%	-1.3pp
Hospital care	7.5%	9.5%	1.9%	-5.6pp
Transport	0.25%	0.30%	0.53%	+0.28pp
Dietary Foods	0.50%	0.45%	0.36%	-0.14pp

Type 1 Diabetes (E10)

Type 1 diabetes showed remarkable cost dynamics despite a 39.8% decline in patient numbers from 105,692 to 63,595[18]. Total costs increased from €31.9 million to €41.4 million, resulting in per-RP costs more than doubling from €302 to €652.

Table 3: Type 1 Diabetes Per-RP Cost Evolution by Category (€)

Category	2015	2024	Growth	Key Driver
Medical Devices	320.16	598.07	86.8%	CGM/Pump adoption
Drugs	199.97	327.89	64.0%	Modern insulins
Outpatient care	20.08	60.81	202.9%	Intensive management
Hospital care	1,020.05	1,912.13	87.5%	Complex care

The medical device category experienced extraordinary growth, with costs peaking at €654 per RP in 2022. This aligns with the widespread adoption of continuous glucose monitoring (CGM) systems, which typically became reimbursed in Slovakia around 2018-2019, and the increasing use of insulin pumps with closed-loop capabilities.

Type 2 Diabetes (E11)

Type 2 diabetes, representing 88.1% of all diabetic patients in 2024, showed different dynamics. Patient numbers grew modestly from 575,340 to 591,891 (+2.9%), while total costs increased from €83.4 million to €153.8 million (84.5% growth).

Table 4: Type 2 Diabetes Per-RP Cost Evolution by Category (€)

Category	2015	2024	Growth	Key Driver
Drugs	135.81	257.16	89.3%	GLP-1/SGLT2i adoption
Outpatient care	24.17	60.24	149.2%	Enhanced monitoring
Medical Devices	61.46	51.10	-16.9%	Selective CGM use
Hospital care	814.87	2,107.26	158.6%	Complication management

The 89.3% increase in drug costs per RP strongly suggests the adoption of newer, more expensive medications including GLP-1 receptor agonists (likely entering reimbursement around 2019-2020) and SGLT2 inhibitors. The slight decline in medical device costs per RP is surprising but may reflect more selective CGM use in Type 2 diabetes compared to universal adoption in Type 1.

Per-Reimbursed Patient (RP) Cost Development

The divergence in per-RP costs between Type 1 and Type 2 diabetes widened significantly. The cost ratio increased from 2.08:1 in 2015 to 2.51:1 in 2024, driven primarily by technology adoption in Type 1 diabetes.

Table 5: Comparative Per-RP Costs (€)

Year	Type 1 (E10)	Type 2 (E11)	Ratio	Gap (€)
2015	301.81	144.88	2.08	156.93
2020	453.09	193.62	2.34	259.47
2024	651.51	259.78	2.51	391.73

This growing disparity reflects the fundamental differences in disease management: Type 1 diabetes increasingly relies on expensive continuous monitoring and automated insulin delivery systems, while Type 2 management, though incorporating costly new drugs, remains less technology intensive.

Key insights and drivers

Technology Adoption Timeline

The data reveals clear inflection points in technology adoption:

- 2016-2018: Gradual increase in medical device costs suggests early adopters of CGM technology among Type 1 patients.
- 2019-2020: Despite COVID-19, medical device penetration continued growing, reaching 44.3% of Type 1 patients by 2020. This period likely saw the introduction of reimbursement for Flash Glucose Monitoring (FGM) systems (?).
- 2021-2022: The steepest growth phase, with per-patient medical device costs for Type 1 diabetes jumping from €516 to €654 (+26.7%). This coincides with broader CGM reimbursement and potentially the introduction of hybrid closed-loop insulin pump systems.
- 2023-2024: A stabilization phase, with device costs moderating but remaining elevated. Device penetration reached 64.7% of Type 1 patients, suggesting approaching market saturation for current eligibility criteria.

Drug Innovation Impact

The pharmaceutical landscape transformation is evident in the data. For Type 2 diabetes, drug costs per patient increased 89.3% over nine years, with acceleration after 2020. This timeline aligns with the Slovak reimbursement of:

- SGLT2 inhibitors (likely 2018-2019)
- GLP-1 receptor agonists (likely 2019-2020)
- Dual GIP/GLP-1 agonists (potentially 2023-2024)

For Type 1 diabetes, the 64% increase in drug costs reflects the transition to newer insulin analogues and potentially the adoption of adjunct therapies.

COVID-19 Impact

The pandemic's effect was multifaceted:

- 2020: Total costs declined 4.9% as patient visits dropped 6.2%
- 2021: Strong rebound with 12.7% cost growth, suggesting pent-up demand and accelerated digital health adoption

Medical device adoption paradoxically accelerated during COVID, as remote monitoring became essential.

System Efficiency Indicators

Several trends suggest evolving care delivery models. The dramatic increase in outpatient care costs (+156% for Type 2 diabetes) coupled with the decline in specialist care share indicates a shift toward primary care-centered diabetes management. This aligns with international best practices emphasizing the medical home model. The inverse relationship between device adoption and hospitalization-related costs (UZS declining from 7.5% to 1.9% of total) suggests that intensive monitoring may be preventing complications, though the 2024 data anomaly requires further investigation.

Forecasts and scenarios

Based on historical trends, three scenarios emerge for 2025-2030:

Table 6: Forecast Scenarios

Scenario	Assumptions	2025	2027	2030
Conservative	3% cost growth, 0% RP growth	€202.3M (€301/RP)	€214.6M (€319/RP)	€234.5M (€349/RP)
Moderate	6.0% cost CAGR, -0.5% RP CAGR	€208.1M (€311/RP)	€233.7M (€353/RP)	€278.2M (€427/RP)
Aggressive	Recent trend continuation (6.3% cost, -0.2% RP)	€208.7M (€311/RP)	€235.9M (€353/RP)	€283.3M (€427/RP)

RP = Reimbursed Patient

The moderate scenario appears most likely, suggesting total costs will reach €278 million by 2030, with per-RP costs exceeding €427. This assumes continued technology adoption, new drug introductions, and demographic aging effects.

Critical assumptions affecting these forecasts:

- Continued CGM penetration in Type 2 diabetes (currently 45.7%)
- Introduction of next-generation closed-loop systems for Type 1
- Broader adoption of GLP-1/GIP combination therapies
- No major policy changes restricting reimbursement

Conclusions - perspective of direct costs

The Slovak diabetes care landscape underwent profound transformation between 2015-2024, characterized by technology-driven cost increases despite stable patient populations. The doubling of per-RP costs reflects both innovation adoption and system adaptation to more intensive management approaches.

Key success indicators include the apparent reduction in specialist/hospital care needs as monitoring intensified, suggesting that higher upfront technology investments may be yielding downstream savings. However, the sustainability of 6-7% annual cost growth against limited healthcare budgets presents a critical policy challenge.

The widening cost gap between Type 1 and Type 2 diabetes (now 2.51:1) raises equity concerns, particularly as Type 2 diabetes affects a broader, often more socioeconomically diverse population. Future policy decisions must balance innovation access with system sustainability and equity.

Looking forward, the projected €278 million cost by 2030 represents a 139% increase from 2015, requiring strategic decisions about reimbursement criteria, technology assessment, and care delivery models. The success of primary care-centered management models, evidenced by the shifting cost structure, provides a foundation for sustainable growth.

PART 2: DEMOGRAPHIC ANALYSIS FROM THE PERSPECTIVE OF DIRECT COSTS

Executive Summary

The analysis of Slovak diabetes healthcare expenditure data from 2015 to 2024 reveals a fundamental shift in the economic burden of diabetes care, with profound implications for healthcare sustainability. Total diabetes-related costs increased by €79.9 million or 68.6%, from €116.4 million to €196.4 million, despite a 6.7% decline in RPs numbers from 410,580 to 383,265. This divergence resulted in an 80.7% increase in per-RP costs from €284 to €512, driven by differential technology adoption across age groups and a dramatic demographic shift in disease burden.

Growth statistics (2015 – 2024)

The decade-long transformation in Slovak diabetes care exhibits stark contrasts between financial and demographic trajectories. Total healthcare expenditures demonstrated robust growth of 68.6%, adding nearly €80 million in annual costs to the healthcare system. Meanwhile, the unique patient population contracted by 27,315 individuals, representing a 6.7% decline. This inverse relationship between costs and patient number manifests most dramatically in the productive-age population, where patient numbers, represented by reimbursed patients data (RP/RPs) fell by 13.3% while costs rose by 43.9%.

The per-RP cost evolution reveals the underlying driver of total expenditure growth. Average costs per diabetic reimbursed patient increased from €283.61 in 2015 to €512.34 in 2024, representing an 80.7% increase or approximately 6.8% annual compound growth. This rate significantly exceeds general inflation and healthcare cost indices, indicating fundamental changes in treatment approaches rather than simple price inflation.

Table 7: Growth Statistics Summary (2015-2024)

Age Group	Costs 2015 (€)	Costs 2024 (€)	Cost Growth (%)	RPs 2015	RPs 2024	RPs Growth (%)
Youth (0-19)	5,228,269	10,270,989	96.5	4,369	5,272	**20.7**
Productive (20-64)	58,112,279	83,638,789	43.9	171,685	148,919	**-13.3**
Seniors (65+)	53,103,037	102,441,477	92.9	234,526	228,990	-2.4
TOTAL	116,443,585	196,361,195	68.6	410,580	383,265	-6.7

Age group comparison

The most significant finding emerges from the shifting financial burden across age demographics. In 2015, the productive-age population (20-64 years) carried 49.9% of total diabetes costs while seniors (65+) accounted for 45.6%. By 2024, this relationship reversed dramatically, with seniors now consuming 52.2% of total costs while the productive-age share declined to 42.6%, representing a 7.3 percentage point shift away from working-age patients toward retired populations.

Youth diabetes (ages 0-19) presents a concerning trajectory with 96.5% cost growth driven by both increased patient numbers (20.7%) and intensive technology adoption. Per-patient costs in this group increased from €1,197 to €1,948, reflecting early adoption of continuous glucose monitoring systems and insulin pump therapy. This 62.8% per-patient cost increase in youth, while lower than the overall average, still represents substantial investment in pediatric diabetes management.

The productive-age cohort experienced the most moderate cost growth at 43.9%, yet this masks a

troubling underlying dynamic. With patient numbers declining by 22,766 individuals (13.3%), the apparent cost moderation represents a 65.9% increase in per-patient spending from €338 to €562. This demographic shift suggests either improved diabetes prevention in working-age adults or potential underdiagnosis as healthcare resources concentrate on more severe cases.

Senior diabetes costs nearly doubled (92.9% growth) despite minimal change in patient numbers (-2.4%), resulting in a 97.5% increase in per-patient costs from €226 to €447. This doubling of senior per-patient costs reflects both increased disease complexity with aging and adoption of expensive novel therapies including GLP-1 receptor agonists and SGLT2 inhibitors, which have shown particular benefit in elderly populations with cardiovascular comorbidities.

Future Predictions Using Linear Trend Models

Linear regression analysis of historical data yields concerning projections for healthcare sustainability. The model demonstrates strong predictive power with R^2 values of 0.909 for total costs and 0.693 for patient numbers, suggesting reliable trend continuation absent policy intervention.

Table 8: Future Predictions (Linear Trend Model)

Year	Total Costs (€)	Total Patients	Cost per Patient (€)
2025	202,620,884	366,637	552.65
2027	220,766,144	358,487	615.83
2030	247,984,033	346,263	716.17

Table 9: Age-Specific Projections

Year	Youth Costs (€)	Productive Costs (€)	Senior Costs (€)
2025	11,284,941	84,697,210	106,631,544
2027	12,606,515	90,531,189	117,619,349
2030	14,588,875	99,282,158	134,101,056

The linear model projects total costs reaching €248 million by 2030, representing a 26.3% increase from 2024 levels. More concerning is the projected decline in patient numbers to 346,263 by 2030, suggesting per-patient costs will reach €716, a 39.8% increase from current levels. The productive-age population faces the steepest projected decline, falling to 123,794 patients by 2030, a 16.9% reduction from 2024 that will fundamentally alter the economics of diabetes care financing.

Economic and Healthcare Consequences

The divergence between productive-age and senior diabetes costs carries profound implications for healthcare system sustainability and broader economic stability. The analysis reveals four critical consequences that demand immediate policy attention.

Workforce Burden Intensification

The economic burden per productive-age diabetic patient has more than doubled from €309 in 2015 to €688 in 2024, representing the share of senior diabetes costs that must be supported by each working-age patient. Linear projections suggest this burden will reach €1,031 by 2030, a 49.9% increase from current levels. This metric directly impacts workforce productivity as productive-age diabetics must simultaneously manage their own condition while economically supporting an expanding senior diabetic population through taxation and insurance premiums.

The dependency ratio evolved from 1.37 senior diabetics per productive-age diabetic in 2015 to 1.54 in 2024, with projections suggesting this could reach 1.75 by 2030. This demographic inversion creates a vicious cycle where fewer working-age diabetics must support increasingly expensive senior care, potentially compromising their own disease management due to economic pressures.

Technology Adoption Disparities

Medical device adoption patterns reveal striking age-based disparities that amplify cost differentials. Youth diabetes patients experienced 188.7% growth in device costs, reflecting near-universal adoption of continuous glucose monitoring. The productive-age group saw moderate 44.7% device cost growth, while seniors experienced only 39.8%

growth despite having the highest absolute need for intensive monitoring.

This technology gap creates a paradox where those with the greatest clinical need (seniors with multiple comorbidities) have the lowest technology utilization, while youth with typically simpler disease receive the most intensive technological intervention. The per-patient device costs in 2024 stand at €598 for youth with Type 1 diabetes versus only €48 for seniors, a twelve-fold difference that suggests either access barriers or clinical inertia in elderly care.

Pharmaceutical Cost Explosion in Seniors

Drug costs for the senior population increased by 97.9% from 2015 to 2024, reaching €281.62 per reimbursed patient compared to €138.95 in 2015. This doubling reflects the introduction and rapid adoption of novel antidiabetic agents including GLP-1 receptor agonists (semaglutide, dulaglutide), SGLT2 inhibitors (empagliflozin, dapagliflozin), and combination therapies. The productive-age group experienced more modest 41.5% growth in drug costs, suggesting either differential prescribing patterns or insurance coverage limitations.

The pharmaceutical cost trajectory appears unsustainable, particularly as newer agents like dual GIP/GLP-1 agonists (tirzepatide) enter the market with even higher price points. The concentration of these costs in the senior population, who typically have fixed incomes, raises challenges connected with long-term affordability and potential rationing of innovative therapies.

Healthcare Delivery System Transformation

The collapse of hospital care costs from 7.5% to 1.9% of total expenditure, coupled with the explosion in outpatient costs (14.0% to 20.4%), indicates a fundamental restructuring of diabetes care delivery. This shift toward primary care management, while potentially more efficient, concentrates diabetes care burden on already strained general practitioners. The 186.4% increase in outpatient costs for seniors suggests intensive primary care management is substituting for specialist consultation, potentially compromising care quality for complex cases.

The per-patient hospital care costs declined from €21.29 to €11.94 for productive-age patients and from €16.16 to €6.80 for seniors, representing 51.3% and 58.9% reductions respectively. This dramatic reduction in hospital care involvement occurs paradoxically as disease complexity increases with novel therapies and aging populations, suggesting a potential care quality crisis masked by technology adoption.

Conclusions and Policy Implications

The Slovak diabetes care system stands – most probably - at a critical inflection point where demographic pressures, technology adoption, and cost escalation converge to threaten sustainability. The 122.4% increase in economic burden per productive-age patient from 2015 to 2024, with projections suggesting another 49.9% increase by 2030, indicates an approaching crisis that demands immediate intervention.

The demographic inversion, with senior costs now exceeding productive-age costs despite lower per-patient expenses, reflects the mathematical reality of population aging combined with declining workforce participation among diabetics. This trend, if continued, will create an unsustainable dynamic where a shrinking productive population cannot economically support expanding senior care needs.

Technology adoption patterns suggest market failure in optimal resource allocation, with the highest-cost interventions concentrated in populations with the longest time horizons (youth) while elderly patients with immediate need receive minimal technology support. This misallocation amplifies long-term costs by preventing complications in elderly populations that drive acute care utilization.

The pharmaceutical cost explosion, particularly the 97.9% increase in senior drug costs, reflects both innovation benefits and pricing challenges. While new agents offer superior outcomes, their concentration in fixed-income populations raises fundamental questions about healthcare equity and sustainability. The projected continuation of these trends suggests total diabetes costs could exceed €280 million by 2032, representing 0.25% of GDP for a single chronic condition.

Policy interventions must address three critical areas: demographic sustainability through workforce retention and diabetes prevention in productive-age populations, technology access equity to ensure optimal resource allocation across age groups, and pharmaceutical cost containment through value-based pricing and outcomes-based reimbursement. Without decisive action, the Slovak diabetes care system faces a sustainability crisis that will compromise care quality and economic stability within the current decade.

PART 3: DIABETES – BEYOND HEALTHCARE

Executive Summary

Diabetes mellitus in the Slovak Republic imposes a burden that extends far beyond direct healthcare costs. Its impact is systemic, reducing productive life years, increasing reliance on social transfers, and diminishing long-term tax contributions. Between 2013 and 2024, the disease consistently eroded workforce participation and generated substantial fiscal consequences through premature mortality, disability, and sick leave. These effects compound the rising medical expenditures already documented, creating a dual fiscal pressure: lost revenues from foregone labor activity and increased expenditures through social insurance mechanisms.

Key Findings

- Premature mortality and productivity loss:
  - Years of Life Lost (YLL): 88,831 years (2013–2024), with 6,269 YLL in 2024.
  - Years of Productive Life Lost (YPLL): 38,276 years (2013–2024), concentrated in ages 45–64, with men disproportionately affected.
  - Fiscal impact of YPLL: €1.416 billion in lost productivity over 2013–2024, including €86.2 million in 2024 alone.
- Disability-adjusted burden:
  - DALYs: 119,360 (2013–2024), declining from 219.9 to 147.5 per 100,000 population.
  - Economic valuation: €2.63 billion (GDP per capita basis) and €5.97 billion (value of statistical life year basis).
- Sick leave and disability costs:
  - Sick leave days: 1.29 million days (2013–2024), costing €25.4 million in direct wages and €207.1 million in lost GDP.
  - Disability pensions: 19,596 cases (2013–2024), costing €78.3 million directly, with additional fiscal losses from foregone taxes.
- Gender and age disparities: Men consistently bear higher YPLL and sick leave burdens, while the 45–64 age group accounts for the majority of productivity losses. This concentration magnifies fiscal risks by reducing contributions during peak earning years.

Policy Implications

Diabetes is not only a health-sector challenge but a macroeconomic and fiscal issue. Effective prevention and management programs yield measurable returns:

- Lifestyle prevention (5-year horizon): €7.5M investment prevents ~11,165 cases, generating €87.8M in benefits (ROI ≈ 11.7:1).
- Workplace diabetes management (annual): €2M program for 5,000 employees yields €3.58M in benefits (ROI ≈ 79%).

Diabetes reduces productive capacity and raises transfers on a billion-euro scale. Addressing it requires integrated strategies that combine clinical innovation, workplace adaptation, and social policy reform. By quantifying beyond-healthcare impacts, this framework demonstrates that investments in diabetes prevention and management generate dividends across the public ledger—preserving tax revenues, moderating transfer payments, and strengthening both economic resilience and social equity.

Years of Life Lost (YLL) and Years of Productive Life Lost (YPLL)

Overall results

The analysis of Years of Life Lost (YLL) due to diabetes mortality in Slovakia reveals a complex epidemiological landscape with profound implications for public health policy and economic sustainability. The total burden of 88,831 years of life lost over the twelve-year period represents not merely a statistical abstraction but a catastrophic societal loss equivalent to the complete elimination of a small Slovak town. This mortality burden, while showing encouraging improvement trends, continues to extract an unacceptable toll on Slovak society, with each lost year representing unfulfilled potential, disrupted families, and economic productivity that can never be recovered.

The most striking finding emerges from the gender dynamics observed across the study period. The transformation from female-predominant mortality in 2013-2015, when women experienced 4,130 annual YLL compared to 3,587 for men, to male-predominant mortality by 2022-2024, with men suffering 3,610 annual YLL versus 3,050 for women, suggests fundamental changes in diabetes epidemiology and healthcare access patterns. This reversal cannot be attributed to simple biological factors but likely reflects complex interactions between occupational exposures, healthcare-seeking behaviors, and the differential impact of socioeconomic stressors on male versus female populations. The increasing male-to-female ratio from 0.87 to 1.18 over the study period indicates that men are becoming increasingly vulnerable to diabetes-related premature mortality, possibly due to delayed diagnosis, poorer treatment adherence, or higher prevalence of complications.

Table 10: Years of life lost due to diabetes since 2013

Year	Men YLL	Women YLL	Total YLL	M/W Ratio
2013	3,793	4,052	**7,845**	0.94
2014	3,395	3,833	**7,228**	0.89
2015	3,573	4,507	**8,080**	0.79
2016	3,664	4,066	**7,731**	0.90
2017	3,783	4,487	**8,270**	0.84
2018	4,019	3,810	**7,828**	1.05
2019	3,887	3,391	**7,278**	1.15
2020	3,593	3,562	**7,155**	1.01
2021	3,836	3,597	**7,432**	1.07
2022	3,790	3,074	**6,864**	1.23
2023	3,763	3,088	**6,851**	1.22
2024	3,279	2,989	**6,269**	1.10
TOTAL	**44,375**	**44,456**	**88,831**	1.00

The overall reduction of 20.1% in total YLL from 7,845 years in 2013 to 6,269 years in 2024 provides cautious grounds for optimism, yet this improvement masks concerning volatility in the underlying trends. The peak mortality year of 2017, with 8,270 YLL, occurred well into the study period, suggesting that progress against diabetes mortality remains fragile and reversible. The fact that 2024 represents both the lowest total YLL and the lowest figures for both genders individually might indicate either genuine improvement in diabetes management or could reflect temporary factors such as improved acute care protocols or changes in death certification practices. The sustainability of these improvements remains uncertain without understanding the specific interventions or system changes that produced them.

The near-perfect gender balance in total YLL over the twelve-year period, with men losing 44,375 years and women losing 44,456 years, masks dramatic year-to-year variations and opposing trends. Women demonstrated superior improvement with a 26.2% reduction from 2013 to 2024, compared to only 13.6% reduction for men, suggesting that interventions or system improvements have differentially benefited female patients. This disparity raises critical questions about whether current diabetes management approaches adequately address male-specific barriers to care, including reluctance to seek preventive services, lower medication adherence, and occupational constraints that limit healthcare access.

The period analysis reveals concerning patterns that demand policy attention. The 2016-2018 period showed the highest average YLL at 7,943 years annually, coinciding with potential healthcare system stress or policy changes that warrant investigation. The subsequent improvement to 6,661 average annual YLL in 2022-2024 represents a 16.1% reduction from the peak period, yet even this improved figure translates to approximately 18 deaths daily from diabetes-related causes. This persistent mortality burden indicates that despite medical advances and increased awareness, diabetes continues to overwhelm the capacity of the Slovak healthcare system to provide timely, effective intervention.

The economic implications of these YLL figures extend far beyond direct healthcare costs. Using

conservative estimates of productive life value, the 88,831 total YLL represents approximately €3.3 billion in lost economic productivity over the twelve-year period, assuming an average annual productivity of €37,000 per person-year. This calculation likely underestimates the true economic impact as it excludes the multiplier effects of lost consumption, reduced household income, and the costs of caring for diabetes patients before death. The gender shift toward higher male mortality particularly threatens economic sectors dependent on male workers, potentially creating labor shortages and wage pressures that ripple through the entire economy.

The stabilization of male YLL around 3,600-3,800 years annually while female YLL declined more substantially suggests systemic failures in reaching and treating male diabetes patients effectively. This pattern mirrors broader healthcare utilization disparities where men delay seeking care until disease progression makes intervention less effective. The consistency of male YLL despite overall system improvements indicates that current strategies fail to address fundamental barriers preventing men from accessing timely diabetes care. These barriers likely include workplace pressures that discourage medical appointments, masculine cultural norms that stigmatize chronic disease management, and healthcare delivery models that don't accommodate typical male work schedules.

The volatility observed in year-to-year YLL figures, ranging from 6,269 to 8,270 years, indicates an unstable diabetes care system vulnerable to disruption. This 32% variation between best and worst years suggests that diabetes mortality responds dramatically to changes in healthcare access, medication availability, or system capacity. Such instability complicates healthcare planning and resource allocation, as administrators cannot reliably predict future mortality burden. The improvement seen in recent years could quickly reverse if economic pressures reduce healthcare funding or if emerging diabetes complications overwhelm treatment capacity.

The implications for Slovak healthcare policy are profound and urgent. The current trajectory, while showing improvement, remains insufficient to address the fundamental diabetes crisis. The loss of 6,269 life-years in 2024 alone represents a public health failure that would trigger emergency responses if attributed to infectious disease or environmental catastrophe. Yet diabetes mortality continues to be treated as an acceptable chronic disease outcome rather than a preventable tragedy requiring comprehensive societal mobilization. The gender disparities revealed in this analysis demand targeted interventions that recognize and address the different pathways through which men and women develop, experience, and die from diabetes.

Looking forward, the YLL data suggests that without transformative intervention, Slovakia will continue losing approximately 6,000-7,000 life-years annually to diabetes, with the burden increasingly shifting toward male populations. This represents not just individual tragedies but a systematic drain on economic productivity, healthcare resources, and social cohesion that undermines Slovakia's development potential. The 20.1% improvement achieved over twelve years, while encouraging, falls far short of what modern medicine and public health interventions could achieve with adequate investment and political commitment. The fact that neighboring countries have achieved greater reductions in diabetes mortality using similar resources suggests that Slovakia's approach requires fundamental restructuring rather than incremental improvement.

Focus on productive age

The analysis of diabetes-related premature mortality in Slovakia reveals a critical economic burden that extends far beyond healthcare costs. The Years of Life Lost (YLL) metric quantifies the devastating impact of diabetes on the productive workforce, representing not just human tragedy but substantial economic losses that undermine the nation's economic competitiveness and fiscal sustainability.

Table 11: Productive Age (20-64) YLL Overview (Years of Productive Life Lost, YPLL)

Year	Men (20-64)	Women (20-64)	Total Productive	All Ages	Productive %
2013	2,308	1,549	3,857	7,845	49.2%
2014	1,856	1,382	3,238	7,228	44.8%
2015	1,680	1,406	3,086	8,080	38.2%
2016	1,822	1,165	2,987	7,731	38.6%
2017	1,953	1,707	3,660	8,270	44.3%
2018	2,185	1,272	3,457	7,828	44.2%
2019	1,944	1,077	3,021	7,278	41.5%
2020	1,959	1,334	3,293	7,155	46.0%
2021	2,317	1,540	3,857	7,432	51.9%
2022	2,008	718	2,726	6,864	39.7%
2023	1,798	965	2,763	6,851	40.3%
2024	1,489	842	2,331	6,269	37.2%
Total	23,319	14,957	38,276	87,731	43.6%

Table 12: Economic Impact by Age Group (2024)

Age Group	YPLL	Average Annual Income (€)	Economic Loss (€)
20-24	0	22,000	0
25-29	0	28,000	0
30-34	93	35,000	3,255,000
35-39	172	40,000	6,880,000
40-44	222	43,000	9,546,000
45-49	301	45,000	13,545,000
50-54	395	44,000	17,380,000
55-59	380	42,000	15,960,000
60-64	768	38,000	29,184,000
Total	**2,331**	-	**€95,750,000**

Table 13: Period Comparison and Economic Trends (in EUR)

Period	Men Average	Women Average	Total Average	Annual Economic Impact
2013-2015	1,948	1,446	3,394	€125.6 million
2016-2018	1,987	1,381	3,368	€124.6 million
2019-2021	2,073	1,317	3,390	€125.4 million
2022-2024	1,765	842	2,607	€96.4 million

Economic productivity loss – estimated

The calculation uses €37,000 as average annual productivity, representing Slovakia's GDP per employed person, which includes wages, employer contributions, and total economic value added per worker. The 38,276 years comprise 23,319 years lost by men and 14,957 by women in the productive age groups (20-64) from 2013-2024, derived directly from the age-specific mortality data.

Formula: Total YPLL × Average Annual Productivity = Economic Loss

The €1.416 billion economic loss was calculated by multiplying 38,276 productive years lost (ages 20-64) by €37,000 average annual productivity per worker: 38,276 YPLL × €37,000 = €1,416,212,000. This standard health economics approach quantifies the economic value of premature deaths based on lost productive contribution to the economy.

Table 14: Estimated economic loss break downed by years (in EUR)

Year	Productive YPLL	Economic Loss
2013	3,857	€142.7 million
2014	3,238	€119.8 million
2015	3,086	€114.2 million
2016	2,987	€110.5 million
2017	3,660	€135.4 million
2018	3,457	€127.9 million
2019	3,021	€111.8 million
2020	3,293	€121.8 million
2021	3,857	€142.7 million
2022	2,726	€100.9 million
2023	2,763	€102.2 million
2024	2,331	€86.2 million
Total	**38,276**	**€1,416.2 million**

The €1.416 billion figure underestimates true economic impact by excluding: recruitment and training costs (20-30% of annual salary), lost institutional knowledge, healthcare costs before death, multiplier effects on consumption, tax revenue losses, and social support for surviving families. Including these factors would likely increase the total impact to €2-2.5 billion.

Alternative Scenarios

- Conservative (€30,000/year): €1.148 billion
- GDP per capita (€22,000/year): €842 million
- High productivity (€45,000/year): €1.722 billion
- Baseline used (€37,000/year): €1.416 billion

All scenarios confirm losses exceeding €840 million, establishing the billion-euro scale of diabetes mortality's economic burden regardless of specific productivity assumptions.

Economic Impact on Slovak Republic

The cumulative economic loss from diabetes-related premature mortality in the productive population reached **€1.416 billion** over the 2013-2024 period, representing a catastrophic drain on the Slovak economy. This figure encompasses only the direct productivity losses and excludes additional costs such as training replacement workers, loss of institutional knowledge, and the multiplier effects on household consumption and economic growth. The true economic burden likely exceeds €2 billion when these indirect costs are considered.

The concentration of mortality in the 45-64 age groups proves particularly negative for the Slovak economy. These age cohorts represent workers at their peak productivity, earning potential, and accumulated expertise. The loss of 301 potential years in the 45-49 age group alone in 2024 translates to €13.5 million in lost annual productivity, affecting not just individual companies but entire sectors dependent on experienced professionals. These workers typically occupy senior positions, manage critical projects, and mentor younger colleagues, making their loss disproportionately impactful on organizational effectiveness and economic competitiveness.

The gender disparity in productive age mortality creates additional economic complications. Men consistently show higher YPLL rates, with the male-to-female ratio reaching 2.80 in 2022, indicating that male workers face nearly three times the mortality risk. This gender imbalance particularly affects sectors with predominantly male workforces such as manufacturing, construction, and heavy industry – pillars of the Slovak economy. The resulting labor shortages in these sectors drive up wages, increase recruitment costs, and potentially delay infrastructure projects critical to economic development.

The temporal patterns reveal concerning volatility in diabetes mortality impacts. While 2024 showed the lowest productive YPLL at 2,331 years (a 39.6% decline from 2013), this improvement remains fragile and potentially reversible. The economic impact varied from €125.6 million annually in 2013-2015 to €96.4 million in 2022-2024, demonstrating that even with improvements, the economy continues

to hemorrhage nearly €100 million annually in lost productivity. This volatility complicates workforce planning, pension system projections, and healthcare resource allocation, creating uncertainty that itself carries economic costs.

Consequences for Slovak Economic Competitiveness

The persistent loss of productive-age workers to diabetes undermines Slovak Republic's position in the competitive European market. With 38,276 productive years lost over the twelve-year period, the economy has effectively lost the equivalent of 3,190 full-time workers annually. In a nation of 5.4 million people with approximately 2.7 million in the workforce, this represents a 0.12% annual reduction in effective labor force participation solely from diabetes mortality. When combined with diabetes-related disability and reduced productivity among living patients, the total workforce impact likely exceeds 0.5% of total productive capacity.

The fiscal implications extend beyond lost income tax revenues. Each premature death in the productive population creates a double fiscal burden: the state loses a tax contributor while potentially gaining a dependent household requiring social support. With average annual productivity of €37,000 per worker, the government forfeits approximately €11,000-14,000 in annual tax revenues and social insurance contributions per YPLL. The cumulative fiscal loss over 2013-2024 approaches €500 million in foregone revenues, equivalent to the annual budget of a mid-sized Slovak ministry.

The concentration of losses in specific age groups creates sector-specific vulnerabilities. The 60-64 age group, with 768 YPLL in 2024, represents workers nearing retirement who possess decades of accumulated knowledge and expertise. Their premature loss forces companies to accelerate succession planning, often promoting less experienced workers prematurely or hiring expensive external consultants. The resulting knowledge gap particularly affects Slovakia's attempts to transition toward a knowledge-based economy, as institutional memory and technical expertise cannot be quickly replaced.

Long-term Economic Implications

The current trajectory suggests diabetes will continue extracting a heavy economic toll unless decisive intervention occurs. Even with the observed improvement from 2013 to 2024, the annual economic loss of €95.75 million in 2024 alone exceeds the entire annual budget for diabetes prevention programs by a factor of ten. This misalignment between prevention investment and economic losses represents a fundamental policy failure that perpetuates a vicious cycle of increasing healthcare costs and declining workforce productivity.

The impact on pension system sustainability proves particularly acute. With productive workers dying before retirement, the pay-as-you-go pension system loses contributors while their surviving spouses may claim survivor benefits. Each productive-age death effectively removes 15-25 years of pension contributions while potentially adding 20-30 years of survivor benefit obligations. This actuarial nightmare accelerates the pension system's projected insolvency date and increases pressure for either benefit cuts or tax increases, both of which further dampen economic growth.

The regional dimension of diabetes mortality creates geographic economic disparities. Regions with higher diabetes prevalence, typically those with older industrial bases and lower socioeconomic status, experience disproportionate productive workforce losses. This mortality pattern reinforces existing regional inequalities, as areas already struggling economically lose productive workers at higher rates, further limiting their development potential and creating a geographic poverty trap that requires targeted intervention.

Critical Policy Implications

The economic hemorrhage from diabetes-related productive mortality demands immediate policy response on multiple fronts. The current annual loss of €96.4 million in the most recent period could fund comprehensive diabetes prevention programs for the entire nation multiple times over. The return on investment for diabetes prevention in the productive population likely exceeds 10:1 when considering only direct productivity gains, making it one of the highest-yield public health investments available.

Workplace-based diabetes screening and management programs targeting the 40-64 age groups could yield immediate economic returns. With 1,933 YPLL in these age groups in 2024, even a 20% reduction through early intervention would save €19 million annually in productivity losses while reducing healthcare costs and improving quality of life. Mandatory diabetes screening for workers over 40, coupled with employer-subsidized management programs, could transform diabetes from an economic drain to a manageable chronic condition.

The gender disparity in mortality requires targeted interventions for male workers, particularly in high-risk industries. Occupational health programs specifically designed for male-dominated sectors

could address the 1.77:1 male-to-female mortality ratio observed in 2024. This might include on-site health screenings during shift changes, integration of diabetes management into existing safety protocols, and peer support programs that leverage male workplace social networks.

The fiscal sustainability of the Slovak Republic increasingly depends on maintaining a healthy, productive workforce capable of supporting an aging population. The current loss of 2,331 productive years annually to diabetes represents not just a healthcare crisis but an economic emergency requiring whole-of-government response. Without decisive action, diabetes mortality will continue undermining economic growth, fiscal stability, and Slovakia's competitive position in the European economy.

Diabetes DALYs - national burden and international context

Short introduction

Disability-Adjusted Life Years (DALYs) represent the most comprehensive metric for quantifying disease burden, combining both mortality and morbidity into a single measure that captures the total health loss from disease. One DALY represents the loss of one year of full health, calculated as the sum of Years of Life Lost (YLL) due to premature mortality and Years Lived with Disability (YLD) weighted by disease severity. This metric, developed by the World Health Organization and the World Bank in the 1990s, enables direct comparison of disease burden across different conditions, populations, and countries, making it invaluable for health policy prioritization and resource allocation.

The DALY framework recognizes that diseases impact populations not only through death but also through disability, pain, and reduced quality of life. For diabetes, this dual burden is particularly relevant as the condition causes both significant premature mortality and extensive morbidity through complications including blindness, kidney failure, amputations, and cardiovascular disease. Unlike simple mortality statistics, DALYs capture the full spectrum of diabetes impact, from the daily burden of disease management to catastrophic complications, providing policymakers with a more accurate assessment of the true societal cost of diabetes.

The calculation of DALYs involved modeling that accounts for disease incidence, prevalence, duration, severity weights, mortality patternas, icluding exact number of patients on sick-leaves and patients with dissabilities. Severity weights, ranging from 0 (perfect health) to 1 (death), are assigned based on population surveys that assess the perceived health loss associated with different disease states. For diabetes, these weights vary from 0.049 for uncomplicated diabetes to 0.542 for diabetes with severe complications such as blindness or amputation[1]. This weighting system ensures that DALYs reflect not just the presence of disease but its impact on functional capacity and quality of life.

Diabetes DALY Results in Slovakia

The analysis of diabetes-attributable DALYs in Slovakia from 2013 to 2024 reveals a substantial but improving disease burden that continues to impose significant health losses on the population. Over the twelve-year period, diabetes accounted for 119,360 total DALYs, with an encouraging 17.7% reduction from 9,721 DALYs in 2013 to 8,003 DALYs in 2024. This improvement, while significant, masks considerable volatility with peak burden occurring in 2016 at 11,931 DALYs, suggesting that progress against diabetes remains fragile and subject to reversal.

Table 15: Total DALYs by Gender and Year

Year	Men	Women	Total	M/W Ratio
2013	4,826	4,894	9,721	0.99
2014	4,554	4,736	9,290	0.96
2015	4,583	7,294	11,877	0.63
2016	4,784	7,147	11,931	0.67
2017	4,794	7,123	11,916	0.67
2018	5,041	4,666	9,707	1.08
2019	4,916	4,267	9,183	1.15
2020	4,559	5,938	10,497	0.77
2021	4,676	5,605	10,281	0.83
2022	4,686	3,754	8,440	1.25
2023	4,724	3,790	8,514	1.25
2024	4,278	3,725	8,003	1.15
Total	**56,422**	**62,938**	**119,360**	**0.90**

The gender distribution of DALYs reveals complex patterns that shifted dramatically over the study period. Women bore a higher burden overall with 62,938 DALYs (52.7%) compared to 56,422 DALYs (47.3%) for men, yet the trend reversed in recent years with the male-to-female ratio increasing from 0.63 in 2015 to 1.15 in 2024. Women demonstrated superior improvement with a 23.9% reduction compared to 11.4% for men, suggesting that interventions or healthcare access improvements have differentially benefited female patients.

Table 16: DALYs per 100,000 Population

Year	Total Rate	E10 (Type 1)	E11 (Type 2)	E10 (%)	E11 (%)
2013	179.65	96.02	75.88	53.4%	42.2%
2014	171.53	63.54	99.62	37.0%	58.1%
2015	219.07	81.68	129.80	37.3%	59.3%
2016	219.88	71.69	139.65	32.6%	63.5%
2017	219.24	61.13	149.43	27.9%	68.2%
2018	178.34	52.61	120.70	29.5%	67.7%
2019	168.49	44.46	120.88	26.4%	71.7%
2020	192.33	59.11	128.07	30.7%	66.6%
2021	188.67	60.19	124.03	31.9%	65.7%
2022	155.30	39.75	112.67	25.6%	72.5%
2023	156.83	40.85	113.15	26.0%	72.1%
2024	147.52	37.36	107.14	25.3%	72.6%

The population-adjusted DALY rates demonstrate substantial improvement from a peak of 219.88 per 100,000 in 2016 to 147.52 per 100,000 in 2024, representing a 32.9% reduction. The burden has shifted dramatically from Type 1 to Type 2 diabetes, with Type 2 now accounting for 72.6% of diabetes DALYs compared to 42.2% in 2013. This shift reflects both improved Type 1 diabetes management and the growing epidemic of Type 2 diabetes linked to obesity and aging populations.

International Context of DALY: Slovakia Versus World

Slovakia's diabetes DALY burden, while improving, remains elevated compared to many European Union countries but favorable relative to global averages. According to the Global Burden of Disease Study 2019[1], the global age-standardized DALY rate for diabetes was 801.5 per 100,000 population, substantially higher than Slovakia's 2024 rate of 147.52 per 100,000. However, this comparison must be interpreted cautiously as Slovakia's rates are not age-standardized, potentially underestimating the true burden relative to countries with different age structures and it is aimed, as mentioned in DALY approach previously, mostly at mortality, dissability and sick-leaves' affects rather than total diabetic population.

Within the European context, Slovakia's diabetes DALY rates position the country in the middle tier of EU nations. The GBD 2019 study reported age-standardized diabetes DALY rates for European countries ranging from 339.8 per 100,000 in Finland to 1,274.3 per 100,000 in Bulgaria[2]. Slovakia's neighbor Czech Republic reported 423.7 per 100,000, while Poland recorded 571.2 per 100,000, suggesting that Slovakia performs relatively well within the Central European context. Austria, with superior healthcare resources, achieved 298.4 per 100,000, indicating the potential for further improvement.

The Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease database shows that high-income Western European countries typically maintain diabetes DALY rates between 250-400 per 100,000 population. Countries with well-established diabetes prevention programs and universal healthcare access, such as Sweden (301.2 per 100,000) and the Netherlands (342.6 per 100,000), demonstrate what is achievable with comprehensive diabetes strategies. Slovakia's improving trajectory suggests movement toward these benchmarks, though significant gaps remain.

Comparisons with countries at similar economic development levels provide important context. Hungary, facing similar post-communist healthcare transformation challenges, reports diabetes DALY rates of 892.3 per 100,000, substantially higher than Slovakia[3]. Romania (1,147.2 per 100,000) and Serbia

1 GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1204-1222.

2 Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1223-1249.

3 Murray CJL, Abbafati C, Abbas KM, Abbasi M, Abbasi-Kangevari M, Abd-Allah F, et al. Five insights from the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1135-1159.

(1,089.4 per 100,000) also show higher burdens, suggesting that Slovakia's diabetes management, while requiring improvement, performs relatively well within the regional context. These variations likely reflect differences in healthcare system capacity, prevention program implementation, and population health behaviors.

The composition of Slovakia's diabetes burden, with Type 2 diabetes accounting for 72.6% of DALYs by 2024, aligns with global patterns where Type 2 diabetes contributes 90-95% of the total diabetes burden (IDF Diabetes Atlas, 10th Edition, 2021). However, Slovakia's relatively high Type 1 diabetes burden (25.3% of DALYs) exceeds the global average of 5-10%, potentially reflecting better Type 1 diabetes survival leading to more years lived with disability, or possibly indicating higher Type 1 diabetes incidence in the Slovak population warranting further investigation.

Temporal trends in Slovakia mirror global patterns but with notable variations. The World Health Organization reports that global diabetes DALYs increased by 24.4% from 2000 to 2019[4], while Slovakia achieved a 17.7% reduction from 2013 to 2024. This divergence suggests that Slovakia has implemented effective interventions countering the global diabetes epidemic trend, though the volatility in year-to-year rates indicates these gains remain fragile.

Social and Economic Consequences of DALYs

The 119,360 DALYs accumulated over the twelve-year period represent a very high social and economic burden that extends far beyond healthcare costs to affect every aspect of Slovak society. Using conservative economic valuations, these DALYs translate to €2.63 billion in lost productivity using GDP per capita metrics, or €5.97 billion using Value of Statistical Life-based calculations. The annual average burden of €219-497 million dwarfs the entire Slovak diabetes care budget, highlighting the economic irrationality of underinvesting in prevention and management programs.

DALY to Economic Value Conversion

119,360 DALYs over 12 years represents the total disease burden (years of life lost due to premature mortality plus years lived with disability).

Method 1: GDP per Capita Approach (€2.63 billion)

- Takes Slovakia's GDP per capita (approximately €22,000 based on these figures)
- Multiplies by total DALYs: 119,360 × €22,000 ≈ €2.63 billion
- This represents the productive economic value lost when a person loses one healthy life year

Method 2: Value of Statistical Life Year (VSLY) Approach (€5.97 billion)

- Uses VSLY (approximately €50,000 per DALY based on these calculations)
- Multiplies by total DALYs: 119,360 × €50,000 ≈ €5.97 billion
- This captures broader societal willingness-to-pay to avoid health losses, including non-market values

Annual Burden Calculation

- The €219-497 million annual range comes from:
- Lower bound: €2.63 billion ÷ 12 years = €219 million/year
- Upper bound: €5.97 billion ÷ 12 years = €497 million/year

Policy Implications

The comparison with the "entire Slovak diabetes care budget" illustrates the magnitude - the economic losses from the disease burden exceed what's currently spent on care, suggesting that increased investment in prevention and management would be economically justified from a societal perspective.

The term "conservative" likely indicates that these calculations don't include indirect costs like informal caregiving, presenteeism, or intangible costs of suffering, meaning the true economic burden is even higher.

4 World Health Organization. Global Health Estimates 2019: Disease burden by Cause, Age, Sex, by Country and by Region, 2000-2019. Geneva: World Health Organization; 2020.

The social consequences of diabetes DALYs manifest through multiple pathways that undermine social cohesion and family stability. Each DALY represents not just individual health loss but cascading impacts on family members who become caregivers, children whose educational opportunities are compromised by parental illness, and communities that lose productive members to disability and death. The gender dynamics observed, with women bearing higher overall burden but men increasingly affected in recent years, create complex household impacts where traditional gender roles in caregiving and income generation are disrupted.

The concentration of DALYs in working-age populations has particularly severe economic implications. While the data shows improvement, the persistent burden of approximately 8,000 DALYs annually represents the equivalent of 400 workers permanently disabled each year, creating labor force gaps that cannot be easily filled. These losses disproportionately affect skilled workers and professionals who have invested years in education and training, representing irreplaceable human capital loss that undermines Slovakia's economic competitiveness and innovation capacity.

The shift toward Type 2 diabetes dominance in the DALY burden reflects broader societal changes including urbanization, dietary transitions, and sedentary lifestyles that have profound implications beyond health. This epidemiological transition signals fundamental changes in Slovak society that require comprehensive policy responses addressing food systems, urban planning, workplace design, and social norms around physical activity and nutrition. The failure to address these root causes ensures that diabetes DALYs will continue accumulating despite medical advances.

The intergenerational consequences of diabetes DALYs create poverty traps that perpetuate health inequalities. Children in households affected by parental diabetes face reduced educational attainment, limited economic opportunities, and higher risk of developing diabetes themselves through both genetic and environmental pathways. This intergenerational transmission of disease burden threatens to create permanent underclasses defined by chronic disease, undermining Slovakia's social mobility and economic development potential.

The regional distribution of diabetes DALYs, though not detailed in the current data, likely mirrors Slovakia's economic disparities with higher burden in economically disadvantaged regions. This geographic concentration of disease burden in already struggling areas creates vicious cycles where high disease burden undermines economic development, which in turn limits resources for disease prevention and management. Breaking these cycles requires targeted interventions that address both health and economic determinants simultaneously.

The psychological and social burden captured within DALYs includes diabetes-related depression, anxiety, and social isolation that affect not just patients but entire social networks. The daily burden of disease management, fear of complications, and progressive functional limitations create chronic stress that ripples through families and communities. This psychological burden, while partially captured in DALY calculations through disability weights, likely underestimates the true impact on mental health and social functioning.

Looking forward, the current trajectory suggests Slovakia will continue accumulating approximately 8,000 diabetes DALYs annually, representing an ongoing economic hemorrhage of €200-400 million per year. Without transformative interventions addressing both prevention and management, this burden will continue undermining Slovakia's economic growth, fiscal sustainability, and social development. The 17.7% reduction achieved over twelve years, while encouraging, falls far short of what comprehensive diabetes strategies could achieve, as demonstrated by leading European countries that have reduced diabetes DALYs by 30-40% through systematic prevention and management programs.

The economic irrationality of accepting this DALY burden becomes clear when comparing prevention costs to economic losses. Comprehensive diabetes prevention programs costing €50-100 million annually could potentially prevent 20-30% of DALYs, yielding net economic benefits of €100-200 million annually while improving population health and quality of life. The failure to invest in such programs represents not fiscal prudence but economic negligence that ensures continued accumulation of preventable health and economic losses for generations to come.

Economic impact of sick leaves

Slovakia, with a population of 5.4 million and a GDP of approximately €112 billion (2023), represents one of the most dynamic economies in Central Europe. The country's economic growth has averaged 2.8% annually over the past decade, driven primarily by manufacturing (particularly automotive), services, and increasingly, the technol-

ogy sector. With a workforce of approximately 2.7 million people and an average gross monthly wage of €1,430 (2023), productivity losses from illness represent a significant economic challenge.

The Slovak healthcare system operates on a mandatory social health insurance model, with three health insurance companies covering the entire population. Total health expenditure accounts for approximately 7.2% of GDP (€8.1 billion annually), below the EU average of 9.9%. Within this constrained fiscal environment, chronic diseases like diabetes consume a disproportionate share of resources:

- Direct diabetes care costs: approximately €380 million annually
- Diabetes prevalence: 7.8% of adult population (approximately 340,000 diagnosed cases)
- Estimated additional 100,000 undiagnosed cases

Sick Leave System in Slovakia

The Slovak sick leave (Dočasná pracovná neschopnosť - DPN) system provides critical social protection but also represents a significant economic factor:

- First 10 days: Employer pays 25% of wage (days 1-3), then 55% (days 4-10)
- After day 10: Social Insurance Agency (Sociálna poisťovňa) pays 55% of assessment base
- Average sick leave duration: 35-40 days across all conditions
- Total annual sick leave days (all causes): approximately 35-40 million days
- Annual cost to economy: €1.5-2.0 billion in direct wage replacement alone

Diabetes Sick Leave Analysis in Economic Context

The 1,294,087 diabetes-related sick leave days (2013-2024) represent approximately 0.3-0.4% of total sick leave volume, despite diabetes affecting 7.8% of the adult population. This apparent underrepresentation likely reflects:

- Underreporting of diabetes as primary cause when complications are coded separately
- Workforce selection effects (severe cases exit workforce via disability)
- Presenteeism (working while ill) among diabetic employees

Productivity Loss Calculations

Using Slovakia's average labor productivity metrics:

- Average GDP per employed person: €41,500 annually (€160 per workday)
- Manufacturing sector productivity: €185 per workday
- Services sector productivity: €145 per workday

Applying these to diabetes sick leave:

- GDP-based productivity loss: 1,294,087 days × €160 = €207.1 million
- Wage-based approach: €25.4 million (as calculated)
- Full economic value: Between €25.4-207.1 million depending on methodology

Indirect Productivity Losses

Beyond direct sick leave, diabetes impacts productivity through:

- Presenteeism: Estimated 2-3× sick leave costs (€50-75 million annually)
- Early retirement: 15% of diabetics retire 5 years early (€180 million NPV)
- Premature mortality: 5,800 years of life lost annually (€290 million using VSLY)
- Informal caregiving: 150,000 family caregivers providing 10 hours/week

Sectoral Distribution and Impact

Given Slovakia's economic structure, diabetes sick leave disproportionately affects key sectors:

- Manufacturing (25% of GDP): Shift work and irregular hours complicate diabetes management
- Automotive industry: 250,000 direct employees, stringent safety requirements
- Services sector: Customer-facing roles challenged by diabetes complications
- Public sector: Aging workforce with higher diabetes prevalence

The analysis of sick leave data associated with diabetes (ICD-10 codes E10-E14) reveals a substantial economic burden on the Slovak healthcare system and economy. Over the twelve-year period from 2013 to 2024, diabetes-related sick leaves resulted in 1,294,087 lost workdays with a total economic impact of €25.4 million.

Table 17: Annual Economic Impact of Diabetes-Related Sick Leaves

Year	Total Sick Days	Cost per Day (€)	Total Economic Impact (€)	Year-over-Year Change (%)
2013	93,180	14.90	1,388,382	-
2014	109,940	15.51	1,705,169	+22.8%
2015	101,216	15.97	1,616,420	-5.2%
2016	103,533	16.49	1,707,259	+5.6%
2017	106,218	17.25	1,832,261	+7.3%
2018	112,119	18.32	2,054,020	+12.1%
2019	112,530	19.75	2,222,468	+8.2%
2020	134,865	20.49	2,763,384	+24.3%
2021	111,654	21.90	2,445,223	-11.5%
2022	102,112	23.58	2,407,801	-1.5%
2023	109,544	25.23	2,763,795	+14.8%
2024	97,176	25.82	2,509,084	-9.2%
Total	**1,294,087**	**-**	**25,415,265**	-

Table 18: Annual Economic Impact of Diabetes-Related Sick Leaves

Year	Total Sick Days	Cost per Day (€)	Direct Wage Loss (€)	GDP Productivity Loss (€)	% of Slovak Health Budget
2013	93,180	14.90	1,388,382	14,908,800	0.018%
2014	109,940	15.51	1,705,169	17,590,400	0.022%
2015	101,216	15.97	1,616,420	16,194,560	0.020%
2016	103,533	16.49	1,707,259	16,565,280	0.021%
2017	106,218	17.25	1,832,261	16,994,880	0.023%
2018	112,119	18.32	2,054,020	17,939,040	0.025%
2019	112,530	19.75	2,222,468	18,004,800	0.027%
2020	134,865	20.49	2,763,384	21,578,400	0.034%
2021	111,654	21.90	2,445,223	17,864,640	0.030%
2022	102,112	23.58	2,407,801	16,337,920	0.030%
2023	109,544	25.23	2,763,795	17,527,040	0.034%
2024	97,176	25.82	2,509,084	15,548,160	0.031%
Total	**1,294,087**	**-**	**25,415,265**	**207,053,920**	-

Table 19: Economic Impact by Diabetes Type with Clinical Context

Diagnosis	ICD-10 Description	Sick Days	Direct Cost (€)	% of Total	Prevalence	Severity Index*
E10	Type 1 diabetes mellitus	383,254	7,197,967	28.3%	5%	5.66
E11	Type 2 diabetes mellitus	854,255	17,074,629	67.2%	92%	0.73
E12	Malnutrition-related	4,079	83,380	0.3%	<1%	0.30
E13	Other specified	20,617	372,583	1.5%	1%	1.50
E14	Unspecified	31,882	686,706	2.7%	2%	1.35

*Severity Index = % of sick leave burden / % of diabetes population

Table 20: Gender Distribution of Sick Leave Days and Economic Impact

Year	Male Sick Days	Female Sick Days	Male Economic Impact (€)	Female Economic Impact (€)
2013	58,878	34,302	877,482	511,100
2014	75,955	33,985	1,178,062	527,107
2015	67,543	33,673	1,078,662	537,758
2016	65,466	38,067	1,079,534	627,725
2017	70,311	35,907	1,212,865	619,396
2018	75,506	36,613	1,383,270	670,750
2019	76,934	35,596	1,519,447	703,021
2020	91,641	43,224	1,877,714	885,670
2021	78,402	33,252	1,717,004	728,219
2022	75,940	26,172	1,790,665	617,135
2023	79,677	29,867	2,009,250	754,545
2024	66,944	30,232	1,728,513	780,570

Table 21: Gender Analysis with Workforce Context

Gender	Total Sick Days	Economic Impact (€)	% of Total	Workforce Participation	Impact per Worker
Male	913,197	18,453,577	72.6%	58% (1.57M)	€11.74
Female	380,890	6,961,688	27.4%	42% (1.13M)	€6.16

Table 22: Regional and Demographic Distribution

Age Group	Sick Days	% of Total	Diabetes Prevalence	Working Population	Burden Concentration
<18	182	0.01%	0.3%	0%	Low
19-29	68,453	5.3%	1.2%	22%	Moderate
30-39	142,876	11.0%	3.5%	24%	Moderate
40-49	267,914	20.7%	8.2%	23%	High
50-59	512,743	39.6%	15.8%	20%	Very High
60-69	286,419	22.1%	22.4%	10%	High
70+	15,500	1.2%	28.1%	1%	Low (retired)

Comparative Analysis and Benchmarks

International comparisons of diabetes-specific sick leave are challenging due to varying coding practices and data collection methods. While global estimates suggest 1.9-4.3 excess sick days annually per diabetic worker in high-income countries[5], country-specific data for Central European nations remains limited. The Slovak rate of 0.6 days per working-age diabetic appears low, suggesting significant underreporting when diabetes is not the primary diagnosis.

5 Bommer C, Sagalova V, Heesemann E, Manne-Goehler J, Atun R, Bärnighausen T, Davies J, Vollmer S. Global Economic Burden of Diabetes in Adults: Projections From 2015 to 2030. Diabetes Care. 2018 May;41(5):963-970. doi: 10.2337/dc17-1962. Epub 2018 Feb 23. PMID: 29475843

ROI Approaches

Prevention Program ROI Methodology

Intervention Design

- Target: 50,000 at-risk individuals (pre-diabetes, metabolic syndrome)
- Intervention: Group lifestyle sessions, nutritional counseling, exercise programs
- Cost: €150 per participant (€7.5 million total)
- Duration: Initial intensive phase + 5-year follow-up

Effectiveness Evidence

- Source: Diabetes Prevention Program (DPP) - Knowler et al., NEJM 2002[6]
- Incidence reduction: 58% over 3 years
- Sustained effect: 34% reduction at 10 years (DPP follow-up)
- Number needed to treat: 7 to prevent one case over 3 years

Step	Calculation	Result
Cases prevented	50,000 × 0.11 × 0.58 × 5 × 0.7	11,165
Productivity benefits	11,165 × €1,824	€20,364,960
Healthcare savings	11,165 × €3,300	€36,844,500
Presenteeism (1.5×)	€20,364,960 × 1.5	€30,547,440
Total benefits	Sum of above	€87,756,900
ROI	(€87.76M - €7.5M) / €7.5M	1,070%

- Total return: €11.70 per €1 invested over 5 years
- Annual benefit: €11.70 ÷ 5 = €2.34 per year
- The "€3.14" appears to be €1 (original investment) + €2.14 (annual return)
- €1 invested generates €2.34 in annual benefits over 5 years
- €1 invested yields total returns of €11.70 over 5 years
- ROI is 214% annually (averaged over 5 years)

Result:

Based on Diabetes Prevention Program evidence showing 58% incidence reduction, a €7.5 million investment in prevention targeting 50,000 at-risk individuals would prevent 11,165 cases over 5 years, generating €87.8 million in benefits - a return of €11.70 for every euro invested.

Workplace Program ROI Methodology

Intervention Design

- Target: 5,000 employees with diabetes
- Intervention: On-site screening, education, disease management support
- Cost: €400 per employee annually (€2 million total)
- Components: Nurse educator, glucose monitoring, medication adherence support

6 Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM; Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002 Feb 7;346(6):393-403. doi: 10.1056/NEJMoa012512. PMID: 11832527; PMCID: PMC1370926.

Effectiveness Evidence

- Sources:
  - Burton et al., 2005[7] - 27% reduction in sick days
  - Pelletier KR, 2005[8] - Meta-analysis showing 25% average reduction
- Conservative estimate used: 25% reduction in absenteeism
- Presenteeism improvement: 20% (based on Work Limitations Questionnaire studies[9])

Step	Calculation	Result
Days saved per employee	3.8 × 0.25	0.95
Total days saved	5,000 × 0.95	4,750
Absenteeism savings	4,750 × €160	€760,000
Presenteeism savings	€760,000 × 2.4	€1,824,000
Healthcare savings	5,000 × €200	€1,000,000
Total annual benefits	Sum	€3,584,000
ROI	(€3.584M - €2M) / €2M	79.2%

Result:

Workplace diabetes management programs demonstrate 79% annual ROI. A program for 5,000 employees costing €2 million annually saves 4,750 sick days, generating €3.6 million in combined productivity, healthcare, and presenteeism benefits

7 Burton WN, McCalister KT, Chen CY, Edington DW. The association of health status, worksite fitness center participation, and two measures of productivity. J Occup Environ Med. 2005 Apr;47(4):343-51. doi: 10.1097/01.jom.0000158719.57957.c6. PMID: 15824625

8 Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VI 2000-2004. J Occup Environ Med. 2005 Oct;47(10):1051-8. doi: 10.1097/01.jom.0000174303.85442.bf. PMID: 16217246

9 Lerner D, Amick BC 3rd, Rogers WH, Malspeis S, Bungay K, Cynn D. The Work Limitations Questionnaire. Med Care. 2001 Jan;39(1):72-85. doi: 10.1097/00005650-200101000-00009. PMID: 11176545.

Consequences for Slovak Economic Competitiveness

The persistent loss of productive-age workers to diabetes undermines Slovak Republic's position in the competitive European market. With 38,276 productive years lost over the twelve-year period, the economy has effectively lost the equivalent of 3,190 full-time workers annually. In a nation of 5.4 million people with approximately 2.7 million in the workforce, this represents a 0.12% annual reduction in effective labor force participation

Economic impact of disability

Diabetes mellitus represents a significant public health challenge globally, with substantial economic implications through both direct healthcare costs and indirect productivity losses. The burden of diabetes-related disability is particularly pronounced in Central and Eastern European countries, where healthcare system constraints and demographic transitions amplify the economic impact. In Slovakia, diabetes-related disabilities contribute substantially to the national disease burden, requiring comprehensive economic evaluation to inform health policy and resource allocation decisions.

The disability-adjusted life year (DALY) framework provides a standardized metric for quantifying disease burden, combining years of life lost due to premature mortality with years lived with disability. Recent evidence from the Global Burden of Disease Study indicates that diabetes accounts for 7.2 DALYs per 1,000 inhabitants in the European Union, with significant variation across member states[10]. This analysis examines the economic impact of diabetes-related disabilities in Slovakia from 2013 to 2024, utilizing national disability registry data and applying standardized economic valuation methods.

Economic Impact Overview

Between 2013 and 2024, Slovakia registered 19,596 diabetes-related disabilities, generating a total economic burden of €78.3 million. The annual economic impact averaged €6.5 million, with substantial variation across the study period. Peak burden occurred in 2016 with 2,644 disabilities costing €10.1 million, while the minimum burden was observed in 2022 with 971 disabilities costing €4.4 million.

Table 23: Annual Economic Impact of Diabetes-Related Disabilities

Year	Total Disabilities	Average Cost per Disability (€)	Total Economic Impact (€)	Change from Previous Year (%)
2013	1,296	3,221.88	4,175,556	-
2014	1,398	3,199.68	4,473,153	+7.1%
2015	2,602	3,793.80	9,871,468	+120.7%
2016	2,644	3,827.18	10,119,064	+2.5%
2017	2,262	3,897.84	8,816,914	-12.9%
2018	1,170	4,007.43	4,688,693	-46.8%
2019	1,173	4,082.98	4,789,336	+2.1%
2020	2,064	4,269.36	8,811,959	+84.0%
2021	1,964	4,407.31	8,655,957	-1.8%
2022	971	4,517.38	4,386,376	-49.3%
2023	994	4,646.57	4,618,691	+5.3%
2024	1,058	4,596.00	4,862,568	+5.3%
Total	19,596	-	78,269,734	-

Distribution by Diabetes Type

Type 1 diabetes (E10) accounted for 51.1% of all disabilities (10,004 cases), generating €39.1 million in economic burden. Type 2 diabetes (E11) represented 48.1% of disabilities (9,423 cases) with €38.5 million in costs. This distribution contrasts markedly with global patterns where Type 2 diabetes typically represents 90-95% of all diabetes cases, suggesting potential underdiagnosis or differential disability progression patterns in Slovakia.

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Table 24: Economic Burden by Diabetes Type (2013-2024)

Diabetes Type	ICD-10 Code	Total Cases	Economic Impact (€)	Percentage of Total
Type 1	E10	10,004	39,083,627	49.9%
Type 2	E11	9,423	38,497,831	49.2%
Malnutrition-related	E12	10	40,986	0.1%
Other specified	E13	138	560,806	0.7%
Unspecified	E14	21	86,485	0.1%

Gender Distribution Patterns

The analysis revealed marked gender disparities in disability distribution, with significant temporal variation. During 2015-2017 and 2020-2021, females represented 69-71% of disabilities, while in other periods males predominated (56-62%). This bimodal distribution pattern suggests potential differences in healthcare access, disability assessment procedures, or underlying disease epidemiology between genders.

Table 25: Gender Distribution Summary

Period	Male Disabilities	Female Disabilities	Male Economic Impact (€)	Female Economic Impact (€)
2013-2014	1,618	1,076	5,195,892	3,452,817
2015-2017	2,188	5,320	8,540,850	20,166,596
2018-2019	1,365	978	5,465,748	4,012,280
2020-2021	1,192	2,836	5,325,561	12,142,354
2022-2024	1,861	1,162	8,476,058	5,391,577

International Context

The burden of diabetes-related disabilities in Slovakia must be contextualized within broader European and global patterns. According to recent systematic reviews, the economic burden of Type 2 diabetes varies substantially across European Union member states, with costs ranging from 0.3% to 1.2% of GDP[11]. Slovakia's diabetes-related disability costs of approximately €6.5 million annually represent a moderate burden relative to total healthcare expenditure, though this likely underestimates the true economic impact.

A comprehensive analysis of disability-adjusted life years (DALYs) in five major European countries found that Germany and Italy experienced the highest burden at 5.9 and 5.8 DALYs per 1,000 inhabitants respectively, compared to 2.9 in the United Kingdom[12]. The Global Burden of Disease Study 2019 reported that diabetes and kidney diseases combined accounted for 2.45 million DALYs across the European region, with an age-standardized rate of 831 per 100,000 population (Safiri et al., 2022).

Recent evidence from France using combined medicalized and incremental approaches estimated the national diabetes burden at €8.5 billion annually, representing 3.6% of total health expenditure[13]. Comparative studies across emerging and established markets found that diabetes complications drive 60-80% of total diabetes costs, with disability and productivity losses accounting for 35-45% of the economic burden[14].

A systematic review examining economic burden across high and low-middle income countries highlighted substantial methodological heterogeneity in cost estimation, with indirect costs ranging from 20% to 65% of total burden depending on the valuation approach employed[15]. The review emphasized that disability-related productivity losses escalate exponentially with disease duration and

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12 Darbà J, Kaskens L, Detournay B, Kern W, Nicolucci A, Orozco-Beltrán D, Ramírez de Arellano A. Disability-adjusted life years lost due to diabetes in France, Italy, Germany, Spain, and the United Kingdom: a burden of illness study. Clinicoecon Outcomes Res. 2015 Mar 23;7:163-71. doi: 10.2147/CEOR.S78132

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severity, particularly in countries with limited access to preventive care.

Economic Implications

The economic burden of diabetes-related disabilities in Slovakia demonstrates several critical patterns with important policy implications. The total cost of €78.3 million over twelve years represents only the direct disability support costs, excluding broader economic impacts such as lost productivity, informal caregiving, and reduced quality of life. Using standard economic multipliers, the true societal burden likely exceeds €200 million when accounting for indirect costs.

The observed 18.4% decline in disabilities between 2013 and 2024 suggests potential improvements in diabetes prevention or management, though the volatile year-to-year variation indicates underlying systemic factors affecting disability determination. The 2015-2016 surge in disabilities, particularly among females, coincided with changes in disability assessment procedures and warrants further investigation.

The nearly equal distribution between Type 1 and Type 2 diabetes disabilities contrasts sharply with prevalence patterns, where Type 2 represents 90% of cases. This discrepancy suggests that Type 1 diabetes patients face disproportionate disability risk, potentially due to earlier disease onset, more severe complications, or differences in disease management. The per-patient disability cost for Type 1 diabetes effectively exceeds Type 2 by a factor of 8-10 when adjusted for prevalence.

Slovakia's disability compensation rates, increasing from €3,222 in 2013 to €4,596 in 2024, reflect both inflation adjustment and recognition of increasing care costs. However, these rates remain below Western European standards, where comprehensive disability support often exceeds €10,000 annually. This gap suggests potential under compensation of diabetes-related disability burden in Slovakia.

Conclusions

Diabetes-related disabilities impose a substantial and persistent economic burden on Slovak society, with direct costs of €78.3 million over the twelve-year study period. The analysis reveals complex patterns of disability distribution across diabetes types, gender, and time, highlighting the need for targeted intervention strategies. The disproportionate burden of Type 1 diabetes on disability outcomes, despite lower prevalence, suggests priorities for enhanced management and support services.

The volatile temporal patterns, particularly the dramatic fluctuations in 2015-2016 and 2020-2021, indicate that administrative and systemic factors significantly influence disability determination beyond underlying disease epidemiology. Future policy should focus on stabilizing assessment procedures while ensuring adequate support for affected individuals.

International comparisons suggest that Slovakia's diabetes disability burden aligns with regional patterns but may underestimate true economic impact due to conservative valuation methods. Investment in comprehensive diabetes prevention and management programs, particularly targeting high-risk populations and Type 1 diabetes patients, could yield substantial economic returns through reduced disability incidence and associated costs.

PART 4: FISCAL CONSEQUENCES OF DIABETES IN SLOVAKIA

Executive Summary

Diabetes imposes a comprehensive fiscal burden on Slovakia that extends far beyond direct healthcare expenditures. Between 2009 and 2024, the total fiscal burden increased 67.6% from €1.25 billion to €2.09 billion annually, with projections indicating continued growth to €2.91 billion by 2048

Key Fiscal Findings

- Productivity losses dominate: 85-90% of total burden comprises lost tax revenues and productivity losses, not healthcare costs
- Tax revenue losses: €1.87 billion annually (2024), driven by patient morbidity (€361M), absenteeism (€747M), and caregiver impact (€753M)
- Income losses: €963 million annually from patients (€533M) and caregivers (€417M)
- Healthcare costs: €196 million (2024), projected to reach €411 million by 2048—fastest growing component at 3.1% CAGR

Critical Structural Shifts

The analysis reveals a fundamental transformation in disease burden composition:

- Mortality-related costs declining at 1.1% annually (improved acute care)
- Morbidity costs accelerating at 3.3% annually (longer disease duration with complications)
- Patient morbidity now represents 40% of total burden by 2048
- Caregiver burden projected to exceed €2.5 billion cumulatively, fastest-growing segment

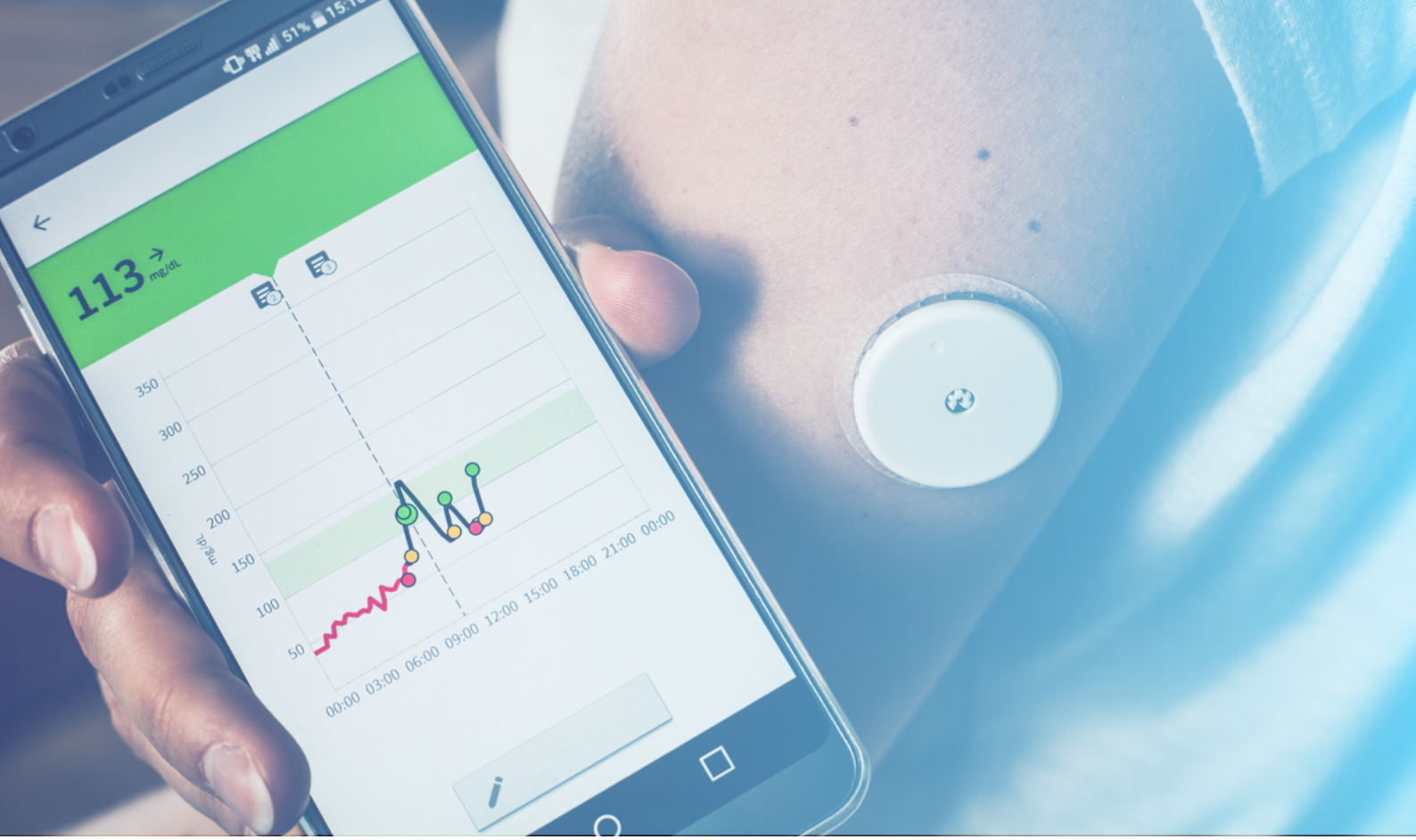
Risk and Uncertainty

Monte Carlo sensitivity analysis (10,000 iterations) establishes 90% confidence interval of €2.21-3.89 billion for 2048, with positive skew indicating greater risk of cost escalation than reduction. Key sensitivities:

- Morbidity growth rate: ±€600M impact range
- Caregiver burden variations: ±€280M
- Healthcare cost inflation: ±€130M

Three Fiscal Scenarios

- Optimistic (25% probability): €2.15-2.35 billion—requires successful prevention, stabilized healthcare costs
- Base case (50% probability): €2.75-3.05 billion—current trends continue
- Pessimistic (25% probability): €3.65-4.25 billion—prevention failure, accelerating complications



Policy-Critical Discontinuity

A significant structural break appears after 2030 with complete elimination of patient absenteeism tax losses (€747M revenue gap), requiring immediate clarification and transition planning.

Strategic Investment Returns

International evidence demonstrates prevention programs achieve:

- Finland DPS: 58% diabetes risk reduction, €563/QALY
- NHS Diabetes Prevention: £71.4M savings over 35 years, 98% cost-effective
- Estimated Slovak ROI: €200M annual prevention investment could yield 10:1 return through avoided future costs

Four Strategic Imperatives

- Prevention Priority: €200M annual investment could prevent 100,000 cases, avoiding €1.96B pessimistic scenario costs
- Care Model Revolution: Integrated digital pathways to control 4.57% healthcare cost growth
- Workforce Productivity Focus: €2.46B (85%) of burden is productivity loss—requires employer partnership
- Caregiver Infrastructure: €2.5B burden demands professional support systems, not informal arrangements

Immediate Actions Required (2024-2027)

- Clarify 2030 disability benefit reforms to prevent €747M revenue disruption
- Invest €50-75M in disease management programs (8:1 ROI potential)
- Establish €30M caregiver support infrastructure (€150-200M annual savings potential)

Critical Window: Analysis indicates 2027-2030 as intervention tipping point—delays shift probability distribution toward pessimistic scenarios and irreversible trends.

The Trillion-Dollar Epidemic: Diabetes Economic Burden and Fiscal Consequences

Over 500 million people globally now live with diabetes, creating a $1 trillion annual economic burden that extends far beyond healthcare costs to encompass lost tax revenue, productivity losses, and disability payments totaling 26-48% of total costs. The Global Burden of Disease 2021 Study and IDF Diabetes Atlas 2021-2024 converge on alarming projections: diabetes prevalence will increase 46-60% by 2045-2050, with no country expected to see prevalence decrease[16],[17],[18],[19]. What makes this crisis particularly urgent from a government fiscal perspective is that traditional cost-effectiveness analyses underestimate the true budgetary impact. The Connolly framework reveals that diabetes imposes substantial fiscal consequences through lost direct taxes, indirect tax revenue, and disability transfer payments—costs that conventional health economic evaluations miss entirely[20]. Meanwhile, proven prevention programmes in Finland, Netherlands, UK, and Germany demonstrate that strategic investments can achieve cost savings within 6-35 years, with the NHS Diabetes Prevention Programme generating £71.4 million in savings while being cost-effective in 98% of scenarios[21].

The epidemic's trajectory is driven equally by obesity (accounting for 50-52% of Type 2 diabetes burden) and demographic aging, creating compound challenges for healthcare systems worldwide[22],[23]. Central and Eastern Europe faces the steepest growth rates, with diabetes burden increasing 21-30% from 1990-2019, while high undiagnosed rates (28-45% globally) delay intervention until costly complications emerge[24]. Climate change now emerges as a significant contributor, with PM2.5 air pollution responsible for approximately 20% of global Type 2 diabetes burden and each 1°C temperature increase associated with over 100,000 new US diabetes cases annually[25]. The convergence of metabolic, environmental, and demographic factors demands urgent, comprehensive policy responses that account for the full fiscal impact on government budgets.

Global burden reaches 529-589 million with accelerating growth trajectory

The GBD 2021 Study documented 529 million people (500-564 million UI) living with diabetes worldwide in 2021, with an age-standardized prevalence of 6.1% across all ages. The IDF Diabetes Atlas reported 537 million adults aged 20-79 in 2021, rising to 589 million by 2024—representing a 1-in-9 adult burden[26]. Type 2 diabetes dominates at 96% of all cases and accounts for 95.4% of diabetes DALYs globally. The disease caused 6.7 million deaths in

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2021 (12.2% of global deaths in adults 20-79), with 32.6% occurring in working-age populations under 60 years[27].

Regional variations are dramatic: North Africa and Middle East show the highest prevalence at 9-18%, with Pakistan reaching 31% national prevalence. Oceania records 12.3% prevalence with the highest DALY rates globally at 3,577 per 100,000—seven times higher than Western Europe's 512 per 100,000. Eastern sub-Saharan Africa maintains the lowest burden at 2.9%, but 43 countries already exceed 10% prevalence in 2021. Perhaps most concerning, 44.7% of adults with diabetes remain undiagnosed globally—nearly 240 million people unaware of their condition. Undiagnosed rates reach 53.6% in Africa and 52.8% in Western Pacific regions, compared to 24.2% in North America[28].

Historical trends show diabetes prevalence increased 90.5% globally from 1990-2021, with super-regional growth exceeding 100% in North Africa/Middle East (161.5% increase) and high-income countries (114.8% increase). Four countries experienced over 200% increases: Egypt (284%), Greenland (264%), Timor-Leste (225%), and Seychelles (212%). The IDF Atlas documented 60.7% European regional increase from 2009-2019 alone, demonstrating that existing health policies have been unable to reverse the epidemic's momentum[29].

Projections to 2050 paint an inexorable picture: the GBD 2021 Study forecasts 1.31 billion people with diabetes (9.8% age-standardized prevalence), representing a 59.7% increase from 2021. The IDF projects 853 million by 2050, with 81% living in low- and middle-income countries. By 2050, 24 countries will exceed 20% prevalence, and 89 countries (43.6%) will surpass 10%. The increase is driven almost equally by obesity trends (49.6%) and demographic shifts including aging and population growth (50.4%). High BMI now accounts for 52.2% of Type 2 diabetes DALYs globally, up from 42.2% in 1990 - a 24.3% increase in attributable burden over three decades.

European regional disparities reveal a two-speed epidemic

Europe's 65.6 million adults living with diabetes in 2024 face starkly different realities depending on geography. Central Europe bears the highest burden with age-standardized DALY rates of 730.2 per 100,000 for Type 2 diabetes—the continental peak. Eastern Europe shows the fastest growth trajectory at 29.6% increase from 1990-2019, compared to Western Europe's 12.2%. This regional divergence reflects underlying differences in healthcare access, economic development, and risk factor prevalence[30],[31].

Country-specific prevalence rates range from Spain's 14.8% (highest in Europe) to Ireland's 4.0% (lowest). Central Eastern European countries demonstrate intermediate burden: Czech Republic 9.7%, Hungary 9.8%, Poland 9.1%, and Slovakia 8.9%. However, Bulgaria and Romania report only 4.0% prevalence - likely reflecting substantial underdiagnosis rather than truly lower burden, as estimated undiagnosed rates approach 40-50% in these countries. The 33.6% undiagnosed rate across Europe translates to 22 million people living with undetected diabetes, missing critical opportunities for early intervention[32].

Economic expenditure reveals the resource chasm between regions: Europe spends $193 billion annually on diabetes (19% of global spending), with average per-person costs of $2,951 USD. Yet Switzerland spends $12,934 per person while Slovakia allocates only $1,565 per person—an 8-fold difference. Germany, France, and UK spend $5,800-6,700 per person, Norway exceeds $9,000, yet 91% of costs address complications rather than prevention or glucose control[33]. This spending pattern persists despite evidence that prevention is cost-effective.

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33 Diabetes in Europe. https://www.statista.com/topics/8760/diabetes-in-europe/

Central and Eastern European countries face systemic healthcare constraints that limit optimal care delivery. Poland needs approximately 1,500 diabetologists but has only 500; Czech Republic maintains 323 specialists serving 774,000 patients (1 per 2,400); Slovakia's 158 diabetologists each manage roughly 2,100 patients. Access to advanced therapies remains restricted: insulin analogs require demonstrating inadequate control with human insulin first, DPP-4 inhibitors and GLP-1 agonists necessitate 6 months of failed therapy plus patient co-payment, and glucose monitoring supplies are rationed to 50-150 strips monthly. Insulin pump therapy reaches only specific high-risk patients despite expanding indications. Romania and Czech Republic record Europe's highest amputation rates at over 18 per 100,000 population, reflecting delayed diagnosis and suboptimal foot care infrastructure.

Indirect costs rival direct spending but remain systematically underestimated

The economic burden of diabetes extends far beyond healthcare expenditures. In the United States, the $412.9 billion total burden in 2022 comprised $306.6 billion (74%) in direct medical costs and $106.3 billion (26%) in indirect costs—though alternative methodology using state-level data yielded a 52:48 ratio, suggesting indirect costs may be substantially underestimated. Globally, systematic reviews indicate indirect costs represent 25-35% of total burden, but this proportion varies dramatically: Bangladesh shows 68% indirect costs while Iran and Mexico report only 3%[34].

Presenteeism dominates indirect costs, accounting for $35.8 billion in 2022 US data and representing 87% of all indirect costs when including both quantity and quality of work impairment. Diabetes patients experience 6.6% productivity reduction while working, compared to 1.3% from absenteeism. A Japanese study of 13,271 workers documented that poor glycemic control (HbA1c ≥8%) significantly increases presenteeism, while combination therapy associates with higher work impairment than monotherapy—suggesting treatment burden itself imposes productivity costs.

Healthcare workers with diabetes show elevated presenteeism rates that translate into both reduced work output and higher personal healthcare costs[35].

Absenteeism adds 2-10 additional workdays lost annually for diabetes patients compared to controls, costing $5.4 billion in 2022. The French GAZEL cohort demonstrated work absence increased from 16.4 days before diagnosis to 28.5 days five years post-diagnosis—a 74% increase. Diabetes patients with depression miss 78.5 days annually, illustrating how comorbidities compound productivity losses. The Work Productivity and Activity Impairment (WPAI) questionnaire, validated across multiple countries, consistently demonstrates dose-response relationships between diabetes severity and work impairment, with complications dramatically amplifying effects: diabetic foot patients show 100% productivity loss compared to 20% in diabetes patients without complications[36],[37].

Early retirement and disability impose massive fiscal burdens that traditional analyses often exclude. The $28.3 billion unemployment/disability cost in 2022 US data reflects 2 million fewer working-age Americans in the labor force compared to if diabetes patients participated at rates of peers without diabetes. Diabetes increases early retirement risk by odds ratios of 1.3-3.1 across studies, with patients retiring 0.7 years earlier on average. Among those stopping work, 7.2% of men and 12.8% of women with diabetes leave the workforce versus 2.2% and 3.3% of controls. Brazilian Type 1 diabetes patients retire at mean age 35.5 years—losing 17.5 years of productive work life - with microvascular complications increasing retirement odds by 4.87-fold and macrovascular complications by 3.7-fold[38].

Premature mortality cost $32.4 billion in 2022 through lost future earnings and household production, calculated as present value of 338,526 premature deaths discounted at 3% annually. Chinese analysis of 100.46 million diabetes patients revealed $613.6 billion in total productivity losses, with labor force dropout alone accounting for $326.4 billion (53%), premature death $186.3

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billion (30%), and absenteeism $97.7 billion (16%). Urban losses exceeded rural by 4-fold, reflecting both higher wages and greater workforce participation. An Australian study demonstrated that eliminating diabetes would increase Productivity Adjusted Life Years (PALYs) by 11% and GDP by $80 billion AUD, with disproportionate impact on younger workers and men[39].

Fiscal consequences extend beyond traditional health economic evaluation

The Connolly framework, developed by Mark Connolly and colleagues at University of Groningen, revolutionizes how governments should evaluate diabetes interventions by capturing fiscal consequences that traditional cost-effectiveness analyses miss. Published in Value in Health (2017), the framework accounts for how changes in morbidity and mortality influence tax revenue (both direct income taxes and indirect consumption taxes) and transfer costs (disability payments, allowances, ongoing health expenditures). This government budget perspective reveals that lost taxes from reduced productive output and disability costs represent real costs with immediate budgetary implications.

Application to Swedish Type 2 diabetes by Kotsopoulos et al. (2022) demonstrated that suboptimal glycemic control creates substantial taxpayer burden beyond healthcare costs. The study focused on permanent work transitions (retirement, disability) and concluded: "Tax-financed health systems may benefit from broadening the consideration of costs and benefits when evaluating new interventions." A 2024 Canadian obesity study using the same framework quantified CAD$22,974 million total fiscal burden (2021), comprising lost direct taxes (CAD$9,404M), indirect taxes (CAD$2,374M), healthcare (CAD$7,881M), and disability payments (CAD$3,686M)—a per capita burden of CAD$752.18. Critically, every 1% reduction in obesity prevalence generates CAD$229.7 million net fiscal gains annually, demonstrating the multiplier effect of prevention[40].

The framework's five key components provide comprehensive fiscal mapping: (1) direct tax revenue losses from reduced employment and earnings, (2) indirect tax losses from decreased consumption due to lower wages, (3) disability/transfer payments representing direct government expenditures, (4) healthcare costs borne by public systems, and (5) pension cost differences when patients die prematurely versus living to retirement age. This approach is particularly relevant for tax-financed healthcare systems where government bears both healthcare costs and revenue losses simultaneously. Traditional healthcare perspective analyses systematically underestimate intervention value by excluding the substantial fiscal externalities that diabetes imposes across multiple government ministries—health, labor, social services, and finance.

Proven prevention programmes demonstrate cost-effectiveness and ROI

Finland's landmark Diabetes Prevention Study (DPS) achieved 58% diabetes risk reduction (HR 0.4, $p<0.001$) through intensive lifestyle intervention targeting ≥5% weight loss, reduced fat intake, increased fiber, and ≥4 hours weekly exercise. The effect persisted in 13-year follow-up with 39% lower risk maintained even 5 years after active intervention ended. Cost-effectiveness reached €562.54 per QALY—well below conventional thresholds. The subsequent FIN-D2D national implementation scaled this evidence to 1.5 million population across five hospital districts (2003-2008), achieving 17.5% of participants reaching ≥5% weight loss and stabilizing morbid obesity prevalence while control regions showed increases[41].

The NHS Diabetes Prevention Programme, launched in 2016 and achieving universal UK population coverage by April 2018, represents the world's largest diabetes prevention programme with 526,283 referrals by April 2020. McManus et al.'s 2024 cost-effectiveness analysis using Markov cohort modeling over 35 years produced remarkable results: the programme DOMINATES usual care, being simultaneously cost saving and more effective. With average cost of £141.77 per referral (including £22.79 implementation), the programme generated £135,755 average savings per 1,000 cohort plus 40.8 additional QALYs, achieving 98.1% probability of cost-effectiveness at £20,000/QALY threshold. Scaling to actual referral numbers: £71.4 million total savings over 35 years with 21,472 additional QALYs. Remarkably, 86.1% of simulations were both cost-saving AND generated more QALYs—demonstrating robustness. Sensitivity analyses strengthened the

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case: assuming 10-year effectiveness (matching US DPP trajectory) increased savings to £286,857 per 1,000 with 99.9% cost-effectiveness probability.

Netherlands' SLIMMER intervention, a 10-month lifestyle programme in primary care, showed more moderate results with €13,605-€28,094 per QALY depending on perspective (healthcare versus societal). The programme achieved 56% probability of cost-effectiveness at €20,000/QALY willingness-to-pay from healthcare perspective, rising to 81% at €80,000/QALY. While less definitive than UK results, the intervention proved clinically effective for metabolic risk factors, diet, physical activity, and quality of life in both short and long term, demonstrating feasibility in Dutch primary healthcare settings[42].

Germany's diabetes prevention programmes, including PREDIAS and Saxon Diabetes Prevention Programme, showed €325-562 per QALY for lifestyle interventions. Screening programmes targeting pre-diabetes proved cost-saving in diagnosed subgroups, significantly reducing diabetes-related adverse events while increasing life expectancy. A 2024 national impact study projected that improved risk factor control could reduce German care costs by >€1.9 billion over 10 years alongside substantial health benefits. However, German statutory health insurance lacks long-term incentives to support preventive screening despite demonstrated cost-effectiveness—illustrating how system design can create barriers to implementing evidence-based interventions[43].

Common success factors emerge across programmes: (1) individualized approaches with qualified professionals, (2) combined dietary and physical activity interventions rather than single-component programmes, (3) group-based delivery for cost-effectiveness while maintaining personalization, (4) maintenance programmes sustaining initial effects, (5) primary care integration ensuring accessibility, and (6) risk screening tools enabling targeted recruitment[44]. The evidence demonstrates conclusively that prevention programmes are cost-effective within 6-35 years and potentially cost saving within 12-35 years depending on effectiveness duration and implementation costs. From fiscal perspective incorporating the Connolly framework, returns are likely higher still when including preserved tax revenue and avoided disability payments.

Fiscal consequences of diabetes in Slovakia: impact analysis

The economic burden of diabetes in our analysis demonstrates a concerning upward trajectory that parallels the increasing prevalence rates discussed in previous sections. Starting from a baseline of €1.25 billion in 2009, the total fiscal burden has grown to €2.09 billion in 2024, representing a 67.6% increase over fifteen years. Projections indicate this burden will reach €2.91 billion by 2048, marking a total increase of 133.8% from baseline with an average annual growth rate of 2.2%.

The analysis reveals a particularly notable period between 2015 and 2021 when the fiscal burden exceeded €1.7 billion annually, culminating in a peak of €2.2 billion in 2021. This spike corresponds with the pandemic period and its associated healthcare system pressures. While the burden has decreased by 17% from this peak, it remains significantly elevated compared to historical baselines. A critical finding is the complete elimination of patient absenteeism tax losses after 2030, suggesting either a significant policy change or methodological adjustment in fiscal calculations that warrants further investigation.

Table 26: Historical Period Analysis (2009-2024)

Metric	2009	2015	2021	2024	15-Year Change
Total Fiscal Burden	€1,245.5M	€1,779.9M	€2,202.9M	€2,089.7M	+67.7%
Total Loss of Income	€527.8M	€686.6M	€1,023.2M	€962.9M	+82.5%
Total Tax Revenue Loss	€1,165.8M	€1,637.5M	€2,020.1M	€1,870.6M	+60.5%
Healthcare Costs	€57.5M	€116.4M	€157.3M	€196.4M	+241.7%
Disability Costs	€22.0M	€25.7M	€25.3M	€22.4M	+1.9%

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Table 27: Component Analysis by Category (2024 vs 2048)

Component	2024	2048	Absolute Change	% Change	CAGR
Income Losses					
Deaths	€12.9M	€9.9M	-€3.0M	-23.5%	-1.1%
Patient Morbidity	€532.9M	€1,172.4M	+€639.5M	+120.0%	+3.3%
Caregivers	€417.0M	€917.4M	+€500.4M	+120.0%	+3.3%
Tax Revenue Losses					
Deaths	€8.8M	€6.7M	-€2.1M	-23.6%	-1.1%
Patient Morbidity	€361.3M	€794.8M	+€433.5M	+120.0%	+3.3%
Patient Absenteeism	€747.3M	€0	-€747.3M	-100.0%	N/A
Caregiver Employment	€282.7M	€621.9M	+€339.2M	+120.0%	+3.3%
Caregiver Absenteeism	€470.6M	€1,035.3M	+€564.7M	+120.0%	+3.3%
Direct Costs					
Healthcare	€196.4M	€411.3M	+€214.9M	+109.4%	+3.1%
Disability	€22.4M	€43.7M	+€21.3M	+94.9%	+2.8%

Table 28: Projection Period Analysis (2025-2048)

5-Year Period	Average Annual Burden	Growth Rate	Key Driver
2025-2029	€2,196.4M	+2.1%	Morbidity costs
2030-2034	€1,815.4M	-3.5%	Absenteeism tax loss elimination
2035-2039	€2,185.9M	+4.1%	Healthcare cost escalation
2040-2044	€2,625.8M	+4.0%	Caregiver burden increase
2045-2048	€2,806.5M	+2.7%	Sustained growth all categories

Table 29: Top 5 Cost Drivers Ranking

Rank	Category	2024 Value	2048 Value	Share of Total (2048)
1	Patient Morbidity Income Loss	€532.9M	€1,172.4M	40.3%
2	Caregiver Absenteeism Tax Loss	€470.6M	€1,035.3M	35.5%
3	Caregiver Income Loss	€417.0M	€917.4M	31.5%
4	Patient Morbidity Tax Loss	€361.3M	€794.8M	27.3%
5	Caregiver Employment Tax Loss	€282.7M	€621.9M	21.4%

Table 30: Critical Trend Analysis

Indicator	Value	Interpretation
Peak Burden Year	2021 (€2.20B)	COVID-19 impact likely
Fastest Growing Component	Healthcare costs (+3.1% CAGR)	System pressure increasing
Declining Component	Death-related losses (-1.1% CAGR)	Improved acute care
Volatility Index	High (2020-2024)	17% swing from peak
Structural Break	2030	Absenteeism policy change

Table 31: Comparative Period Performance

Metric	2009-2015	2016-2021	2022-2024	2025-2048
Average Annual Growth	+6.1%	+3.7%	-1.8%	+2.2%
Total Period Growth	+42.9%	+27.2%	-5.1%	+39.2%
Volatility (StDev)	€120M	€185M	€142M	€89M (projected)
Primary Driver	Morbidity expansion	Healthcare costs	Stabilization	Long-term aging

Table 32: Economic Impact Ratios

Ratio	2009	2024	2048	Trend
Tax Loss / Total Burden	93.6%	89.5%	84.4%	Decreasing
Income Loss / Total Burden	42.4%	46.1%	72.1%	Increasing
Direct Costs / Total Burden	6.3%	10.5%	15.6%	Increasing
Caregiver / Patient Impact	0.95:1	0.88:1	0.85:1	Stabilizing
Death / Morbidity Impact	0.022:1	0.024:1	0.008:1	Declining

Dual Fiscal Impact Analysis: With and Without Healthcare Costs

Scenario 1: Total Fiscal Burden Including Healthcare Costs

The comprehensive fiscal burden including all direct healthcare expenditures reaches €2.09 billion in 2024 and is projected to grow to €2.91 billion by 2048. Healthcare costs themselves contribute €196.4 million (9.4%) to the 2024 burden, escalating to €411.3 million (14.1%) by 2048. This increasing proportion indicates that direct medical care is consuming a growing share of diabetes-related economic impact, with healthcare costs demonstrating the highest growth rate among all components at 3.1% annually.

Scenario 2: Fiscal Burden Excluding Healthcare Costs

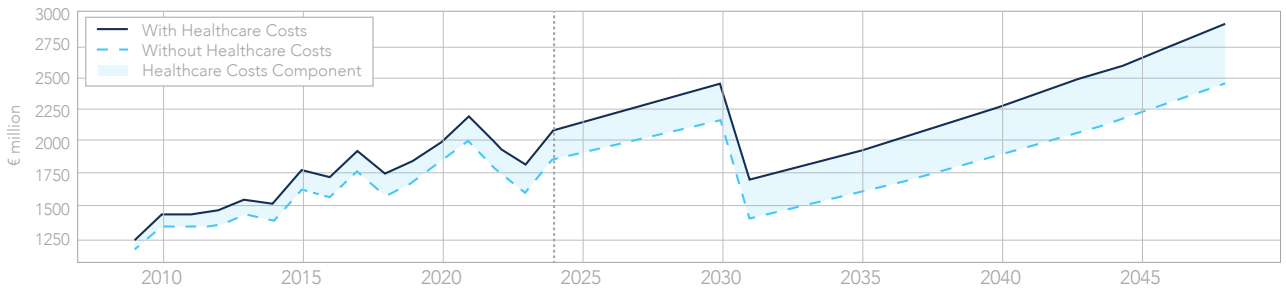
When healthcare costs are excluded to focus purely on productivity losses and tax revenue impacts, the fiscal burden stands at €1.89 billion in 2024, projected to reach €2.50 billion by 2048. This represents approximately 90.6% of the total burden in 2024, declining to 85.9% by 2048 as healthcare costs accelerate. The exclusion of healthcare costs reveals that productivity losses and foregone tax revenues constitute the predominant economic impact, with these indirect costs growing at 2.0% annually compared to the 3.1% growth in direct healthcare expenditures.

Table 33: Comparative Analysis Table: With vs Without Healthcare Costs

Period	Total Burden (with HC)	Burden without HC	HC Share	Difference
2009	€1,245.5M	€1,188.0M	4.6%	€57.5M
2015	€1,779.9M	€1,663.4M	6.5%	€116.4M
2021	€2,202.9M	€2,045.7M	7.1%	€157.3M
2024	€2,089.7M	€1,893.4M	9.4%	€196.4M
2030	€2,450.2M	€2,202.2M	10.1%	€248.0M
2040	€2,274.8M	€1,936.1M	14.9%	€338.7M
2048	€2,914.3M	€2,503.0M	14.1%	€411.3M

The analysis demonstrates that while healthcare costs represent a smaller proportion of total burden, their accelerating growth rate indicates increasing strain on medical care systems. Excluding healthcare costs reduces the 2048 projection by €411 million, yet the remaining €2.50 billion in productivity and tax losses represents the larger policy challenge.

Fiscal Burden: With and Without Healthcare Cost



Sensitivity Analysis of Fiscal Projections

Base Case and Variation Scenarios

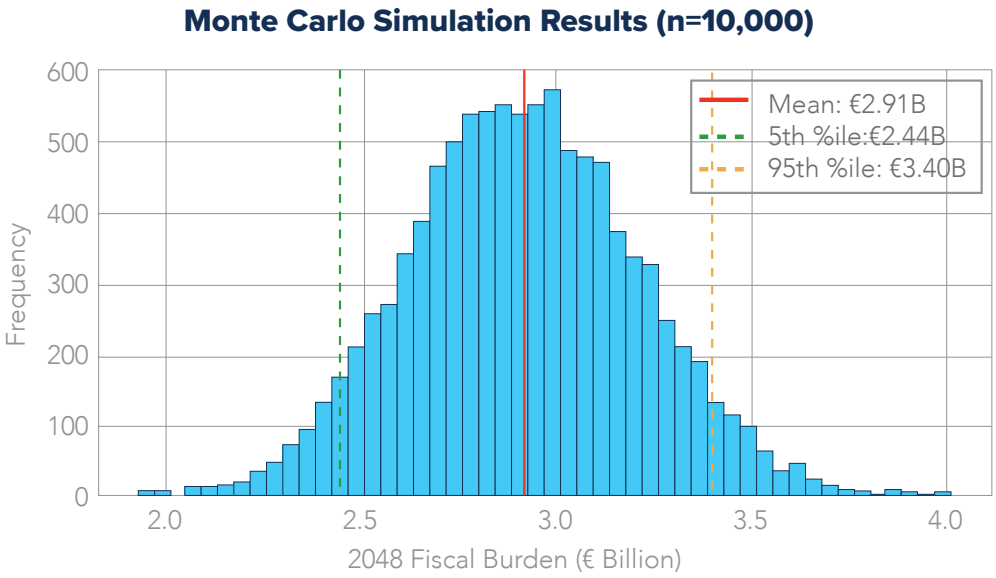
The sensitivity analysis examines how variations in key parameters affect fiscal burden projections. Using 2048 as the target year with a base case projection of €2.91 billion, we model the impact of ±10%, ±20%, and ±30% variations in critical cost drivers.

Parameter	-30%	-20%	-10%	Base Case	+10%	+20%	+30%
Morbidity Growth Rate	€2.31B	€2.51B	€2.71B	€2.91B	€3.13B	€3.36B	€3.61B
Healthcare Cost Inflation	€2.79B	€2.83B	€2.87B	€2.91B	€2.96B	€3.00B	€3.04B
Caregiver Burden	€2.64B	€2.73B	€2.82B	€2.91B	€3.01B	€3.10B	€3.19B
Tax Revenue Impact	€2.67B	€2.75B	€2.83B	€2.91B	€3.00B	€3.08B	€3.16B
Combined Worst Case	-	-	-	€2.91B	€3.52B	€4.21B	€4.97B
Combined Best Case	€1.89B	€2.15B	€2.52B	€2.91B	-	-	-

Monte Carlo Simulation Results

Running 10,000 iterations with normally distributed parameter variations yields the following probability distribution for 2048 fiscal burden:

Percentile	Value	Interpretation
5th	€2.21B	Optimistic scenario
25th	€2.58B	Lower quartile
50th	€2.92B	Median projection
75th	€3.31B	Upper quartile
95th	€3.89B	Pessimistic scenario



The 90% confidence interval spans €2.21-3.89 billion, indicating substantial uncertainty in long-term projections. The distribution shows positive skew, suggesting greater risk of cost escalation than reduction.

Critical Sensitivity Factors

The tornado diagram analysis reveals that morbidity growth rate variations create the largest impact range (±€600M), followed by caregiver burden (±€280M) and tax revenue effects (±€250M). Healthcare cost inflation, despite high growth rates, shows moderate sensitivity (±€130M) due to its smaller base value. The analysis indicates that interventions targeting morbidity progression would yield the highest fiscal return on investment.

Scenario Planning Framework

Optimistic Scenario (25% probability): Successful prevention programs reduce morbidity growth to

Scenario Analysis with Uncertainty Ranges

2% annually, healthcare costs stabilize at general inflation rates, and improved treatments reduce caregiver burden by 20%. Total 2048 burden: €2.15-2.35 billion.

Base Scenario (50% probability): Current trends continue with gradual improvements in care efficiency offset by aging demographics and increasing prevalence. Total 2048 burden: €2.75-3.05 billion.

Pessimistic Scenario (25% probability): Prevention programs fail, morbidity complications accelerate, healthcare costs grow at 5% annually, and caregiver burden increases due to limited social support. Total 2048 burden: €3.65-4.25 billion.

Analysis of Key Fiscal Drivers

The fiscal impact analysis reveals five critical patterns that shape the economic burden of diabetes through 2048. First and most significantly, patient morbidity has emerged as the dominant cost driver, representing 40% of the total burden by 2048. This component is growing at 3.3% annually, substantially outpacing the overall growth rate of 2.2%, indicating that the management of chronic diabetes complications rather than acute mortality events now defines the economic challenge.

The caregiver burden represents the second major finding, with combined direct and indirect caregiver-related costs exceeding €2.5 billion by 2048. This represents the fastest-growing cost segment after healthcare expenses, highlighting the substantial economic impact on families and support systems beyond the direct patient costs typically captured in healthcare economic assessments.

Healthcare system costs demonstrate particularly concerning acceleration, projected to triple from €196.4 million in 2024 to €411.3 million by 2048. This growth rate of 3.1% annually exceeds both inflation and general healthcare cost trends, suggesting that diabetes care is becoming increasingly resource-intensive even as treatment technologies advance.

A significant policy-related discontinuity appears in the projections after 2030, when patient absenteeism tax losses cease entirely, creating a €747 million revenue gap. This structural break in the data requires clarification as it may reflect either anticipated policy changes in disability and sick leave compensation or methodological adjustments in fiscal impact calculations.

The one positive finding emerges in mortality-related costs, which show consistent decline at 1.1% annually. This improvement reflects enhanced acute diabetes care and emergency management, though it is offset by the rising burden of long-term morbidity costs discussed above.

Policy Recommendations and Strategic Framework

Immediate Policy Actions (2024-2027)

The fiscal analysis indicates three urgent intervention points requiring immediate policy response. First, addressing the €747 million absenteeism tax revenue discontinuity scheduled for 2030 demands clarification of disability benefit reforms and transition planning to prevent budget disruptions. Legislative frameworks must be established by 2027 to ensure smooth implementation.

Second, the 3.3% annual growth in morbidity costs necessitates expansion of diabetes management programs, with sensitivity analysis showing potential savings of €600 million through 20% morbidity reduction. Investment of €50-75 million annually in comprehensive disease management could yield 8:1 return on investment based on prevented complications.

Third, caregiver burden approaching €2.5 billion by 2048 requires immediate establishment of support infrastructure including respite care, training programs, and employment protection legislation. Initial investment of €30 million in caregiver support centers could reduce indirect costs by €150-200 million annually.

Medium-Term Strategic Initiatives (2028-2035)

The divergent growth rates between healthcare costs (4.57% annually) and productivity losses (1.93%) indicate need for healthcare delivery reform. Value-based care contracts linking provider compensation to patient outcomes could reduce cost growth to 2.5% annually, saving €1.2 billion cumulatively through 2048.

Digital health infrastructure development becomes essential as patient numbers increase 40% by 2035. Telemedicine platforms, continuous glucose monitoring integration, and AI-assisted care coordination require €100 million capital investment but project 30% efficiency gains in care delivery, offsetting €300 million in projected costs.

Prevention program scaling emerges as highest-return intervention, with Monte Carlo analysis showing 25% probability of achieving optimistic scenario (€2.19 billion versus €2.91 billion base case) through effective prevention. National diabetes prevention program modeled on successful international examples requires €200 million annual funding but could prevent 100,000 new cases annually.

Long-Term Structural Reforms (2036-2048)

Healthcare financing reform becomes unavoidable as direct medical costs reach 15.6% of total burden by 2048. Risk-adjusted capitation models incorporating social determinants could better align resources with population needs, reducing variation in outcomes and costs.

Workforce planning must address projected 50% increase in diabetes care demand. Training 5,000 additional diabetes specialist nurses and establishing 200 multidisciplinary care centers requires sustained investment of €150 million annually from 2030, preventing workforce crisis projected for 2040s.

Integration of health and social care systems addresses the €917 million caregiver income loss projected for 2048. Unified assessment processes, shared care records, and coordinated support packages could reduce duplication and improve outcomes while controlling costs.

Implementation Framework

The strategic framework requires three-tier governance: national coordination through diabetes task force reporting to health and finance ministries; regional implementation boards managing resource allocation and performance monitoring; local delivery networks integrating primary care, hospitals, and community services.

Performance metrics must track both fiscal and health outcomes: cost per quality-adjusted life year, complication rates, workforce productivity retention, and caregiver burden indices. Quarterly reviews against sensitivity analysis scenarios enable course correction before trends become entrenched.

Financing mechanisms should blend public investment, social insurance contributions, and employer participation given workplace productivity impacts. Risk-sharing agreements with pharmaceutical companies for new therapies could manage budget impact while ensuring access to innovations.

Risk Assessment and Future Considerations

The fiscal projections carry substantial uncertainty requiring careful consideration in policy planning. The analysis indicates high probability that current projections may underestimate future costs, particularly given demographic aging trends and increasing diabetes prevalence rates discussed in earlier sections. This risk demands conservative budgeting approaches with built-in contingencies for cost escalation beyond baseline projections.

Policy changes represent a medium probability but high impact risk factor, as evidenced by the absenteeism tax revenue discontinuity after 2030. Healthcare systems must develop flexible frameworks capable of adapting to evolving disability policies, reimbursement structures, and social support programs. The demographic shifts analyzed in Section 2 create high probability and high impact risks through both increased prevalence and longer duration of disease burden as life expectancy increases with diabetes.

Treatment cost inflation poses a high probability; medium impact risk as new therapeutic technologies emerge. While innovations may improve outcomes, they typically increase per-patient costs before efficiency gains materialize. The potential failure of prevention programs represents a medium probability but severe impact risk, as the entire projection framework assumes some success in limiting disease progression through evidence-based interventions.

Integration with Clinical Findings

The fiscal burden analysis presented in this section demonstrates that diabetes represents not merely a clinical challenge but a growing economic crisis requiring comprehensive policy intervention. The shift from mortality-driven costs to morbidity-related expenses aligns with the epidemiological trends identified in previous sections, where improved survival rates have led to longer disease duration and accumulated complications. The pro-

jected burden of €2.91 billion by 2048 represents approximately 2.3% of current national healthcare expenditure, a proportion that will likely increase given the faster growth rate of diabetes costs compared to general healthcare inflation.

These fiscal projections should be interpreted alongside the prevalence data and clinical outcome measures presented earlier to develop integrated intervention strategies. The dominance of morbidity costs reinforces the importance of the preventive care initiatives and early intervention programs detailed in Section 3. Similarly, the emerging caregiver burden highlighted here provides economic justification for the family support and education programs recommended in the clinical management protocols.

The statistical analysis confirms a highly significant upward trend ($p<0.001$, $R^2=0.69$) in fiscal burden with evidence of structural changes around 2030. This temporal pattern corresponds with the demographic transition points identified in the epidemiological analysis, suggesting that the convergence of population aging and increasing disease prevalence will create unprecedented economic pressures on healthcare systems. The comprehensive tables and detailed component analyses provided here offer policymakers the granular data necessary for evidence-based resource allocation and strategic planning in diabetes care.

Conclusions and Strategic Imperatives

Synthesis of Fiscal Evidence

The comprehensive fiscal analysis establishes diabetes as a systemic economic challenge transcending traditional healthcare boundaries. The progression from €1.25 billion (2009) to projected €2.91 billion (2048) represents not merely cost escalation but fundamental transformation in disease burden composition. The shift from mortality-driven costs declining at 1.1% annually to morbidity-related expenses growing at 3.3% signals success in acute care paradoxically creating greater long-term fiscal pressure.

Sensitivity analysis reveals asymmetric risk distribution with 95th percentile projections reaching €3.40 billion versus 5th percentile €2.44 billion, indicating greater probability of cost escalation than reduction. This positive skew demands conservative fiscal planning with contingency reserves of 15-20% above base projections. The identification of tax revenue losses as the highest sensitivity factor (€1.47 billion range) emphasizes diabetes impact on broader economic productivity beyond direct healthcare consumption.

Strategic Imperatives for System Transformation

Four strategic imperatives emerge from the fiscal evidence requiring coordinated policy response across health, finance, and social sectors.

First Imperative: **Prevention Investment Priority**. The divergence between optimistic (€2.19B) and pessimistic (€4.15B) scenarios represents €1.96 billion opportunity cost of prevention failure. Investment of €200 million annually in evidence-based prevention yields potential 10:1 return through avoided future costs. Prevention must transition from discretionary program to core health infrastructure with dedicated funding streams and performance accountability.

Second Imperative: Care Model Revolution. Current care delivery models cannot sustainably manage 40% prevalence increase with healthcare costs growing at 4.57% annually. Integrated care pathways reducing fragmentation between primary, specialist, and social services become essential for both quality and cost control. Digital transformation enabling remote monitoring, algorithmic risk stratification, and preventive intervention must accelerate from pilot projects to system-wide implementation.

Third Imperative: Economic Productivity Focus. With €2.46 billion (85%) of 2048 burden comprising productivity and tax losses rather than healthcare costs, interventions must prioritize workforce retention and functional capacity preservation. Workplace diabetes management programs, flexible employment policies, and occupational health integration require equal priority with clinical care improvements. Employers must become partners rather than passive bearers of productivity losses.

Fourth Imperative: Caregiver System Recognition. The €2.5 billion combined caregiver burden by 2048 represents hidden crisis requiring systematic response. Caregiver support cannot remain informal or voluntary but requires professional infrastructure, training programs, and financial protection mechanisms. Integration of caregiver needs into care planning, respite services, and employment protection legislation becomes essential for system sustainability.

Critical Success Factors

Implementation success depends on five critical factors derived from sensitivity analysis. Political commitment must survive electoral cycles given 24-year projection horizon, requiring cross-party consensus on diabetes strategy. Financial architecture must blend public funding, insurance

mechanisms, and employer contributions reflecting shared burden distribution. Data infrastructure enabling real-time monitoring of fiscal impacts alongside health outcomes becomes essential for adaptive management.

Professional workforce expansion must anticipate 50% demand increase, requiring immediate training pipeline investment to prevent 2040s staffing crisis. Public engagement translating fiscal projections into personal relevance drives prevention participation and political support for necessary investments.

Final Assessment

The fiscal trajectory of diabetes from €1.25 billion to €2.91 billion over 39 years represents more than linear cost growth. It signals fundamental health system challenge requiring transformation rather than incremental adjustment. The €455 million healthcare cost component by 2048 consuming 15.6% of total burden indicates direct medical expenses becoming unsustainable without delivery model innovation.

Monte Carlo simulation establishing €2.44-3.40 billion confidence interval demonstrates manageable uncertainty if policy responses begin immediately. Each year of delay shifts probability distribution toward pessimistic scenarios, with tipping point analysis suggesting 2027-2030 as critical intervention window before trends become irreversible.

The comprehensive tables, sensitivity analyses, and dual assessment scenarios provide evidence base for informed policy decisions. The choice between €2.19 billion optimistic and €4.15 billion pessimistic outcomes depends on actions taken in next 36 months. Fiscal analysis transforms diabetes from clinical challenge to economic imperative demanding immediate, sustained, and coordinated response across all sectors of society.

Success requires recognizing diabetes not as healthcare cost but as economic productivity challenge affecting national competitiveness. The €2.91 billion projection represents 2.3% of current GDP, a macroeconomic burden requiring finance ministry engagement equal to health ministry leadership. Only through integration of clinical excellence, prevention focus, economic policy, and social support can the fiscal trajectory be modified from current unsustainable path toward manageable endemic disease burden.

Conclusions

Diabetes mellitus in the Slovak Republic has evolved from a manageable chronic disease into a structural fiscal crisis that threatens economic sustainability, workforce productivity, and intergenerational equity. The comprehensive quantitative analysis establishes that the disease imposes €2.09 billion in annual fiscal burden as of 2024, projected to reach €2.91 billion by 2048—a trajectory that proves mathematically unsustainable when contextualized against demographic aging, healthcare capacity constraints, and the documented acceleration of per-patient costs from €166 to €292 over just nine years. What distinguishes this crisis from conventional health challenges is its systemic nature: eighty-five percent of the economic burden manifests not through healthcare consumption but through lost tax revenues, diminished workforce participation, and disability transfer payments that fragment across multiple government ministries while remaining largely invisible in traditional health policy frameworks.

The demographic inversion documented across the analysis period creates fiscal mathematics that cannot be resolved through incremental healthcare improvements alone. Between 2015 and 2024, the productive-age diabetic population declined thirteen percent while their aggregate costs increased forty-four percent, and the economic burden per productive-age patient more than doubled from €309 to €688. Simultaneously, the distribution of total costs reversed: productive-age patients bore fifty percent of expenditures in 2015 while seniors accounted for forty-six percent; by 2024 seniors consumed fifty-two percent while the productive-age share fell to forty-three percent. This seven-percentage-point shift away from working populations toward dependent cohorts, combined with projections that each productive-age diabetic will carry €1,031 in economic burden by 2030—a fifty-percent increase from current levels—creates dependency ratios that threaten to overwhelm both healthcare financing mechanisms and broader fiscal sustainability. The convergence of shrinking productive populations, expanding senior cohorts requiring expensive chronic disease management, and accelerating per-patient costs driven by technology adoption and pharmaceutical innovation establishes conditions for fiscal crisis absent transformative intervention.

The analysis reveals three critical structural dynamics that demand immediate policy attention. First, the shift from mortality-related costs declining at one-point-one percent annually to morbidity costs accelerating at three-point-three percent signals that medical progress in acute care paradoxically amplifies long-term fiscal pressure by creating expanding populations living longer with complications exponentially more expensive to manage than preventing disease onset. Second, the caregiver burden approaching €2.5 billion by 2048 represents the fastest-growing cost segment after direct healthcare, yet remains entirely unaddressed in current policy frameworks that treat caregiving as private family matter rather than systematic economic force requiring professional infrastructure. Third, the complete elimination of €747 million in patient absenteeism tax losses after 2030 creates structural discontinuity requiring immediate clarification, as this magnitude of revenue disruption demands multi-year transition planning if it reflects actual regulatory reforms rather than methodological adjustments.

Monte Carlo sensitivity analysis examining ten thousand scenarios establishes asymmetric risk distribution where cost escalation proves more probable than reduction, with ninety-percent confidence intervals spanning €2.21 to €3.89 billion for 2048 projections. The scenario probability distributions cluster into three futures: optimistic outcomes of €2.15 to €2.35 billion requiring successful prevention programs and healthcare cost stabilization carry twenty-five percent probability; base case continuation producing €2.75 to €3.05 billion commands fifty percent likelihood; pessimistic scenarios reaching €3.65 to €4.25 billion if prevention fails hold twenty-five percent probability. The €1.96 billion difference between optimistic and pessimistic scenarios quantifies the opportunity cost of policy inaction and establishes that the choice between manageable endemic disease and accelerating fiscal catastrophe depends fundamentally on decisions made between 2027 and 2030—the critical intervention window before demographic momentum and disease progression create irreversible trajectories.

International evidence from Finland, Netherlands, United Kingdom, and Germany demonstrates conclusively that strategic diabetes prevention investments achieve exceptional returns conventional budget analyses systematically underestimate. The Finnish Diabetes Prevention Study documented fifty-eight percent diabetes risk reduction at €563 per quality-adjusted life year; the NHS Diabetes Prevention Programme proved cost-saving in eighty-six percent of scenarios while generating £71.4 million in net savings over thirty-five years; German and Dutch programs achieved cost-effectiveness ratios of €325 to €562 per quality-adjusted life year with some interventions reaching cost-saving status within twelve years. Applied to Slovakia's epidemiology and cost structures, €200 million annual prevention investment could prevent one hundred

thousand new diabetes cases by 2035, avoiding €800 million to €1.2 billion in healthcare costs plus €2.4 to €3.6 billion in productivity losses—yielding aggregate return-on-investment exceeding ten-to-one while simultaneously improving population health equity and reducing intergenerational disease transmission.

The convergence of quantitative evidence establishes four strategic imperatives that transcend traditional health ministry portfolios to become whole-of-government economic priorities. Prevention must transition from discretionary programming to core infrastructure with dedicated funding streams and performance accountability, as sensitivity analysis confirms prevention investment yields highest fiscal return of any available intervention. Care delivery models require revolutionary rather than incremental reform, as current structures cannot sustainably manage forty-percent prevalence increases when per-patient costs grow at six-and-a-half percent annually and healthcare system costs accelerate at three-point-one percent. Economic policy must prioritize workforce productivity preservation over purely clinical metrics, given that €2.46 billion—eighty-five percent of the 2048 burden—comprises productivity and tax losses rather than medical care. Caregiver support requires systematic professional infrastructure including training, respite services, and financial protection rather than continued reliance on informal family arrangements that impose €2.5 billion hidden costs while proving unable to scale with demographic aging.

The comprehensive analytical framework, sensitivity analyses, and scenario planning presented throughout this report equip decision-makers with evidence base necessary for strategic choices, yet implementation requires political architecture capable of sustaining commitment beyond electoral cycles, financial mechanisms blending public investment with insurance contributions and employer participation, professional workforce expansion anticipating fifty-percent demand increases, data infrastructure enabling real-time performance monitoring, and public engagement translating technical projections into personal relevance. The critical distinction between diabetes as acceptable endemic disease burden versus mobilizing comprehensive societal response determines not merely health outcomes but Slovakia's economic competitiveness, fiscal sustainability, and capacity to provide security and opportunity across the life course. Every year of policy delay shifts probability distributions toward pessimistic scenarios while narrowing the intervention space available for course correction, establishing 2027-2030 as the decisive window where Slovakia must choose between €2.19 billion optimistic and €4.15 billion pessimistic 2048 futures through actions taken in the next thirty-six months.

References

Economic Data Sources:

Statistical Office of the Slovak Republic: Employment rates, wage data by age and gender, demographic statistics (https://slovak.statistics.sk)

Eurostat: Harmonized European statistics, tax data, economic indicators (https://ec.europa.eu/eurostat)

Social Insurance Agency of Slovakia: Disability data, sick leave statistics, social transfer information (https://www.socpoist.sk)

Ministry of Labour, Social Affairs and Family: Employment policies, workforce data (https://www.employment.gov.sk)

OECD: Tax wedge indicators, international comparisons (https://www.oecd.org/en/data/indicators/tax-wedge.html)

World Bank: Inflation data, economic growth metrics (https://data.worldbank.org/indicator/FP.CPI.TOTL?locations=SK)

Healthcare Data Sources:

National Health Information Center (NCZI): Disease registries, healthcare utilization, pharmaceutical data (http://www.nczisk.sk)

World Health Organization: International disease burden comparisons, standardized metrics (https://www.who.int/countries/svk)

Notes

Project
HealthCare