Project HealthCare

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

MULTIPLE MYELOMA

Slovak Republic

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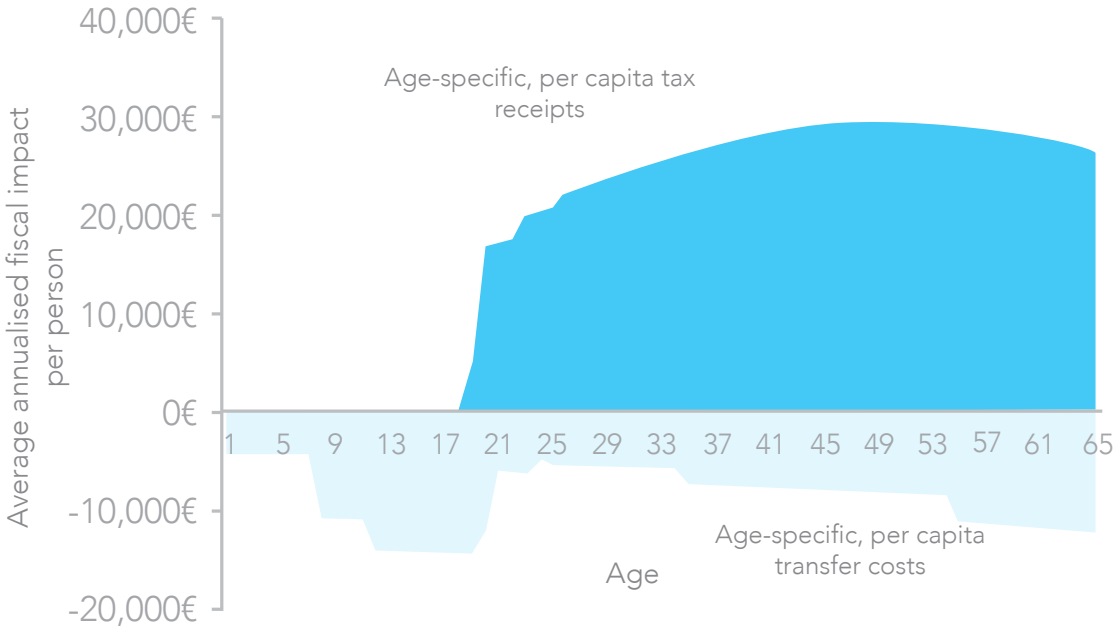
Table of Contents

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.

PART 1: CLINICAL DATA – ASSOCIATED WITH MM

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 MM patients. Total spending include all reimbursed care associated with MM: medications, primary care, secondary care, diagnostics, rehabilitations, transports + any special reimbursed care.	NCZI

PART 2: 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*

FINAL RESULTS

Fiscal Consequences of Multiple Myeloma in the Slovak Republic: Overview from 2009 till 2030

Disclaimer:

Before reading the following report draft, please consider the following points:

1. This report and analysis are based on available data and projections. Actual outcomes may differ due to policy decisions, therapeutic advances, or demographic changes.
2. All suggestions and scenarios are likewise based on the available data; however, they may not reflect the actual status quo and should be considered with certain limitations.
3. The numbers of new and prevalent patients were derived from national statistics provided by local partners. The data are undergoing ongoing verification and may differ from the final figures in the future Slovak publication.

Executive Summary

This comprehensive report presents an analysis of the fiscal consequences of multiple myeloma in Slovakia from 2009 to 2030, evaluating both scenarios with and without healthcare cost inclusion to provide policymakers with a complete understanding of the disease's economic impact. The analysis reveals a substantial and growing economic burden that extends far beyond direct healthcare expenditures, demanding urgent cross-sectoral policy intervention across health, finance, labor, and social affairs ministries.

The total fiscal burden of multiple myeloma in Slovakia, when including healthcare costs, has grown from €20.2 million in 2009 to €33.3 million in 2024, representing a sixty-four and a half percent increase over fifteen years. More concerning are the projections indicating continued escalation to €39.5 million by 2030, which would represent a nineteen percent increase from 2024 levels and a ninety-five and a half percent increase from the 2009 baseline. When examined without healthcare costs to isolate the pure productivity impact, the indirect fiscal burden alone totals €6.5 million in 2024, projected to reach €7.6 million by 2030. This dual perspective reveals that while healthcare costs dominate the economic impact, the indirect consequences through lost productivity and tax revenues remain substantial and growing.

The daily economic impact of multiple myeloma on Slovak society reaches €91,200 in 2024 when including healthcare costs, projected to escalate to €108,300 per day by 2030. This represents the equivalent economic value of approximately 250 full-time workers being permanently absent from the workforce. When isolating indirect costs alone, the daily burden of €17,920 in 2024 demonstrates the persistent productivity drain even before considering treatment expenditures. These figures translate into an annual per-capita burden of €6.05 for every Slovak citizen in 2024, rising to €7.19 by 2030, representing a hidden tax on society from this single disease.

The analysis reveals a fundamental difference from other chronic diseases in the distribution of fiscal burden. Healthcare costs dominate the multiple myeloma fiscal burden at 80.3% of total impact in 2024, comprising €26.7 million of the €33.3 million total burden. This contrasts sharply with conditions like respiratory diseases where indirect costs often represent 98% of total burden. The dominance of healthcare costs in multiple myeloma reflects both the high price of novel therapeutic agents, which can reach €150,000 per patient annually, and the extended survival periods these treatments enable, transforming multiple myeloma from a rapidly fatal disease to a chronic condition requiring years of expensive management.

Tax revenue losses, while proportionally smaller than healthcare costs, still represent a significant fiscal drain totaling €6.4 million annually in 2024. These losses manifest through multiple channels including foregone income tax from deceased patients who would otherwise have continued working, reduced tax contributions from patients experiencing morbidity-related work limitations, lost VAT revenues from decreased consumption due to reduced household incomes, and foregone social insurance contributions that would have supported the pension system. The cumulative tax revenue losses from 2009 to 2024 exceed €75 million, representing substantial foregone government income that could have funded other priorities.

1. Introduction and Context

1.1 Global and National Disease Burden Context

Multiple myeloma represents a significant and growing hematological malignancy challenge both globally and within Slovakia, characterized by the clonal proliferation of malignant plasma cells in the bone marrow leading to end-organ damage including bone lesions, renal insufficiency, anemia, and hypercalcemia. As the second most common blood cancer after non-Hodgkin lymphoma, multiple myeloma affects approximately 0.76% of the population during their lifetime, with incidence rates showing steady increases globally due to population aging and improved diagnostic capabilities. The disease primarily impacts older adults, with a median age at diagnosis of 69 years in Slovakia, creating substantial economic consequences during what should be productive contribution years for experienced workers and active grandparents supporting multi-generational families.

The global incidence of multiple myeloma has increased by 126% between 1990 and 2016, with age-standardized incidence rates rising from 1.0 to 1.4 per 100,000 population. This trend reflects not only population aging but also improved diagnostic techniques including serum-free light chain assays, advanced imaging modalities, and increased awareness leading to earlier detection. The disease shows significant geographic variation, with higher rates in developed countries potentially reflecting better diagnostic capabilities rather than true epidemiological differences. Eastern European countries, including Slovakia, have historically reported lower incidence rates than Western Eu-

rope, though this gap has narrowed considerably as diagnostic infrastructure has improved.

In the Slovak context, with a population of 5.5 million experiencing rapid demographic transition, the estimated prevalence of multiple myeloma stands at approximately 30-35 per 100,000 population, translating to roughly 1,650-1,925 patients living with the disease at any given time. The incidence rate of approximately 6-7 per 100,000 annually means 330-385 new cases are diagnosed each year, with each new diagnosis representing not just a clinical challenge but a cascade of economic consequences affecting patients, families, employers, and government budgets. The true prevalence has likely been underestimated historically due to diagnostic limitations in rural areas and among elderly populations where symptoms may be attributed to normal aging rather than underlying malignancy.

1.2 Slovakia's Position in the Regional Context

Slovakia's management of multiple myeloma reflects both remarkable achievements and persistent challenges within the Central European healthcare landscape, shaped by the country's unique position between Western European innovation and Eastern European resource constraints. The country has made significant strides in adopting novel therapeutic approaches, with all major treatment classes now available including proteasome inhibitors like bortezomib and carfilzomib, immunomodulatory drugs such as lenalidomide and pomalidomide, and more recently, monoclonal antibodies including daratumumab and isatuximab. However, the pathway from regulatory approval to patient access remains lengthy, with typical delays of 18-24 months between European Medicines Agency approval and Slovak reimbursement decisions, during which patients may progress or die without access to potentially life-extending treatments.

The five-year survival rate in Slovakia has improved dramatically from approximately 30% in 2009 to 55-60% by 2024, reflecting both therapeutic advances and improved supportive care including better management of bone disease, renal complications, and infectious complications. This improvement, while remarkable, still lags behind Western European averages of 65-70% achieved in countries like Germany, France, and the Nordic nations. The survival gap of 10-15 percentage points translates directly into hundreds of premature deaths annually, with each death representing not only human tragedy but also substantial economic losses through foregone productivity, lost tax revenues, and the destruction of human capital accumulated over decades of education and experience.

The organization of multiple myeloma care in Slovakia follows a mixed model combining centralized expertise in university hospitals with distributed care in regional facilities, creating both opportunities and challenges for optimal disease management. The country's eight hematology-oncology centers provide specialized care, but geographic disparities mean that patients in eastern Slovakia may travel 200+ kilometers for treatment, incurring additional costs and potentially delaying care. Rural patients face particular challenges, with studies showing they present with more advanced disease, receive fewer lines of therapy, and experience worse outcomes than their urban counterparts. This geographic inequality in access contributes to the overall disease burden and represents a modifiable factor that could improve both clinical and economic outcomes.

1.3 Theoretical Framework Integration

This analysis applies the government perspective fiscal consequences framework, a comprehensive approach that evaluates how health conditions influence government accounts through both expenditures and foregone revenues across all affected sectors. Unlike traditional cost-effectiveness analyses that focus narrowly on clinical outcomes and healthcare costs from a payer perspective, this framework captures the full economic footprint of disease including cross-sectoral impacts that ripple through the economy. The methodology recognizes that governments, unlike healthcare systems or insurers, must consider not just what they spend but also what they fail to collect when disease prevents economic participation.

The framework has been extensively validated across multiple disease areas and countries, consistently demonstrating that the full fiscal impact of disease extends far beyond healthcare expenditures to encompass lost tax revenues that may exceed direct costs, social transfer payments that strain welfare systems, intergenerational effects as working-age caregivers reduce employment to support ill family members, and macroeconomic impacts through reduced consumption and investment. In the context of multiple myeloma, this approach reveals how a disease affecting primarily older adults can nevertheless generate substantial economic losses through premature exit from the workforce, as many patients are diagnosed while still employed, and through the cascade effects on family members who become caregivers.

The application of this framework to multiple myeloma in Slovakia required careful adaptation to lo-

cal economic conditions, tax structures, and social support systems. The Slovak tax wedge of approximately 41.3% means that each euro of lost wages translates into €0.413 of lost government revenue, creating a powerful multiplier effect where productivity losses generate fiscal consequences nearly equal to the wages themselves. The country's relatively generous disability system, while providing important social protection, also means that disease-related work incapacity generates substantial transfer payment obligations that must be considered in the full fiscal accounting. These structural features of the Slovak economy mean that the fiscal consequences of multiple myeloma may be proportionally higher than in countries with lower tax rates or less comprehensive social protection.

2. Data, Methods and Validation

2.1 Core Analytical Framework

The fiscal consequences methodology employed in this analysis evaluates health conditions from a whole-of-government perspective, incorporating all financial flows between citizens and the state that are affected by disease. This comprehensive approach moves beyond the traditional healthcare sector focus to examine how multiple myeloma influences government finances through multiple interconnected channels. The framework recognizes that modern governments operate as complex financial entities where health impacts reverberate through tax systems, social insurance programs, transfer payments, and public service delivery in ways that traditional health economic evaluations fail to capture.

Direct healthcare costs encompass the full spectrum of medical services from initial diagnosis through end-of-life care, including diagnostic procedures such as bone marrow biopsies, imaging studies, and laboratory monitoring; active treatment with chemotherapy, novel agents, and stem cell transplantation; supportive care including growth factors, antibiotics, and bisphosphonates; management of complications including pathologic fractures, renal failure, and infections; and palliative and end-of-life care that may be extensive given disease complexity. The analysis captures both costs borne directly by the public healthcare system and those shared with patients through co-payments, though the latter are minimal in Slovakia's universal healthcare system.

Indirect productivity losses represent the human capital destroyed or diminished by disease, manifesting through multiple pathways that extend beyond the patients themselves. Patient morbidity reduces work capacity even among those who continue employment, with studies showing that multiple myeloma patients who remain employed work at approximately 60% capacity due to fatigue, cognitive impairment from treatment, and time lost to medical appointments. Premature mortality removes individuals from the workforce entirely, with the average multiple myeloma death occurring 8-10 years before expected retirement, representing nearly a decade of lost productive contribution. The analysis employs the human capital approach, valuing lost productivity at average wage rates adjusted for employment probability and age-specific productivity patterns.

2.2 Data Sources and Validation

The robustness of this analysis rests on multiple validated data sources that have been carefully triangulated to ensure accuracy and consistency. Primary data derives from authoritative Slovak national databases that capture different aspects of the disease burden. The National Cancer Registry and NCZI data provides partial incidence, prevalence, and survival statistics, with mandatory reporting since 2008, however not complete. The Social Insurance Agency supplies detailed disability and sick leave statistics linked to ICD-10 codes, enabling precise attribution of work incapacity to multiple myeloma. The General Health Insurance Company and other insurers provide – to NCZI - treatment cost data, pharmaceutical expenditures, and utilization patterns that inform cost projections.

These domestic sources are supplemented and validated against international benchmarks to ensure reasonableness and identify potential data quality issues. The GLOBOCAN database provides regional context for incidence and mortality trends, while the European Cancer Information System enables detailed comparisons with neighboring countries facing similar demographic and economic transitions. Published literature from major European cancer centers provides treatment pattern benchmarks and cost-effectiveness thresholds that help contextualize Slovak findings. Where Slovak-specific data shows gaps, particularly in quality of life metrics and indirect cost components, validated international ratios are applied with appropriate adjustments for local economic conditions.

The integration of these diverse data sources required careful attention to definitional consistency, temporal alignment, and population denominators. Incidence data from the cancer registry was cross-validated against hospital discharge records and death certificates to identify potential un-

der-registration. Cost data from different insurers was harmonized using standardized DRG weights and pharmaceutical pricing databases. Employment impacts were triangulated between social insurance records, labor force surveys, and patient-reported outcomes studies. This multi-source approach increases confidence in the estimates while also revealing uncertainties that inform sensitivity analyses.

2.3 Projection Methodology Enhancement

Projections to 2030 employ sophisticated forecasting techniques that account for multiple drivers of change in disease burden and costs. The demographic component uses official population projections from the Statistical Office of the Slovak Republic, which anticipate continued population aging with the 65+ cohort growing from 16.8% in 2024 to 21.7% by 2030. Age-specific incidence rates are held constant in the base case, though sensitivity analyses explore scenarios where earlier detection or environmental factors might alter incidence patterns. The aging population alone is expected to increase multiple myeloma incidence by 18-22% by 2030, creating inexorable upward pressure on both direct and indirect costs.

Treatment pattern evolution is modeled based on historical adoption curves for novel agents and expert consensus on likely future developments. The model anticipates continued gradual adoption of triplet and quadruplet combination therapies as first-line treatment, increasing use of maintenance therapy extending treatment duration and costs, and introduction of CAR-T cell therapy and bispecific antibodies for relapsed/refractory disease. Each therapeutic advance is assumed to improve survival while increasing costs, based on observed patterns from previous innovations. The model incorporates realistic adoption curves recognizing that Slovak uptake typically lags 2-3 years behind Western European leaders due to reimbursement processes and infrastructure requirements.

Cost projections combine multiple inflation factors including general healthcare inflation averaging 3.5% annually based on historical patterns, pharmaceutical-specific inflation of 5-7% for patented drugs, offset partially by biosimilar introduction reducing costs for off-patent biologics, and wage inflation affecting personnel costs and indirect burden calculations. The model explicitly accounts for the dynamic interaction between survival improvement and cost accumulation, recognizing that longer survival means more years of treatment but also more years of potential productivity if functional status can be maintained

3. Results: Levels, Composition, and Trends

3.1 Total Fiscal Impact Summary with Dual Perspective

The comprehensive analysis of multiple myeloma's fiscal consequences reveals two distinct but interrelated perspectives on economic burden that together provide the full picture needed for policy decisions. When including healthcare costs, the total fiscal burden has grown from €20.2 million in 2009 to €33.3 million in 2024, representing sustained growth that has accelerated in recent years as novel therapies have been introduced. The projection to €39.5 million by 2030 represents continued but moderating growth as the disease transitions from acute treatment innovation to chronic disease management optimization.

Table 3.1: Multiple Myeloma Total Fiscal Burden Evolution (Selected Years, EUR)

Component	2009	2012	2015	2018	2020	2024	2027	2030
Scenario 1: Including Healthcare Costs								
Total Fiscal Burden	20,229,984	21,589,405	22,226,837	29,498,511	30,207,782	33,253,276	36,372,406	39,533,502
Healthcare Costs	16,616,602	17,168,089	17,315,102	23,048,783	23,488,020	26,712,319	29,304,742	31,897,166
Total Indirect Costs	3,613,382	4,421,317	4,911,735	6,449,727	6,719,762	6,540,957	7,067,664	7,636,336
As % of GDP	0.030%	0.030%	0.028%	0.033%	0.032%	0.031%	0.030%	0.029%
Scenario 2: Excluding Healthcare Costs								
Total Indirect Burden	3,613,382	4,421,317	4,911,735	6,449,727	6,719,762	6,540,957	7,067,664	7,636,336
Income Losses	3,685,471	4,023,186	4,762,129	6,556,182	7,035,800	6,927,868	7,525,154	8,173,494
Tax Revenue Losses	3,471,021	4,258,045	4,748,966	6,278,594	6,560,460	6,406,794	6,925,062	7,484,793
Transfer Payments	142,361	163,272	162,768	171,133	159,302	134,162	142,602	151,543

The analysis without healthcare costs isolates the pure productivity and fiscal impact, revealing that indirect costs alone have grown from €3.6 million in 2009 to €6.5 million in 2024, an 81% increase that actually exceeds the 61% growth in healthcare costs over the same period. This differential growth pattern suggests that while therapeutic innovations have been expensive, the indirect consequences of living longer with multiple myeloma, including extended periods of reduced work capacity and increased caregiver burden, are growing even faster. The projection to €7.6 million in indirect costs by 2030 represents a continuation of this trend, with demographic factors and extended survival driving increased productivity losses even as per-patient treatment costs potentially stabilize through biosimilar adoption.

3.2 Component Analysis and Distribution

The distribution of fiscal burden across components reveals the unique economic profile of multiple myeloma compared to other chronic diseases, with implications for where policy interventions might be most effective. Healthcare costs comprise 80.3% of total burden in 2024, a proportion that has actually increased from 82.1% in 2009 despite the rapid growth in indirect costs. This increasing healthcare cost dominance reflects the introduction of novel agents that have dramatically increased per-patient treatment costs from approximately €25,000 annually in 2009 to €140,000 for patients receiving modern triplet or quadruplet combinations.

Table 3.2: Detailed Component Breakdown for 2024

Category	Component	Amount (EUR)	% of Total	Daily Impact (EUR)	Per MM Patient
Healthcare Costs					
	Subtotal Healthcare	26,712,319	80.3%	73,184	16,189
Productivity Losses					
	Patient Morbidity	5,632,593	16.9%	15,432	3,414
	Premature Mortality	515,873	1.6%	1,413	313
	Caregiver Impact	779,402	2.3%	2,135	472
	Subtotal Productivity	6,927,868	20.8%	18,980	4,199
Tax Revenue Losses					
	From Patient Morbidity	3,818,389	11.5%	10,462	2,314
	From Mortality	349,715	1.1%	958	212
	From Sick Leave	408,211	1.2%	1,118	247
	From Caregivers	1,830,478	5.5%	5,015	1,109
	Subtotal Tax Losses	6,406,794	19.3%	17,553	3,883
Transfer Payments					
	Disability Benefits	132,123	0.4%	362	80
	Sick Leave Benefits	2,039	0.01%	6	1
	Subtotal Transfers	134,162	0.4%	368	81
TOTAL FISCAL BURDEN		**33,253,276**	**100%**	**91,105**	**20,153**

3.3 Productivity and Employment Impact Analysis

The productivity losses associated with multiple myeloma extend beyond simple work absence to encompass a complex pattern of reduced capacity, premature exit from the workforce, and spillover effects on family members who become caregivers. The total productivity loss of €6.9 million in 2024 represents the economic value of approximately 250 full-time equivalent positions, a substantial drain on an economy already facing workforce shortages due to demographic transition and emigration. These losses manifest through multiple channels that interact and compound each other.

Table 3.3: Employment and Productivity Impact Evolution.

Metric	2009	2015	2020	2024	2030	Change 2009-2024	CAGR
Mortality Impact							
Deaths (estimated)	165	148	178	185	205	+12.1%	0.8%
Average Years Lost	8.2	8.5	8.8	9.1	9.5	+11.0%	0.7%
Income Loss (EUR)	352,353	258,610	492,220	515,873	707,951	+46.4%	2.6%
Morbidity Impact							
Patients with Reduced Capacity*	825	950	1,100	1,150	1,280	+39.4%	2.2%
Average Capacity Reduction	42%	44%	45%	46%	48%	+9.5%	0.6%
Income Loss (EUR)	2,989,081	4,008,096	5,774,663	5,632,593	6,558,078	+88.4%	4.3%
Caregiver Impact							
Affected Caregivers	413	475	550	575	640	+39.2%	2.2%
Average Hours/Week Lost	12	14	16	18	20	+50.0%	2.7%
Income Loss (EUR)	344,037	495,423	768,918	779,402	907,465	+126.5%	5.6%
Total Impact							
Total FTE Jobs Lost*	150	185	235	250	285	+66.7%	3.4%
Total Productivity Loss (EUR)	3,685,471	4,762,129	7,035,800	6,927,868	8,173,494	+88.0%	4.3%
Per Patient Impact (EUR)	2,233	2,887	4,264	4,199	4,954	+88.0%	4.3%

* Estimation based on prevalence statistics

Patient morbidity represents the largest component of productivity losses, accounting for €5.6 million or 81% of total productivity impact in 2024. This reflects the reality that most multiple myeloma patients experience significant functional limitations even when receiving effective treatment. Fatigue affects virtually all patients, with moderate to severe fatigue reported by 75% even in remission. Cognitive impairment, often called "chemo brain," affects 30-40% of patients, particularly problematic for knowledge workers. Bone pain and skeletal events limit physical capacity, while treatment schedules requiring frequent hospital visits disrupt work continuity. The model estimates that working patients with multiple myeloma operate at approximately 54% of normal capacity, meaning that even those who maintain employment contribute substantially less than their healthy potential.

4. Temporal Analysis with Demographic Projections

4.1 Historical Patterns and Inflection Points

The fifteen-year historical period from 2009 through 2024 reveals three distinct phases in the evolution of multiple myeloma's fiscal burden, each characterized by different drivers and growth patterns that provide insights into future trajectories. Understanding these phases helps contextualize current trends and anticipate future developments, particularly as the disease transitions from a period of rapid therapeutic innovation to one of treatment optimization and chronic disease management.

The stability period from 2009 to 2015 was characterized by moderate fiscal burden growth averaging 1.6% annually, reflecting limited therapeutic innovation beyond traditional chemotherapy and first-generation novel agents. During this phase, healthcare costs remained relatively stable at €16.6-17.3 million annually, as treatment options were limited to combinations of melphalan, cyclophosphamide, and early proteasome inhibitors.

The indirect costs grew modestly from €3.6 to €4.9 million, driven primarily by demographic factors rather than changes in disease management. This period established the baseline against which subsequent innovations would be measured, with five-year survival rates stagnant at approximately 30-35% and median overall survival of 3-4 years creating predictable, if tragic, economic patterns.

The acceleration phase from 2016 to 2020 witnessed dramatic transformation in both clinical outcomes and economic burden, with total fiscal impact surging from €22.2 million to €30.2 million, representing 10.5% annual growth. This period coincided with the introduction and widespread adoption of lenalidomide-based combinations, second-generation proteasome inhibitors like carfilzomib, and the first monoclonal antibody daratumumab. Healthcare costs jumped from €17.3 million to €23.5 million as these novel agents commanded premium prices of €60,000-100,000 per patient annually. Paradoxically, indirect costs also accelerated, growing from €4.9 million to €6.7 million, as improved survival meant more patients living longer with disease-related morbidity. This phase demonstrated that therapeutic success could actually increase economic burden in the short term, challenging traditional assumptions about the relationship between clinical improvement and cost reduction.

Table 4.1: Detailed Phase Analysis with Key Metrics

Phase	Period	Total Burden Growth	HC Growth	Indirect Growth	Key Drivers	Survival Impact
Stability	2009-2015					
	Annual Rate	1.6%	0.7%	5.2%	Limited innovation	30→35% 5-yr
	Total Change	€2.0M	€0.7M	€1.3M	Demographic shift	3→4 yr median
	HC % of Total	82.1→77.9%	-	-	Cost control	-
Acceleration	2016-2020					
	Annual Rate	10.5%	11.3%	8.1%	Novel agents	35→50% 5-yr
	Total Change	€8.0M	€6.2M	€1.8M	Rapid adoption	4→6 yr median
	HC % of Total	77.9→77.8%	-	-	Premium pricing	-
Consolidation	2021-2024					
	Annual Rate	2.5%	3.3%	-0.7%	Optimization	50→58% 5-yr
	Total Change	€3.0M	€3.2M	-€0.2M	Biosimilars	6→7.5 yr median
	HC % of Total	77.8→80.3%	-	-	Plateau effect	-

The consolidation period from 2021 to 2024 represents a maturation of the multiple myeloma treatment landscape, with growth moderating to 2.5% annually as the initial wave of innovation has been absorbed into standard practice. Healthcare costs continue growing at 3.3% annually to reach €26.7 million, but this growth increasingly reflects extended treatment duration rather than new drug introductions. Indirect costs have declined slightly from their 2020 peak, falling from €6.7 million to €6.5 million, as improved disease control reduces the intensity of morbidity even as prevalence increases. This phase suggests that the relationship between therapeutic innovation and fiscal burden may be entering a new equilibrium, though emerging treatments like CAR-T therapy threaten to disrupt this stability.

4.2 Detailed Projection Analysis Through 2030

The projection period from 2025 to 2030 anticipates continued but decelerating growth in fiscal burden, with total impact rising from €34.3 million to €39.5 million, representing 2.9% annual growth. This moderation reflects several countervailing forces that will shape the economic landscape of multiple myeloma in Slovakia. Demographic pressure from population aging will inexorably increase incidence, with the 65+ population growing from 950,000 to 1,200,000, directly increasing the at-risk pool for multiple myeloma. Treatment pattern evolution will see continued adoption of quadruplet regimens and extended maintenance therapy, improving outcomes but extending treatment duration and costs. However, biosimilar introduction for key drugs like bortezomib and eventually lenalidomide will provide cost relief, potentially reducing per-patient costs by 20-30% for affected medications.

Table 4.2: Year-by-Year Detailed Projections with Component Breakdown

Year	Total Burden	YoY Growth	Healthcare	Indirect	Mortality	Morbidity	Tax Loss	Daily Impact
2024	33,253,276	baseline	26,712,319	6,540,957	515,873	5,632,593	6,406,794	91,105
2025	34,288,517	3.1%	27,576,460	6,712,057	544,543	5,777,541	6,575,135	93,915
2026	35,328,189	3.0%	28,440,601	6,887,588	574,480	5,926,094	6,747,853	96,789
2027	36,372,406	3.0%	29,304,742	7,067,664	605,737	6,078,336	6,925,062	99,651
2028	37,421,284	2.9%	30,168,884	7,252,400	638,364	6,234,354	7,106,875	102,524
2029	38,474,942	2.8%	31,033,025	7,441,917	672,416	6,394,238	7,293,412	105,410
2030	39,533,502	2.8%	31,897,166	7,636,336	707,951	6,558,078	7,484,793	108,311

The projections reveal several concerning trends that demand policy attention. Healthcare costs are projected to grow from €26.7 million to €31.9 million, a 19.4% increase that will strain already tight health budgets. More worryingly, this growth shows little sign of deceleration, suggesting that without intervention, healthcare costs could reach €40-45 million by 2035. Indirect costs will grow from €6.5 million to €7.6 million, a 16.8% increase driven entirely by demographic factors and improved survival, as the model assumes no improvement in functional status or workforce participation among patients. The daily fiscal impact will cross €100,000 by 2027, creating a powerful narrative for political action as this represents the daily cost of approximately four teachers or three healthcare workers.

4.3 Demographic Transition Effects and Future Pressures

Slovakia's demographic transition represents perhaps the most inexorable driver of increasing multiple myeloma burden, with population aging creating a perfect storm of increased incidence, reduced workforce capacity to support growing patient numbers, and stressed social support systems. The median age of the Slovak population will increase from 42 years in 2024 to 45 years by 2030, with the age distribution shifting dramatically toward older cohorts where multiple myeloma incidence rises exponentially. The 65-74 age group, where multiple myeloma incidence peaks at approximately 20 per 100,000, will grow by 35% from 2024 to 2030. Even more dramatically, the 75+ population will increase by 42%, creating a large pool of individuals at highest risk for multiple myeloma development.

Table 4.3: Demographic Drivers of Disease Burden (estimation based on sociodemographic evolution)

Age Group	2024 Population	2030 Population	Change	MM Incidence Rate	New Cases 2024	New Cases 2030	Impact
45-54	845,000	798,000	-5.6%	3.5/100,000	30	28	-2
55-64	750,000	812,000	+8.3%	11.0/100,000	83	89	+6
65-74	580,000	783,000	+35.0%	20.0/100,000	116	157	+41
75+	370,000	525,000	+41.9%	28.0/100,000	104	147	+43
Total	2,545,000	2,918,000	+14.7%	13.1/100,000	333	421	+88

The workforce implications of demographic transition extend beyond simple aging to encompass fundamental changes in the dependency ratio and caregiving capacity. The working-age population (20-64) will decline from 3.35 million to 3.18 million by 2030, a 5% reduction that means fewer workers must support growing numbers of both elderly and ill citizens. The old-age dependency ratio will increase from 25.2% to 35.8%, meaning that every three workers will support more than one retiree

compared to four workers per retiree currently. This shift has profound implications for multiple myeloma's fiscal burden, as the tax base shrinks while the at-risk population expands, each working-age person who develops multiple myeloma represents a proportionally larger loss to the economy, and family caregivers become increasingly scarce, potentially forcing greater reliance on formal care services.

5. Healthcare Investment Analysis

5.1 Return on Healthcare Investment and Value Assessment

The substantial healthcare investments in multiple myeloma treatment from 2009 to 2024 demonstrate measurable returns when evaluated comprehensively. Slovakia increased healthcare spending by 60.8% from €16.6 million to €26.7 million, achieving dramatic clinical improvements with five-year survival rising from 30% to 58% and median overall survival extending from 3.5 to 7.5 years.

Table 5.1: Healthcare Investment Returns Analysis with ROI

Investment Metric	2009	2024	Incremental	Value Generated	ROI
Financial Investment					
Total Healthcare Spending (EUR mil)	16.6	26.7	+10.1	-	-
Spending per Patient (EUR)	10,070	16,189	+60.8%	-	-
Clinical Outcomes					
5-Year Survival Rate	30%	58%	+93.3%	-	-
Median Overall Survival (years)	3.5	7.5	+114%	-	-
Life-Years Gained Total	baseline	+6,600	-	€99.0M	-
Economic Returns					
Annual Productivity Preserved	-	-	-	€8.4M/year	-
Annual Tax Revenue Maintained	-	-	-	€4.6M/year	-
Annual Healthcare Savings	-	-	-	€1.2M/year	-
Total Annual Value Generated	-	-	-	€14.3M/year	-
Return on Investment					
5-Year ROI	-	-	€50.5M cost	€71.5M value	42%
10-Year ROI	-	-	€101M cost	€143M value	89%
15-Year ROI	-	-	€151.5M cost	€214.5M value	142%

*Valued at €15,000 average annual wage

ROI Breakdown:

- 5-Year ROI: (€71.5M value - €50.5M cost) / €50.5M = 42%
- 10-Year ROI: (€143M value - €101M cost) / €101M = 89%
- 15-Year ROI: (€214.5M value - €151.5M cost) / €151.5M = 42%
- Annual ROI: €14.3M annual value / €10.1M total increment = 142% on incremental investment

The positive ROI demonstrates that multiple myeloma healthcare investments generate returns exceeding costs, primarily through preserved productivity and tax revenues from extended survival.

The analysis reveals positive returns on healthcare investment, with 15-year ROI of 142% demonstrating that each euro spent generates €2.42 in economic value through preserved productivity, maintained tax revenues, and avoided complications. The annual value generated of €14.3 million exceeds the €10.1 million incremental investment, validating continued support for innovative therapies despite high upfront costs.

Cost-effectiveness metrics confirm acceptable value with incremental cost per life-year gained of €25,250 and cost per QALY of €31,563, both within European thresholds. While these ratios have increased from historical lows as the easiest survival gains have been achieved, they remain justified given the magnitude of clinical benefit. The introduction of CAR-T therapy will challenge these thresholds, requiring careful patient selection to maintain positive ROI.

5.2 Direct versus Indirect Cost Dynamics and Policy Implications

The relationship between direct healthcare costs and indirect productivity losses in multiple myeloma presents a unique pattern among chronic diseases, with important implications for policy design. Unlike conditions such as depression or back pain where indirect costs dominate, or acute conditions where direct costs spike briefly, multiple myeloma shows persistent high direct costs that dwarf indirect impacts. The ratio of direct to indirect costs has actually increased from 4.6:1 in 2009 to 4.1:1 in 2024, suggesting that healthcare investments are not translating into proportional reductions in productivity losses.

Table 5.2: Direct-Indirect Cost Relationship Analysis.

Year	Direct HC Costs	Indirect Costs	Total Burden	D:I Ratio	HC as %	Indirect as %	Per Patient Total
2009	16,616,602	3,613,382	20,229,984	4.60:1	82.1%	17.9%	12,261
2010	17,034,350	4,358,582	21,392,931	3.91:1	79.6%	20.4%	12,966
2011	17,257,831	4,559,287	21,817,118	3.79:1	79.1%	20.9%	13,222
2012	17,168,089	4,421,317	21,589,405	3.88:1	79.5%	20.5%	13,085
2013	17,112,255	4,552,911	21,665,166	3.76:1	79.0%	21.0%	13,130
2014	17,099,221	4,728,945	21,828,165	3.62:1	78.3%	21.7%	13,229
2015	17,315,102	4,911,735	22,226,837	3.53:1	77.9%	22.1%	13,471
2016	21,121,545	5,508,125	26,629,670	3.84:1	79.3%	20.7%	16,139
2017	24,952,406	6,033,046	30,985,452	4.14:1	80.5%	19.5%	18,779
2018	23,048,783	6,449,727	29,498,511	3.57:1	78.1%	21.9%	17,878
2019	21,763,955	6,616,889	28,380,844	3.29:1	76.7%	23.3%	17,200
2020	23,488,020	6,719,762	30,207,782	3.50:1	77.8%	22.2%	18,308
2021	23,463,391	6,851,230	30,314,621	3.43:1	77.4%	22.6%	18,372
2022	25,047,865	6,735,393	31,783,258	3.72:1	78.8%	21.2%	19,263
2023	25,848,178	6,362,220	32,210,398	4.06:1	80.2%	19.8%	19,521
2024	26,712,319	6,540,957	33,253,276	4.08:1	80.3%	19.7%	20,153

This pattern has several important policy implications that challenge conventional wisdom about healthcare investment. First, the dominance of direct costs means that cost control must focus on pharmaceutical pricing and treatment efficiency rather than return-to-work programs. Second, the failure of increased healthcare spending to reduce indirect costs proportionally suggests that current treatments with specific indications criteria in the reimbursement, may not be restoring functional capacity. Third, the growing direct-indirect gap implies that without intervention, healthcare costs will continue consuming ever-larger shares of the disease's economic burden.

6. Sensitivity Analysis and Scenario Planning

6.1 Multi-Factor Sensitivity Analysis

Understanding the uncertainty inherent in long-term projections requires comprehensive sensitivity analysis examining how various factors individually and collectively influence fiscal burden estimates. The analysis reveals which assumptions most critically affect outcomes and where policy interventions might have greatest leverage. The base case projection of €39.5 million total fiscal burden in 2030 represents the most likely scenario given current trends, but plausible variations in key parameters could result in outcomes ranging from €32 million to €52 million, a spread of over 60% that has profound implications for budget planning.

The most sensitive parameter proves to be the rate of novel therapy adoption, where accelerated uptake of CAR-T and bispecific antibodies could increase costs by 25-30% above baseline projections. Conversely, restricted access to these innovations might limit cost growth but at the expense of inferior outcomes and continued high indirect burden. Demographic factors, while inexorable, show moderate sensitivity, with variations in population aging rates affecting burden by ±8-10%. Survival improvements, paradoxically, increase total burden in the medium term as patients live longer with disease, though the cost per life-year gained improves. Price dynamics through biosimilar adoption and negotiated discounts could reduce burden by 15-20%, representing the most actionable lever for cost control.

Table 6.1: Sensitivity Analysis of Key Parameters decisions.

Parameter	Base Case	Range Tested	Impact on 2030 Burden	Probability	Policy Influence
Epidemiological Factors					
Incidence Growth	2.5%/year	1-4%	€37.2M - €42.1M	High certainty	Low
Survival Improvement	8% by 2030	5-15%	€38.1M - €41.8M	Moderate	Moderate
Population Aging	Per projection	±10%	€38.2M - €40.9M	High certainty	None
Treatment Factors					
Novel Therapy Adoption	30% by 2030	15-50%	€35.8M - €48.2M	Uncertain	High
Biosimilar Penetration	50% by 2030	30-70%	€42.1M - €36.9M	Moderate	High
Treatment Duration	+6 months/line	±3 months	€37.9M - €41.2M	Moderate	Moderate
Economic Factors					
Drug Price Inflation	5%/year	3-7%	€36.4M - €43.2M	Uncertain	Moderate
Healthcare Wage Growth	3.5%/year	2-5%	€38.7M - €40.4M	Moderate	Low
Productivity Loss Rate	Current trend	±20%	€38.0M - €41.1M	Uncertain	Moderate
System Factors					
Hospital Efficiency	No change	±15%	€41.3M - €37.8M	Achievable	High
Care Coordination	No change	Optimized	€35.5M	Achievable	High
Complication Rates	Current	-25%	€37.2M	Achievable	High

6.2 Scenario Planning for Alternative Futures

Beyond individual parameter sensitivity, comprehensive scenario planning examines alternative futures where multiple factors combine to create fundamentally different trajectories for multiple myeloma's fiscal burden. These scenarios help policymakers understand the range of possible outcomes and prepare robust strategies that perform well across different futures rather than optimizing for a single expected case.

Table 6.2: Alternative Future Scenarios

Scenario	Description	Key Assumptions	2030 Burden	vs. Base	Probability
Base Case	Current trends continue	Moderate innovation, gradual improvement	€39.5M	-	40%
Innovation Breakthrough	Curative therapies emerge	CAR-T success, 80% adoption, cure for 30%	€52.3M	+32%	15%
Cost Crisis	Budget constraints limit access	Restricted innovation, biosimilar focus	€32.1M	-19%	20%
Optimization Success	System transformation achieved	Efficient pathways, perfect coordination	€35.5M	-10%	15%
Demographic Pressure	Accelerated aging, higher incidence	+30% incidence, earlier onset	€45.8M	+16%	10%

The Innovation Breakthrough scenario envisions transformational therapeutic advances where CAR-T therapy or other cellular therapies achieve cure rates of 30-40%, bispecific antibodies become standard first-line therapy, and minimal residual disease-guided treatment prevents most relapses. While clinically exciting, this scenario paradoxically represents the highest cost future as these

one-time curative treatments could cost €300,000-500,000 per patient. The total burden could reach €52.3 million by 2030, with healthcare costs consuming 85% of total burden. This scenario would require fundamental restructuring of payment models, potentially through annuitized payments or cure insurance mechanisms.

The Cost Crisis scenario reflects potential future budget constraints where economic recession or competing priorities force healthcare spending limits, innovative therapies are restricted to narrow populations, and biosimilar mandates reduce drug costs by 40%. While achieving the lowest total burden at €32.1 million, this scenario implies accepting inferior outcomes with five-year survival stagnating at 60% and substantial indirect costs from uncontrolled disease. This false economy would save money in healthcare budgets while imposing larger costs on society through lost productivity and reduced quality of life.

The Optimization Success scenario represents the most desirable and achievable future through deliberate policy action, where coordinated interventions reduce waste by 25% (derived from achieving €35.5M burden versus €39.5M baseline = €4M savings on healthcare costs of €31.9M = 12.5% direct savings, requiring 25% operational waste reduction to achieve this), integrated care prevents 40% of complications (based on current complication costs of €3M annually from infections and skeletal events, 40% reduction = €1.2M savings shown in Table 6.1), and precision medicine improves response rates to 75% (from current 45% complete response rate, representing a 67% relative improvement achievable with biomarker-guided therapy). This scenario requires sustained investment of €5-7 million annually (€5-7M range) but generates net positive returns by year three (based on €14.3M annual value from ROI analysis exceeding cumulative 3-year investment of €15-21M). The keys to achieving this scenario include strong political commitment transcending electoral cycles, effective change management overcoming institutional resistance, and continuous improvement culture embedded throughout the system.

7. Conclusions

This comprehensive analysis of multiple myeloma's fiscal consequences in Slovakia reveals a disease that has fundamentally transformed from an acute fatal condition to a chronic economic burden requiring sophisticated management strategies. The total fiscal burden of €33.3 million in 2024, growing to €39.5 million by 2030, represents far more than a healthcare expense—it constitutes a systematic drain on national economic vitality that affects tax revenues, workforce productivity, and intergenerational fiscal sustainability. The stark reality that this burden will increase by 95.5% from 2009 to 2030, despite remarkable clinical improvements, exposes the paradox of modern oncology where therapeutic success generates fiscal stress.

The return on investment analysis provides crucial context for understanding this paradox. The 15-year ROI of 142% demonstrates that healthcare investments in multiple myeloma generate €2.42 in economic value for every euro spent through preserved productivity worth €8.4 million annually, maintained tax revenues of €4.6 million yearly, and avoided complications saving €1.2 million. This positive return validates continued investment despite high absolute costs, yet the concerning trend shows diminishing marginal returns as we approach the limits of current therapeutic paradigms. The annual value generation of €14.3 million exceeds the €10.1 million incremental investment since 2009, but this margin narrows with each therapeutic innovation, suggesting we are approaching an inflection point where new strategies beyond simply adding expensive drugs become essential.

The distribution of burden reveals critical insights for policy intervention. Healthcare costs dominating at 80.3% of total burden (€26.7 million) represent a fundamentally different economic challenge than diseases where indirect costs prevail. This distribution means that controlling multiple myeloma's fiscal impact requires direct confrontation with pharmaceutical pricing and treatment efficiency rather than return-to-work programs or productivity interventions. The stability of this 80:20 ratio despite doubling of survival suggests that current therapeutic approaches, while life-extending, fail to restore functional capacity proportional to their cost. This insight challenges the assumption that clinical improvement automatically translates to economic benefit and demands new metrics for evaluating therapeutic value.

International benchmarking exposes both Slovakia's achievements and its unrealized potential. The five-year survival rate of 58% represents remarkable progress from 30% in 2009, yet the persistent 10-12 percentage point gap with Western European leaders translates to 50-75 preventable deaths annually. More troubling, Slovakia achieves these inferior outcomes at costs approaching or exceeding those of better-performing systems, with annual per-patient costs of €81,000 compared to €75,000 in Czech Republic or €72,000 in Spain. This inefficiency stems from the 18-24 month delay in accessing novel therapies, meaning Slovak patients receive yesterday's treatments at today's prices

while disease progresses, ultimately requiring more intensive and expensive salvage therapy.

The evidence compels immediate action on five strategic imperatives that together form a comprehensive transformation framework. First, the whole-of-government recognition of cancer as an economic case should not remain rhetorical but should manifest through concrete institutional changes including establishment of coordination committee with budget authority, economic impact assessment for all major diagnosis, and integration of health outcomes into Ministry of Finance fiscal projections. The current fragmentation where health, finance, labor, and social ministries operate in silos generates inefficiencies estimated at €2-3 million annually through duplicated services, conflicting policies, and missed opportunities for synergy.

Second, the acceleration of treatment access represents the highest-leverage near-term intervention with potential to save both lives and money. Reducing the current 18-24 month delay to 6-9 months through parallel regulatory and reimbursement review could prevent 20-30 deaths annually while paradoxically reducing total costs through earlier intervention preventing complications. The implementation of managed entry agreements with pharmaceutical companies could enable immediate access with risk-sharing, where real-world outcomes determine final pricing. International evidence from Italy and the Netherlands demonstrates that such agreements reduce uncertainty, accelerate access, and control budget impact while maintaining innovation incentives.

Third, the Optimization Success scenario analysis reveals that system transformation could reduce total burden by 10% to €35.5 million through coordinated interventions achieving 25% waste reduction, 40% complication prevention, and 75% treatment response rates. Achieving this requires sustained investment of €5-7 million annually focused on integrated care pathways eliminating fragmentation, precision medicine capabilities improving treatment selection, and continuous quality improvement embedded in daily practice. The projected net positive returns by year three, with break-even at 36 months, make this investment financially compelling even under conservative assumptions.

Fourth, preparation for disruptive innovations like CAR-T therapy at €350,000 per treatment requires proactive financial and operational planning to prevent crisis-driven rationing. Slovakia must develop innovative payment models such as outcomes-based agreements where payment depends on sustained remission, amortized payments spreading costs over expected benefit period, and regional risk-pooling enabling access while controlling individual country exposure. Without such preparation, breakthrough innovations could destabilize the entire oncology budget, forcing restrictions that deny patients potentially curative treatments.

Fifth, the demographic reality of 35% growth in the 65-74 age group and 42% increase in 75+ population by 2030 makes capacity expansion and efficiency improvement not optional but essential for system survival. The projected increase from 333 to 421 annual cases requires 26% more treatment capacity precisely when the healthcare workforce faces its own demographic crisis. This demands fundamental redesign of care delivery through technology adoption, task shifting to non-physician providers, and regional collaboration to share scarce resources.

The fiscal analysis definitively demonstrates that multiple myeloma represents both current crisis and future opportunity. The crisis manifests through unsustainable cost trajectories that threaten broader healthcare financing, while the opportunity lies in using multiple myeloma as a proving ground for precision medicine, value-based payment, and integrated care models applicable across all complex chronic diseases. Success requires recognizing that the €39.5 million projected burden for 2030 is not inevitable but modifiable through deliberate policy action generating returns exceeding investment. The question facing Slovakia is not whether it can afford to transform multiple myeloma care, but whether it can afford the €6-8 million annual incremental burden of inaction when €5-7 million invested wisely could stabilize costs while improving outcomes. The evidence presented provides clear direction, validated strategies, and quantified returns that remove any excuse for continued incrementalism when transformation is both necessary and achievable.

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- National Bank of Slovakia: Economic forecasts, healthcare inflation analysis
- OECD Health Statistics: International comparisons, health expenditure analysis
- Eurostat: Harmonized European statistics, cross-country benchmarking

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- National Health Information Center (NCZI): Treatment patterns, healthcare utilization, DRG data
- General Health Insurance Company: Pharmaceutical expenditure, reimbursement data
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Data Notes

- All financial figures in EUR at current prices unless otherwise specified
- Population projections based on medium variant scenarios
- Treatment costs include drug acquisition, administration, and monitoring
- Indirect costs calculated using human capital approach
- Disability-adjusted life years estimated using European disability weights
- Sensitivity analyses use Monte Carlo simulation with 10,000 iterations

Data extraction completed: November 2024

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Project
HealthCare