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Economic Impact of Biomarker Testing for Lung Cancer Patients in Romania

EXECUTIVE SUMMARY

Cancer prevalence is quickly becoming not only a health, but also a major economic vulnerability in Romania. Not only there is a constantly growing prevalence of cancer like everywhere in the world, but also a skewed prevalence in the active age population group—up to three times higher than in the EU for certain cancer pathologies.

Healthcare programs and interventions should be regarded as an investment in the key productivity component in Romania: its labour force. With much larger cancer prevalence in working age population then elsewhere in Europe, it is important to deliver more effective procedures for early diagnostic and better treatment. Even in the case of advanced lung cancer patients, better diagnostic measures such as precision diagnostic treatment (PDT) can have an important positive economic impact, beyond the obvious gains in quality-adjusted life years (QALYs).

As opposed to other cost-effectiveness assessment of spending, our method looks at value lost in the national economy by not spending on certain healthcare interventions or programs. Public expenditures for better diagnostic and treatment could diminish the very large losses we currently register in the national gross value added (GVA) due to cancer prevalence, especially amongst the active age patients and caretakers. This allows us to expand even further he potential cost-effectiveness thresholds of budgetary allocations for healthcare in Romania—which are already underspent by 10 to 30 times less than what the WHO recommends.[1] This is not only linked to the availability of budgetary resources (i.e. WHO's recommendations are based on the GDP per capita reference value in a country), but also on the prospective economic gains. Recent studies showed that public investments targeting better diagnostic, treatment, and quality of life of cancer patients has the potential to unlock 10x larger economic benefits in the national economy.[2]

For Romania, lung cancer has the largest morality rate amongst cancer patients, with the second largest incidence, representing alone over a tenth of all new annual cancer diagnostics. The patient pathway in lung cancer in Romania currently involves up to 6 months delays from first symptoms to diagnostic. This affects severely the treatment chances and quality of life of patients, but also creates an unjust burden of uncertainty and logistical effort for patients and their caretakers during the diagnostic period. Non-small-cell lung cancer (NSCLC) represents 85% of total lung cancer new patients in Romania. In the case of advanced non-small-cell lung cancer (NSCLC) new standards of care with regards to diagnostic include the recommended testing for EGFR, ALK, ROS1, BRAF, NTRK, PDL-1, according to ESMO Guideline,[3] before initiating any treatment (i.e., chemotherapy, targeted therapies, immunotherapies). Reflex testing rather than waiting for a physician order can reduce the time to initiating treatment.[4]

Our estimates show that on average, the total gross-value added lost in the Romanian economy related to lung cancer prevalence in the next decade is estimated at 177 mil. EUR per year. For the entire modelled period of 2020-2038, the negative economic impact in the labour market of lung cancer prevalence is estimated at 2.49 billion EUR (present value). Additionally, over 100 mil. EUR will be lost in the same period due to the productivity loss of caregivers that spend their time with family member or friends in the diagnostic and treatment procedures. While smaller in size, this latter category of economic losses can be very easily addressed through better support services in the healthcare sector (e.g., transportation, more efficient diagnostic procedures).

Only the diagnostic period for lung cancer patients brings about approximately 71 mil. EUR loss in productivity and forgone fiscal revenues. If the current average 6 months period of delay between first symptoms and diagnostic would be reduced to the best practice of 2 months,[5] these losses would be reduced by three-fold. At current prices, the annual average annual budgetary cost for biomarker testing in the case of non-small lung cancer patients is about 9 mil. EUR. While this expenditure cannot offset the entire

1. Woods, B., Revill, P., Sculpher, M., & Claxton, K. (2016). Country-level cost-effectiveness thresholds: initial estimates and the need for further research. *Value in Health*, 19(8), 929-935.

2. Knaul, Felicia Marie, Hector Arreola-Ornelas, Rifat Atun, Oscar Méndez, Ramiro Guerrero, Marcella Alsan, and Janice Seinfeld (2012) "INVESTING IN CANCER CARE AND CONTROL." Closing the Cancer Divide: An Equity Imperative. Harvard University Press.

3. Updated version published online in September 2020, CLINICAL PRACTICE GUIDELINES
Metastatic non-small cell lung cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up, available online at: https://www.esmo.org/content/download/347819/6934778/1/ESMO-CPG-mNSCLC-15SEPT2020.pdf

4. Pennell, N. A., Arcila, M. E., Gandara, D. R., & West, H. (2019). Biomarker testing for patients with advanced non-small cell lung cancer: real-world issues and tough choices. *American Society of Clinical Oncology Educational Book*, 39, 531-542.

5. InoMed (2020) Cancerul pulmonar, prioritate pentru sistemul de sănătate din România. [in Romanian].

economic losses in gross value added for lung cancer patients of working age in Romania, it can significantly contribute to diminishing the economic losses of almost 50 mil. EUR annually related exclusively to current delays in lung cancer diagnostic.

PATIENT PATHWAYS AND NEW CONCEPTUALIZATIONS OF THE ECONOMIC BURDEN OF CANCER

Given that the labour force in Romania is a key economic factor, the health of the population is one of the most important aspects of productivity and value contribution into the national economy. As such, public expenditures for better diagnostic and treatment could diminish the very large losses we currently register in the national gross value added (GVA) due to cancer prevalence, especially amongst the active age patients. Beyond the patients themselves, an often-overlooked impact is the way caretakers and family members are also affected. By looking at the overall losses in the Romanian economy from poor management of the disease, we are better able to understand the rentability of targeted expenditures to address these issues. Public investments targeting better diagnostic, treatment, and quality of life of cancer patients has the potential to unlock 10x larger economic benefits in the national economy.[6]

The patient pathway, including sequencing and timing of various diagnostic procedures have a major impact on the efficiency of the subsequent treatment.

Overall, there is a disproportionately large mortality amongst cancer patients in Romania compared to other EU (see Figure 1) member states, and this is linked to systemic failures and deficiencies in both the diagnostic and the treatment phases.[7]

For Romania, lung cancer has the largest morality rate amongst cancer patients, with the second largest incidence, representing alone over a tenth of all new annual cancer diagnostics. In the case of advanced non-small-cell lung cancer (NSCLC) new standards of care with regards to diagnostic include the recommended testing for EGFR, ALK, ROS1, BRAF, NTRK, PDL-1, according to ESMO

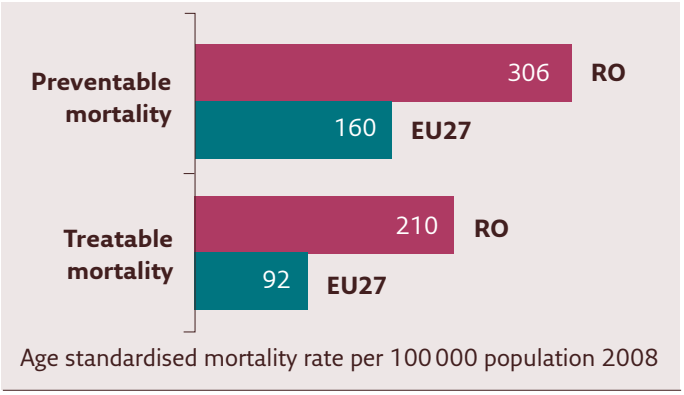

Figure 1: Mortality amongst cancer patients

Guideline,[8] before initiating any treatment (i.e., chemotherapy, targeted therapies, immunotherapies).

A number of studies have been recently developed to evaluate the cost-effectiveness of precision diagnostic testing (PDT), using biomarkers to identify cancer patients that may respond to precision medicine approaches (e.g., targeted agents and immune-oncology drugs) (see for example the systematic review conducted by Henderson et al 2021).[9] They show that the wide variety of methods used for such assessments world-wide, leaves room for improvement, as Henderson et al suggest that "more robust health economic evaluation could help identify additional approaches towards PDT cost-effectiveness, underpinning value-based care and enhanced outcomes for patients with NSCLC" (2021: 2673).

Traditionally, the cost-effectiveness thresholds (CETs) of any healthcare policy intervention are defined in relation to the budgetary capacity of each country, which in turn can be linked to its economic development level—usually measured as GDP per capita. The more wealth is produced in the economy, the more the

6. Knaul, Felicia Marie, Hector Arreola-Ornelas, Rifat Atun, Oscar Méndez, Ramiro Guerrero, Marcella Alsan, and Janice Seinfeld (2012) "INVESTING IN CANCER CARE AND CONTROL." Closing the Cancer Divide: An Equity Imperative. Harvard University Press.
7. EC (2021) State of Health in the EU: Romania Country Health Profile 2021, p. 3.
8. Updated version published online in September 2020, CLINICAL PRACTICE GUIDELINES
Metastatic non-small cell lung cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up, available online at: https://www.esmo.org/content/download/347819/6934778/1/ESMO-CPG-mNSCLC-15SEPT2020.pdf.
9. Henderson, R., Keeling, P., French, D., Smart, D., Sullivan, R., & Lawler, M. (2021). Cost-effectiveness of precision diagnostic testing for precision medicine approaches against non-small-cell lung cancer: a systematic review. *Molecular Oncology.*

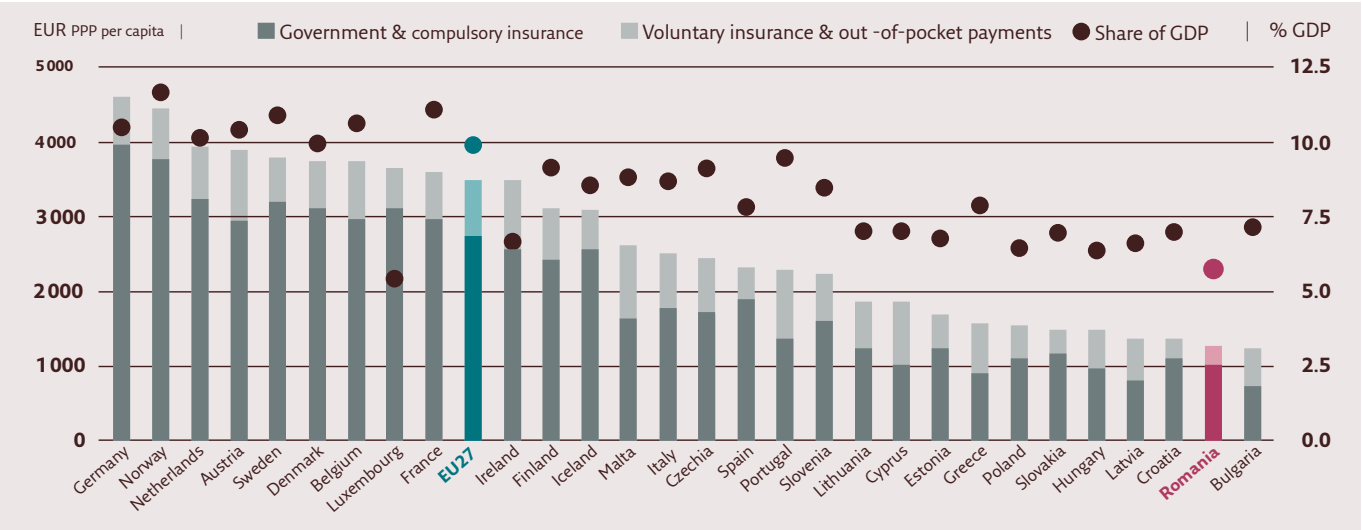

Figure 2. Healthcare system allocation | Source: EC 2021

state can afford to spend on healthcare and other social services it provides. However, this is not always the case, as despite large growth rates, countries such as Romania sometimes lag behind in terms of healthcare spending. For example, in 2019, according to the most recent data available, Romania continues to score the second lowest allocation of resources in the EU in all care areas (see Figure 2). Despite a universal insurance coverage system, out-of-pocket expenses are very high for all patients (see Figure 2), but up to the par of public spending in the first year of diagnostic for cancer patients due to large inefficiencies in the healthcare system (Volintiru et al., 2021).

Given the WHO recommendation of cost-effectiveness threshold (CET) for healthcare interventions of between 1 and 3 times the gross domestic product (GDP) per capita of a country,[10] Romania would have cost-effectiveness in healthcare spending of up to approximately 35,000 EUR per capita, which is almost 30 times more than what it is currently spending. We argue that this is not linked only to budgetary constraints or inefficiencies in program implementation (e.g. screening and prevention programs), but also due to a poor conceptualization of healthcare spending as a cost, rather than as an investment.

With a large reliance on the productivity of its working-age population, public spending to improve cancer treatment and diagnostic in Romania can yield significant economic gains, not just individual well-being.

ECONOMIC IMPACT OF LUNG CANCER PREVALENCE IN ROMANIA

The impact of cancer patients on the Romanian economy can be measured by the loss of average annual productivity per person in Romania (total Gross Value Added – GVA). It accounts for the annual incidence (i.e., new patients), the overall potential evolution of disease (i.e., survivors and deaths), and the indirectly affected cohort of the population (i.e., caregivers). This analysis can be applied to the overall incidence of the disease, but also for specific pathologies such as lung cancer.

This methodological approach allows us to move away for the simplistic cost-determinations quantification and establish the broader losses that the disease and its mismanagement bring about into the national economy.

Our model accounts for various determinants of loss of productivity in the lung cancer patient' pathway in Romania, from about two months per year because of delays in diagnosis, to the full productivity loss of patients undergoing treatment for advanced stage disease. Additionally, we calculated the annual loss of productivity for caregivers of patients (see the Methodology from Annex I).

To calculate the economic indirect effects of lung cancer in the value creation of the labour market in Romania (i.e., labour productivity) we include in our modelling only the active age population from total representing patients with ages between 15 and 64 years, around 44% of total cases (see Table 1). According to ECIS, the incidence of cancer in Romania is much larger for the active age population than the EU average, up to three times for certain cancer pathologies.

The estimates for lung cancer patients were realized starting from Globocan data for 2020, 2025, and 2030 while the annual values within every interval were calculated based on a linear change rate keeping in mind the Globocan estimates in 2025 and 2030.

Based on the Globocan data, we were able to model various scenarios of the lung cancer population, with regards to the annual survival and mortality rates. Thus, based on the new annual cases for lung cancer, the survival rate, and mortality rate, we estimated the total number of affected individuals with lung cancer (i.e., new cases, survivors, and deaths) between 2020 and 2030. Also, in order to cover the last cohort of new cases included in the analysis in 2030, we extended the period until 2038. For 2020 we covered only the new cases of active persons (see Annex II).

Table 2 below shows the annual GVA impact (both current EUR values and present values). Subsequently, after calculating the annual current values, the amounts obtained were adjusted with a discount rate of 3,5% as is recommended in other scientific papers regarding the health sector economy (see also Hofmarcher et al., 2020).

On average, the total economic impact (Gross Value-Added loss) of lung cancer patients between 2020 and 2030 in the Romanian economy is estimated at 177 mil. EUR per year, and for the entire 2020-2038 period is estimated at 131 mil. EUR per year (present value). The total value for the period 2020–2038 is estimated at 2.49 billion EUR (present value).

Our model accounts for the total cumulated impact between 2020 and 2038, having in mind the labor productivity development until 2038 (Table 2). It was based on the average labor productivity from 2010 to 2020 (compound annual growth rate of 7.5%)[11] until 2025 and lower rates after 2030: 7% until 2030, 6% until 2035, and 5% until 2038. We reduced the productivity compound annual growth rate due to the convergence process that is expected to slow down the pace of labor productivity growth rate during the time.

10. Woods, B., Revill, P., Sculpher, M., & Claxton, K. (2016). Country-level cost-effectiveness thresholds: initial estimates and the need for further research. Value in Health, 19(8), 929-935.

11. CAGR=[(Ending Value)/(Starting Value)]1/N−1, where N=number of years

	0	1	2	3	4	5	6	7	8	9	10
	2020	2021	2022	2023	2024	**2025**	2026	2027	2028	2029	**2030**
Total cases	**12122**	12219	12317	12415	12515	**12543**	12635	12727	12816	12906	**12950**
Active pop.	**5384**	5375	5366	5357	5348	**5330**	5449	5570	5695	5765	**5827**

Table 1. Total lung cancer population and active age patients (2020-2030) | Source: Globocan, authors' calculation

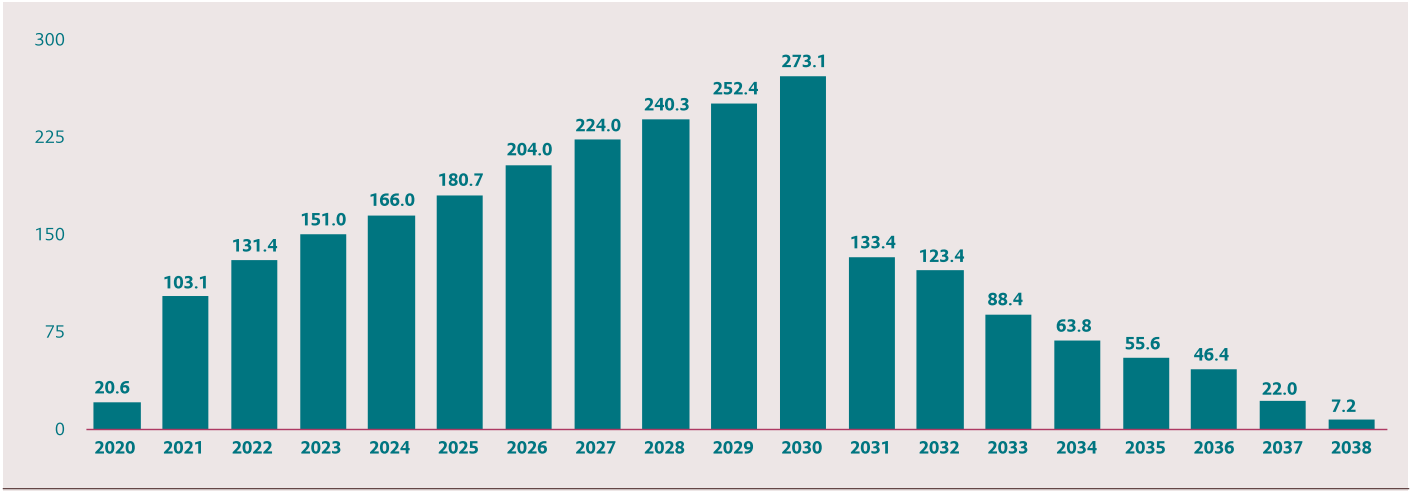

Figure 3. Total GVA impact of lung cancer patients (2020-2038) – Mil. EUR present values

Additionally, we have also calculated the impact of caregivers in terms of GVA loss. It accounts for an average annual value of 7.3 mil. EUR for period 2020-2030 and 5.3 mil. EUR for the entire period 2020-2038 (present value) as the patients are usually accompanied at hospitals by friends or relatives with impact on their working time. The total value for the period 2020–2038 is estimated at almost 100 mil. EUR (present value).

We considered that every new patient and survivor that are in the diagnostic process or treatment has at least one caregiver that supports them during the process. Thus, the caregiver who accompanies the new patients and survivors has one day per week alongside the patient for a period of two months (8 days of 60 days).

Moreover, we also realized a comparison depending on the diagnostic time for the annual number of new cases of lung cancer in two routes[12] (Figure 5):

Scenario 1: Enhanced Diagnostic Efficiency. This scenario involves using an early testing of biomarkers for lung cancer patients and other measures deployed for a swifter and more specific diagnostic of lung cancer in Romania. In this scenario, the inactivity period in the diagnostic phase is estimated at only 2 months in the first year.

Scenario 2: Baseline. This scenario models the current patient route, without early or reflexive biomarkers diagnostic, and with the multiple delays and logistical burdens faced by lung cancer patients in Romania. – expected inactivity period: 6 months in the first year.

12. In the NCCP draft, this interval is between 30 to 45 days. We used the larger 60 days interval based on previous studies that showed the 6 months delays between first symptoms and diagnostic for lung cancer in Romania. Thus the Baseline scenario of 6 months is based on the Inomed 2020 study on the lung cancer patient pathway in Romania, and the Enhanced Diagnostic Efficiency scenario is based on the international best practices estimates.

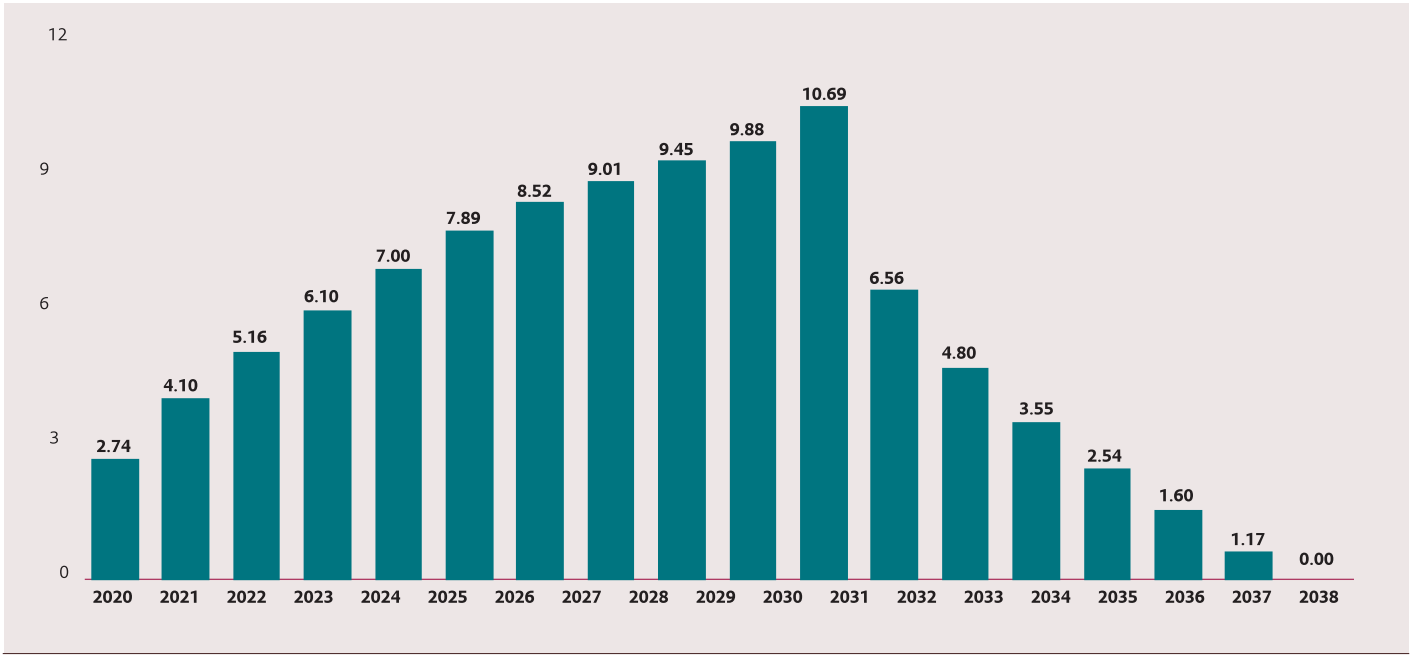

Figure 4. Indirect GVA impact on caregivers' patients (2020-2038) – present values
Source: author's estimates based on Romanian National Statistics Institute and Globocan

	Gross Value Added impact - patients							Factor discount	Present values	
	Year	Survivors & New patients	Deaths	2M productivity per person	12M productivity per person	Total loss (EUR)	Mil.EUR	r=3.5%	Patients impact (PV)	
0	**2020**	5384	0	3819	22915	20562248	20.6	1.00	20.6	0
1	**2021**	7712	3047	4106	24633	106727639	106.7	0.966	103.1	1
2	**2022**	9314	3764	4413	26481	140775278	140.8	0.934	131.4	2
3	**2023**	10548	4124	4745	28467	167430637	167.4	0.902	151.0	3
4	**2024**	11607	4289	5100	30602	190453572	190.5	0.871	166.0	4
5	**2025**	12574	4363	5538	33229	214606903	214.6	0.842	180.7	5
6	**2026**	13166	4857	5926	35555	250719769	250.7	0.814	204.0	6
7	**2027**	13494	5242	6341	38044	284994750	285.0	0.786	224.0	7
8	**2028**	13698	5491	6785	40707	316445710	316.4	0.759	240.3	8
9	**2029**	13880	5583	7259	43557	343935492	343.9	0.734	252.4	19
10	**2030**	14067	5649	8031	48186	385196892	385.2	0.709	273.1	10
11	**2031**	8356	2408	8593	51077	194777660	194.8	0.685	133.4	11
12	**2032**	5918	2438	9195	54142	186396764	186.4	0.662	123.4	12
13	**2033**	4235	1683	9838	57390	138232874	138.2	0.639	88.4	13
14	**2034**	2924	1312	10527	60833	110572298	110.6	0.618	68.3	14
15	**2035**	1780	1144	11264	63875	93107881	93.1	0.597	55.6	15
16	**2036**	709	1071	12052	67069	80379157	80.4	0.577	46.4	16
17	**2037**	181	528	12896	70422	39499301	39.5	0.577	22.0	17
18	**2038**	0	181	13799	73943	13379843	13.4	0.538	7.2	18
								Average 131.1 Mil. EUR		

Table 2. Total GVA loss due to patients' inactivity (2020-2038)
Source: author's estimates based on Romanian National Statistics Institute and Globocan; data source for annual productivity (12 months productivity) was the National Statistics Institute, for new patients and survivors was Globocan. The 3,5% discount rate was based on the study of Hofmarcher et al. (2020).

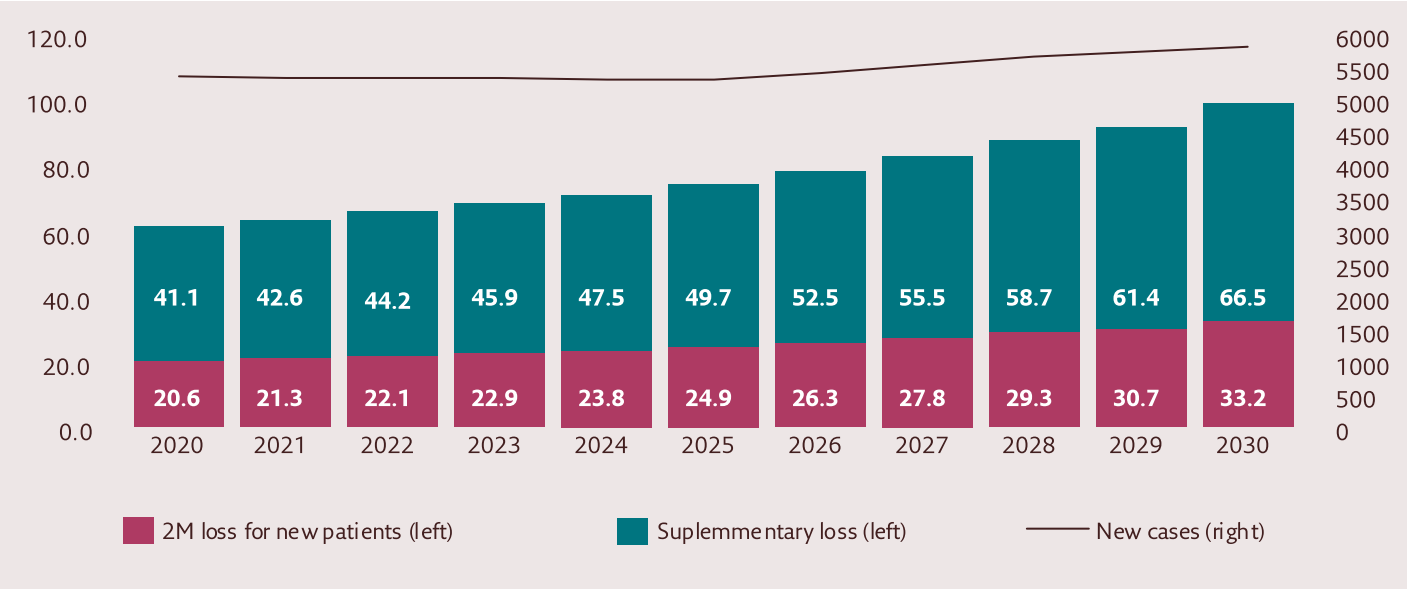

Figure 5. GVA impact of new patients depending on the routes (2020-2030) - Mil. EUR present values

Figure 5 shows that there are significant differences between routes mainly determined by the necessary time allocated to diagnostic and treatment identification (2 months for biomarkers and 6 months for the non-biomarkers use) of new patients every year. Additionally, lower time wasted in the diagnostic phase increases the productivity of caretakers. As such, we present a differentiated scenario of value lost in the working-age population of lung cancer patients in Romania, based on the baseline scenario (i.e. non-biomarker diagnostic), and enhanced diagnostic efficiency scenario (i.e. biomarker testing).

In the current baseline scenario, only the diagnostic period leads to approximately 77.1 mil. EUR (present values) on average per year between 2020 and 2038 for lung cancer cases. This amount can be diminished by threefold in the enhanced diagnostic efficiency scenario, by decreasing the diagnostic period to 2 months.

Another important dimension of loss value is linked to the forgone fiscal revenues. If the active patients have an inactivity period of 2 months per year13, the total uncollected taxes are around 7.6 million EUR per year (present values) between 2020 and 2030 due to social contribution and personal income tax (5.4 Mil. EUR) and uncollected VAT (1.2 Mil. EUR) as consumption-based on wage income decrease. These values are based only on the new cases of lung cancer patients from Table 1. The main hypothesis was that the new patients are working with the average gross salary and the average consumption propensity is about 0.8 of the total income (0.2 was the savings propensity).

Healthcare interventions such as precision diagnostic testing (PDT) decrease the time waisted in the diagnostic period and increase the quality of life of patients under treatment, by accessing new precision medicine approaches (e.g., targeted agents and immune-oncology drugs).

Even if not all advanced non-small-cell lung cancer (NSCLC) choose to maintain an active professional life during treatment, many might either due to financial constraints, or due to psychological well-being effects derived from an active life. In the shifting context of labour market conditions, with substantial increases in remote work or work from home, cancer patients have much larger flexibility in maintaining an active professional life during treatment. It is particularly in the professions of high self-reliance (e.g. self-employed, liberal activities) that the medical leave can offer the highest decrease in income, but also have the larger flexibility to maintain an active professional life if their time is not consumed entirely by the diagnostic and treatment process.

13. Wage increase is equivalent with productivity increase starting with an average gross wage of 1087 (611 net wage).

Bugetary impact (1 EUR=4.9488 lei)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Avarage gross salary – 1 month	1087	1169	1256	1350	1452	1561	1670	1787	1912	2046	2189
CAS – 25%	272	292	314	338	363	390	417	447	478	511	547
CASS – 10%	109	117	126	135	145	156	167	179	191	205	219
PIT – 10%	71	76	82	88	94	102	109	116	124	133	142
CAM – 2.25%	24	26	28	30	33	35	38	40	43	46	49
State revenues	476	511	550	591	635	683	731	782	837	895	958
Individual net wage (EUR)	611	657	706	759	816	878	939	1005	1075	1150	1231
2 months – Salaries related costs (Mil. EUR)	5.1	5.3	5.5	5.7	5.9	6.1	6.5	6.8	7.2	7.6	7.9
2 months – Individual consumption (Mil. EUR)	5.3	5.5	5.7	5.9	6.1	6.3	6.7	7.0	7.4	7.8	8.1
2 months Uncollected VAT (Mil. EUR)	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5
Discount factor (r=3.5%)	1	0.97	0.93	0.90	0.87	0.84	0.81	0.79	0.76	0.73	0.71
Present values (salaries related costs + VAT)	**6.1**	**6.3**	**6.6**	**6.8**	**7.1**	**7.3**	**7.7**	**8.2**	**8.6**	**9.1**	**9.5**
6 months – Salaries related costs (Mil. EUR)	15.4	15.9	16.5	17.1	17.8	18.4	19.4	20.5	21.7	22.7	23.8
6 months – Individual consumption (Mil. EUR)	15.8	16.5	17.0	17.6	18.3	18.9	20.0	21.1	22.3	23.4	24.4
6 months Uncollected VAT (Mil. EUR)	3.0	3.1	3.2	3.3	3.5	3.6	3.8	4.0	4.2	4.4	4.6
Present values (salaries related costs + VAT)	**18.4**	**19.0**	**19.7**	**20.5**	**21.2**	**22.0**	**23.2**	**24.6**	**25.9**	**27.2**	**28.4**

Table 3. The annual budgetary impact of new lung cancer patients (2020-2030) – present values
Source: author's estimates based on Romanian National Statistics Institute and Globocan; all taxes and social contributions are maintained at 2020 rates.

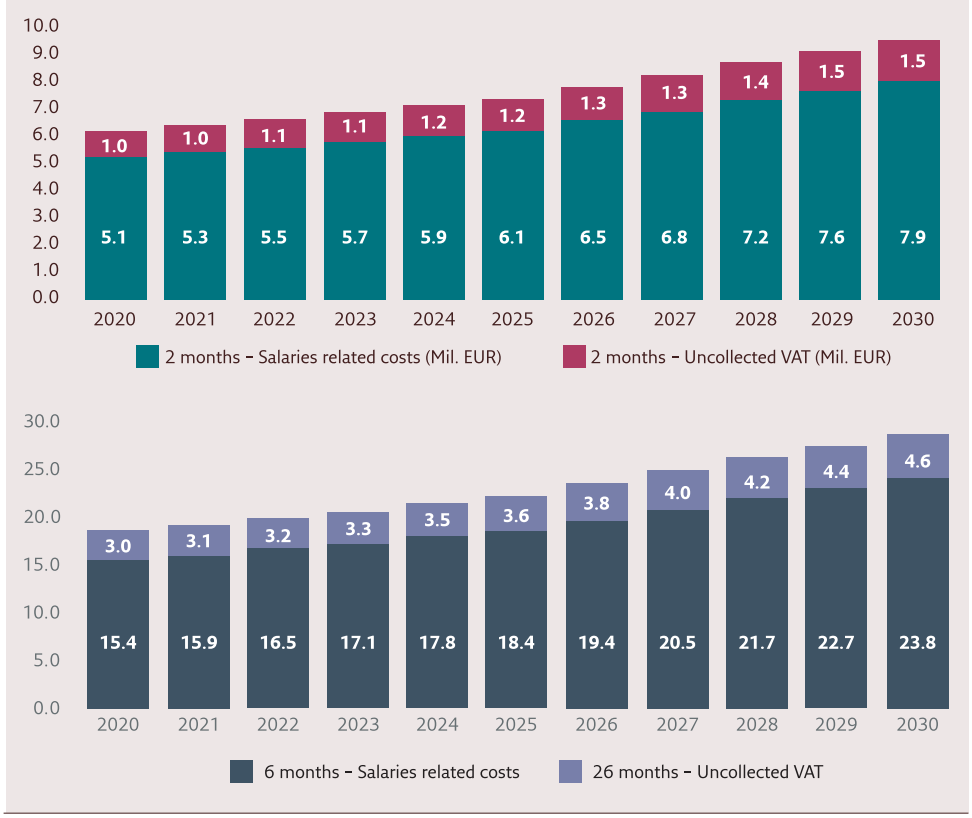

Figure 6. Uncollected taxes due two and six months of inactivity (2020-2030) – present values
Source: author's estimates based on Romanian National Statistics Institute and Globocan

BUDGETARY IMPACT OF BIOMARKER TESTING FOR LUNG CANCER PATIENTS

A systematic implementation of biomarker testing for advanced non-small-cell lung cancer (NSCLC) patient's diagnostic would increase the effectiveness of cancer treatments leading to both a higher quality of life and higher survival rates for patients, but also a lower level of losses in the national economy derived from forgone gross value added.

As the previous section showed the economic losses of every lung cancer patient in Romania is significant. As patients live longer and better, the multiplication effects of their consumption behavior, the productivity of their active age family members (i.e. spouses or children) and the fiscal revenues they could provide to the national budget by remaining partially active are all important contributions to the national economy.

In the following paragraphs we model the potential budgetary impact a biomarker testing program might have. As the data shows, the potential gains are much higher than the budgetary impact. However, in the absence of public healthcare sector capabilities for testing, national scale implementation of such a program might be unfeasible. As such, a phased approach might be necessary.

Depending on the number of biomarkers, the cost is estimated between 101 and 200 EUR, while the whole package of six biomarkers is evaluated at 850 EUR per set at market prices. These values could however be very different in a National Program for biomarker testing, given on one hand the increased cost of final price including laboratory testing, and on the other hand the discount values of en gros supply from the listing prices. Furthermore, the costs of laboratory testing are currently measured in our model based on private medical laboratory prices. If a consolidated capacity for testing is developed within the national healthcare system, these prices would be lowered by extracting the private sector mark-ups.

However, the total budgetary cost associated with lung cancer patients is estimated at around 8,8 mil. EUR (present values calculated with a discount rate of 3,5%) for the period 2020-2030 for all patients (economically active and non-active) tested for non-small-cell lung cancer (representing 85% of total lung cancer new patients). At current prices, the annual average budgetary cost for the entire period is about 9 mil. EUR (and 7,66 mil. EUR present values).

Biomarkers	Average market price (EUR)
EGFR	200
ALK	101
ROS1	127
BRAF	168
PD-L1	127
NTRK	127
Total	**850**

Table 4. Biomarkers prices
Source: average market prices

Mil. EUR	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NSCLC new cases	10304	10386	10469	10553	10637	10662	10739	10818	10894	10970	11008
NSCLC budgetary costs – final prices	8.758	8.828	8.899	8.970	9.042	9.062	9.128	9.195	9.259	9.324	9.356
PV Discount factor (r=3.5%)	1.0000	0.96618	0.93351	0.90194	0.87144	0.84197	0.81350	0.78599	0.75941	0.73373	0.70892
NSCLC budgetary costs – Present values	8.758	8.530	8.307	8.090	7.879	7.630	7.426	7.227	7.032	6.842	6.633

Table 5. Budgetary costs of biomarkers
Source: author's estimates based on Romanian National Statistics Institute and Globocan

POLICY RECOMMENDATIONS

The evidence presented in this report allows us to formulate a set of policy recommendations that cover the diagnostic and treatment process informed by biomarker testis. The economic evaluation of the relative economic impact of biomarker testing in Romania, both in terms of what they would contribute to minimize in terms of economic losses, and in terms of the potential budgetary impact of a national program suggests a very clear logic of economic efficiency.

Our estimates show that on average, the total gross-value added lost in the Romanian economy related to lung cancer prevalence in the next decade is estimated at 177 mil. EUR per year. Only the diagnostic period for lung cancer patients brings about approximately 71 mil. EUR loss in productivity and forgone fiscal revenues every year. At current prices, the annual average annual budgetary cost for biomarker testing in the case of non-small lung cancer patients is about 9 mil. EUR. Reflexive biomarker testing which could make a substantial contribution towards diminishing the economic losses incurred in the national economy in the diagnostic period of lung cancer patients.

The potential economic gains offset the estimated budgetary impact in our present modelling scenarios. As such, several aspects could and should be addressed by relevant stakeholders in Romania:

FINANCING – National Health Insurance Agency (CNAS)

The National Health Insurance Agency (CNAS) should include a dedicated subprogram for funding and testing of relevant biomarkers (i.e., EGFR, ALK, ROS1, BRAF, NTRK, PDL-1), in its National Oncology Program that it develops, implements, and funds. This would be aligned to the current European Society for Medical Oncology (ESMO) recommendations. As presented in the economic modelling results, our estimated annual budgetary impact of such a subprogram could be maximum 9 mil. EUR, while the annual losses related only to the diagnostic period of lung cancer patients and caretakers in Romania is larger than 71 mil. EUR annually.

IMPLEMENTATION – Health Ministry

The Health Ministry together with all relevant central, regional and local authorities should support the creation and/or development of a national network of reference laboratories for testing biomarkers, based on the methods recommended by the ESMO guidelines and protocols. Compliance to relevant standards of medical laboratory testing, technical proficiency, as well as cost considerations should be some of the elements covered in a structured governmental intervention deployed to raise diagnostic and treatment efficiency in lung cancer in Romania. This effort should involve both public and private sector actors that are relevant providers of medical laboratory services in Romania. Furthermore, this recommendation involves not only budgetary allocations, but also larger public investment management considerations, as new medical infrastructure capabilities should be developed in all the development regions in Romania. However, for the following period, large financial resources are available for medical infrastructure investments in Romania through the EU funded programs (e.g., National Recovery and Resilience Plan (PNRR) or the Multiannual Financial Framework (MFF 2021-20217).

AWARENESS AND EDUCATION – Professional Associations

Professional medical associations, alongside the relevant national authorities should develop a unique national biomarker testing protocol for non-small-cell lung cancer (NSCL). This would provide a common reference point for all relevant actors within and outside the medical field providing testing services or equipment for biomarker testing. Furthermore, it should be translated in broad public awareness and information programs that increase the adoption of such good practices in lung cancer diagnostic. As such, professional associations, patients' associations, universities and other organizations should develop educational projects on personalized medicine in oncology, addressed to physicians and patients, with a focus on biomarker testing best practices. Once again, EU funded programs could be used to support such public education campaigns.

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ANNEX I.

GVA loss estimates formula

$$GVAloss\ t = NP\ t * W2M\ t + St * W2M\ t + Dt * W12M\ t$$

Where:
GVA = Gross Value Added
NP = New annual patients
S = Annual Number of Survivors
D = Annual Number of Deaths
W2M = two months productivity loss
W12M = twelve months productivity loss
t = year

ANNEX II.

Estimated total number of active age lung cancer patients' distribution (per year) in Romania

	Year	2020		2021		2022		2023		2024		2025		2026		2027		2028		2029		2030		Total affected
		S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	S	D	
0	2020	5384																						5384
1	2021	2337	3047	**5375**																				10759
2	2022	1615	721	2333	3042	**5366**																		13078
3	2023	1249	366	1613	720	2329	3037	**5357**																14671
4	2024	1077	172	1247	366	1610	719	2325	3032	**5348**														15896
5	2025	996	81	1075	172	1245	365	1607	718	2321	3027	**5330**												16937
6	2026	489	507	994	81	1073	172	1243	364	1605	717	2313	3017	**5449**										18023
7	2027	167	322	488	506	993	80	1071	171	1241	364	1599	714	2365	3084	**5570**								18736
8	2028	0	167	167	321	487	505	991	80	1070	171	1237	362	1635	730	2418	3153	**5695**						19189
9	2029			0	167	166	321	486	505	989	80	1066	171	1264	371	1671	746	2471	3223	**5765**				19463
10	2030					0	166	166	320	486	504	986	80	1090	174	1292	379	1708	763	2502	3263	**5873**		19717
11	2031								166	166	320	484	502	1008	83	1114	178	1321	387	1729	772	2533	3304	14067
12	2032									0	166	165	319	495	513	1031	84	1139	182	1337	392	1751	782	8356
13	2033											0	165	169	326	506	525	1053	85	1153	184	1354	397	5918
14	2034														169	173	333	517	536	1066	86	1167	187	4233
15	2035															0	173	177	341	523	543	1080	88	2924
16	2036																	0	177	179	345	530	550	1780
17	2037																			0	179	181	349	709
18	2038																					0	181	181

New cases **S=Survivors** **D=Death**

ABOUT THE AUTHORS

Marius Geantă is President and Co-Founder of the Center for Innovation in Medicine, a non-governmental organisation based in Bucharest, Romania, focused on innovation in the healthcare sector. The aim of the Center for Innovation in Medicine is to shorten the time between the emergence of innovations in the medical sector and their application so that they can benefit patients both in Romania and elsewhere. In the context of Romanian Presidency of EU Council 2019, The Center for Innovation in Medicine proposed the vision paper "A new vision for cancer in Europe: data, technology and human touch" to be included in the EU Beating Cancer Plan. Marius Geantă is a pioneer in the field of personalised medicine in Romania and Central Eastern Europe and is involved in some pan-European innovative healthcare projects, such as Information Technology: The Future of Cancer Treatment, DigiTwins Consortium, International Consortium for Personalised Medicine, Public Health Genomics Network, PECAN, Building Blocks for Personalised Medicine. As President of the Centre for Innovation in Medicine, Marius Geantă is the coordinator of "State of Innovation in Medicine" Annual Report and the organiser of the high-level events Science meets Politicians (in partnership with Romanian Parliament) and Personalised Medicine Conference (two editions in partnership with Romanian Presidential Administration).

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