Faculty of Medicine

DETERMINANTS OF INNOVATIVE DRUGS' ADOPTION: EVIDENCE FROM LITHUANIA
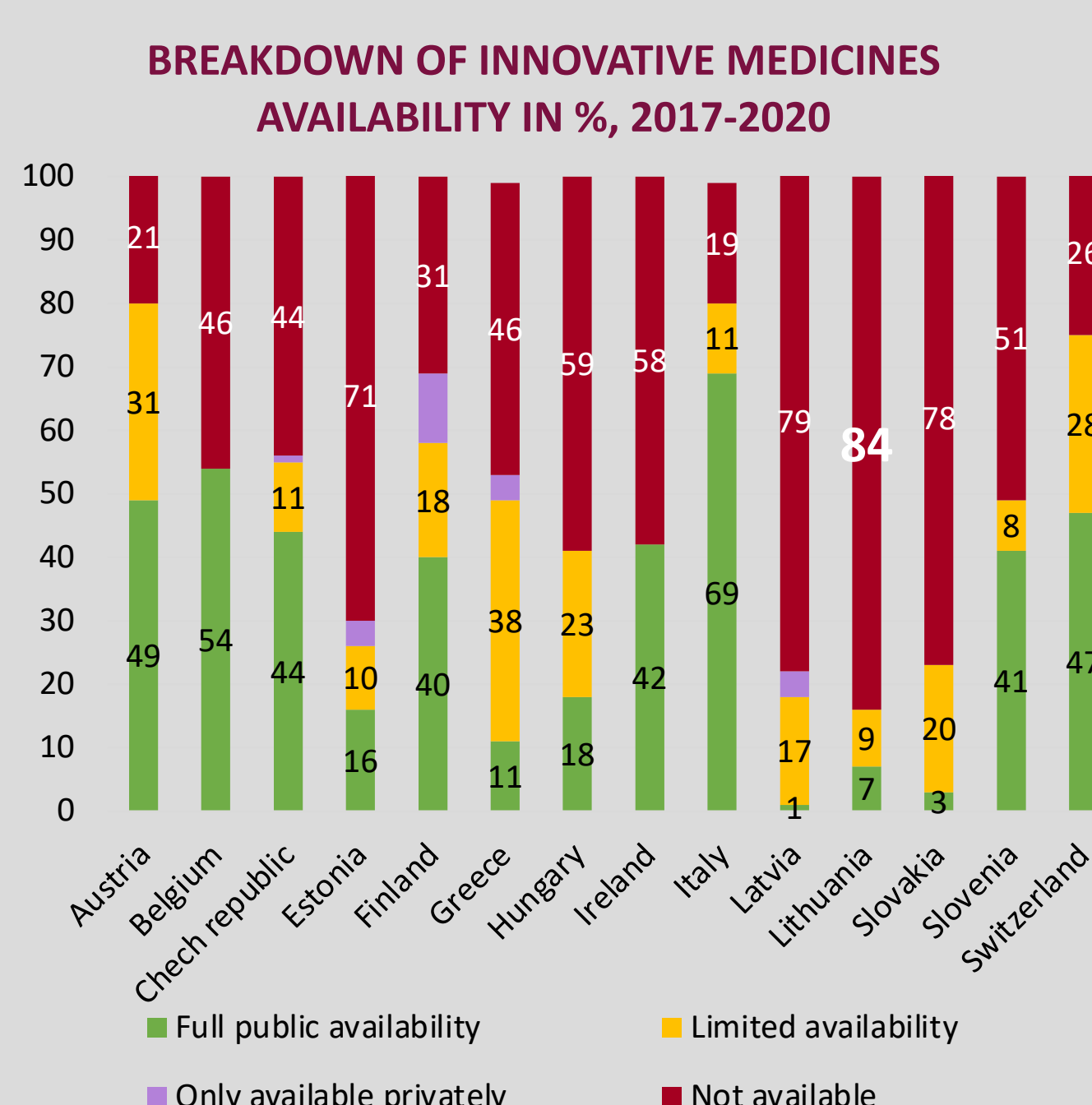
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INTRODUCTION

- At least 1/3 of medical innovations do not produce expected improvements in the population's health (Dube et al, 2014; Greenhalgh et al.,2017).
- Empirical data suggests that gender, age, and education of doctors can explain the speed of medical innovation adoption (Steffensen, Sørensen, Olesen, 1999; Tamblyn et al., 2003 Bourke, Roper, 2012; Méndez, Scott, Zhang, 2021).
- Some research shows that women, older male physicians, and those with lower overall prescription rates tend to adopt innovations later. (Steffensen et al.,1999; Tamblyn et al., 2003; Bourke and Stephen, 2011).
- Data also suggests the influence of rural vs. urban and multidisciplinary vs. single–practice determinants on innovative drugs' adoption by doctors (Heinrich and Cummings, 2014).
- Continuously rising healthcare expenditure makes it very important to understand the factors determining the speed and scope of innovation adoption by healthcare professionals.

BREAKDOWN OF INNOVATIVE MEDICINES AVAILABILITY IN %, 2017-2020

Full public availability | Limited availability
Only available privately | Not available

Source: Efpia W.A.I.T. report, 2022

DATA

DATA: Lithuanian data for the period of 2018-2021
NEWLY DIAGNOSED PATIENTS (with diagnosis codes used to prescribe the analyzed innovative drugs): 945020
NUMBER OF UNIQUE DOCTORS vs. NUMBER OF PRESCRIPTIONS: 698 / 2058
NUMBER OF HEALTHCARE INSTITUTIONS vs. LOCATIONS: 174 / 53
OTHER STATISTICS:

Innovative drug	Disease group description	Year(s) of prescription	Total Prescriptions	Newly diagnosed patients during the year(s) of prescriptions
Durvalumab	Oncology	2020-2021	23	11078
Abemaciclib		2021	119	30205
Apalutamide		2021	12	28428
Emicizumab	Hemophilia A	2019-2021	75	528
Ertugliflozin	Type 2 diabetes	2019-2021	46	564718
Ocrelizumab	Multiple Sclerosis	2019-2021	162	12509
Erenumab, Fremanezumab	Migraine	2020-2021	1369	85360
Benralizumab	Asthma	2019-2021	175	198872
Upadacitinib	Rheumatic arthritis	2021	83	13322

	100k & more	10 k & more	Less than 10k
Prescriptions per location / total locations	4/4	22/25	27/74

Clinical institution	Total prescrip.	Drugs prescribed
Kaunas' clinics	483	all 10 drugs
Santaros' clinics	235	all 10 drugs
Kardiolita*	121	erenumab, fremanezumab,
Klaipeda university hospital	66	benralizumab, erenumab, fremanezumab, ocrelizumab, upadacitinib
Siauliai national hospital	57	abemaciclib, durvalumab, erenumab, fremanezumab, ocrelizumab, upadacitinib

*The only private clinic among the top 5 institutions by the numbers of prescriptions in the dataset

HYPOTHESES, AIM & QUESTIONS

THE HYPOTHESES:
I. Government's speed to include innovative drugs into the compensated drugs' list determines the speed of innovative drugs' adoption by doctors.
II. Higher priced drugs are adopted more slowly than cheaper drugs.
III. Younger male doctors with specialty license are faster in adopting innovative drugs than other doctors.

THE AIM:
To examine the impact of institutional factors, price, demographic and professional characteristics of doctors on the speed of innovative drugs' adoption on the microlevel.

THE RESEARCH QUESTIONS:
What are the determinants of the speed of innovation dissemination in clinical practice once it becomes available for doctors to prescribe?
a. Do demographic and professional characteristics of the doctor impact doctors' prescription speed of innovative drugs after the first registration date?
b. Does price affect the uptake of innovation?
c. Does the inclusion of the drug into the compensated drugs' list increase the innovative drug prescription probability?
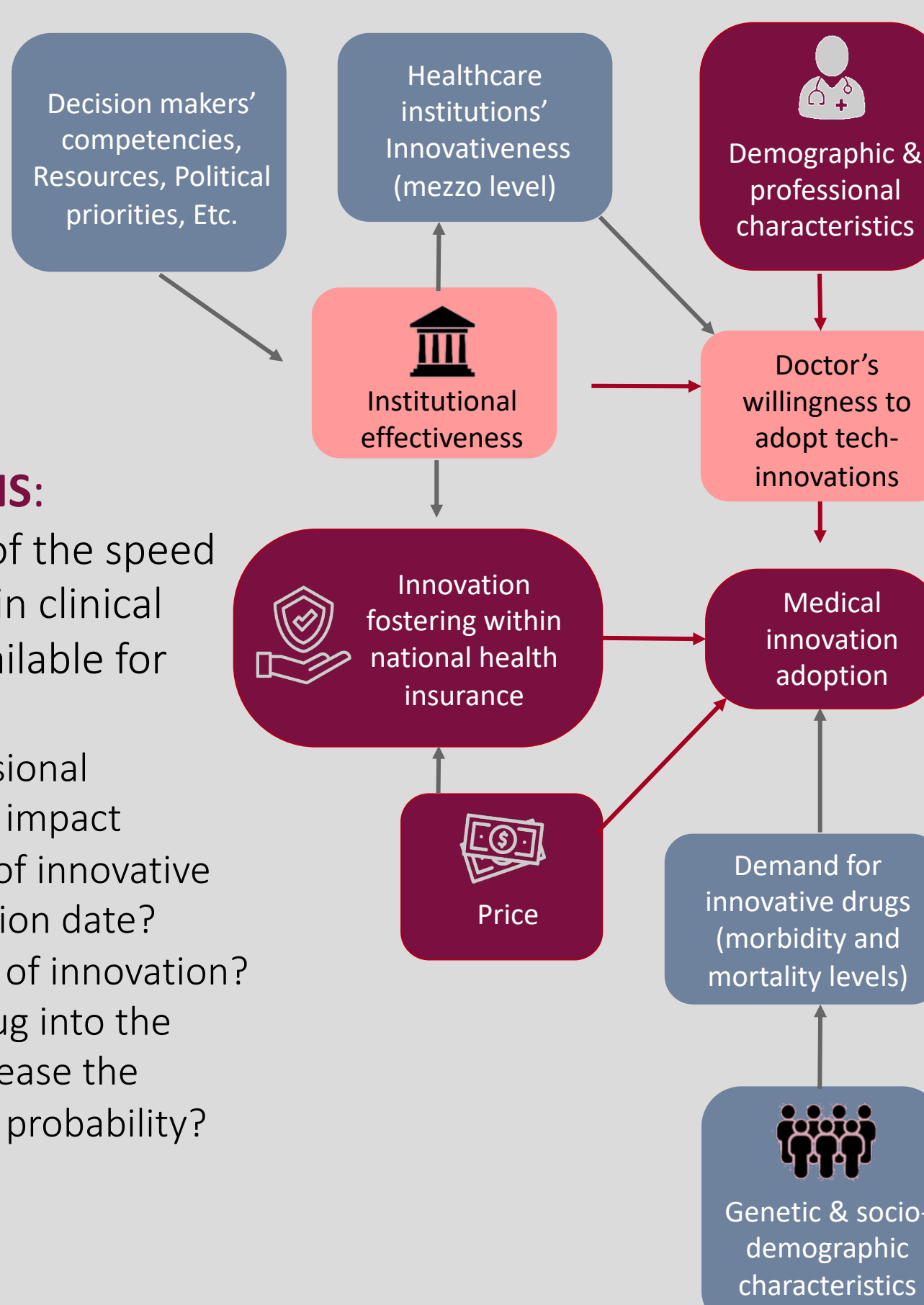
METHODOLOGY

MODEL
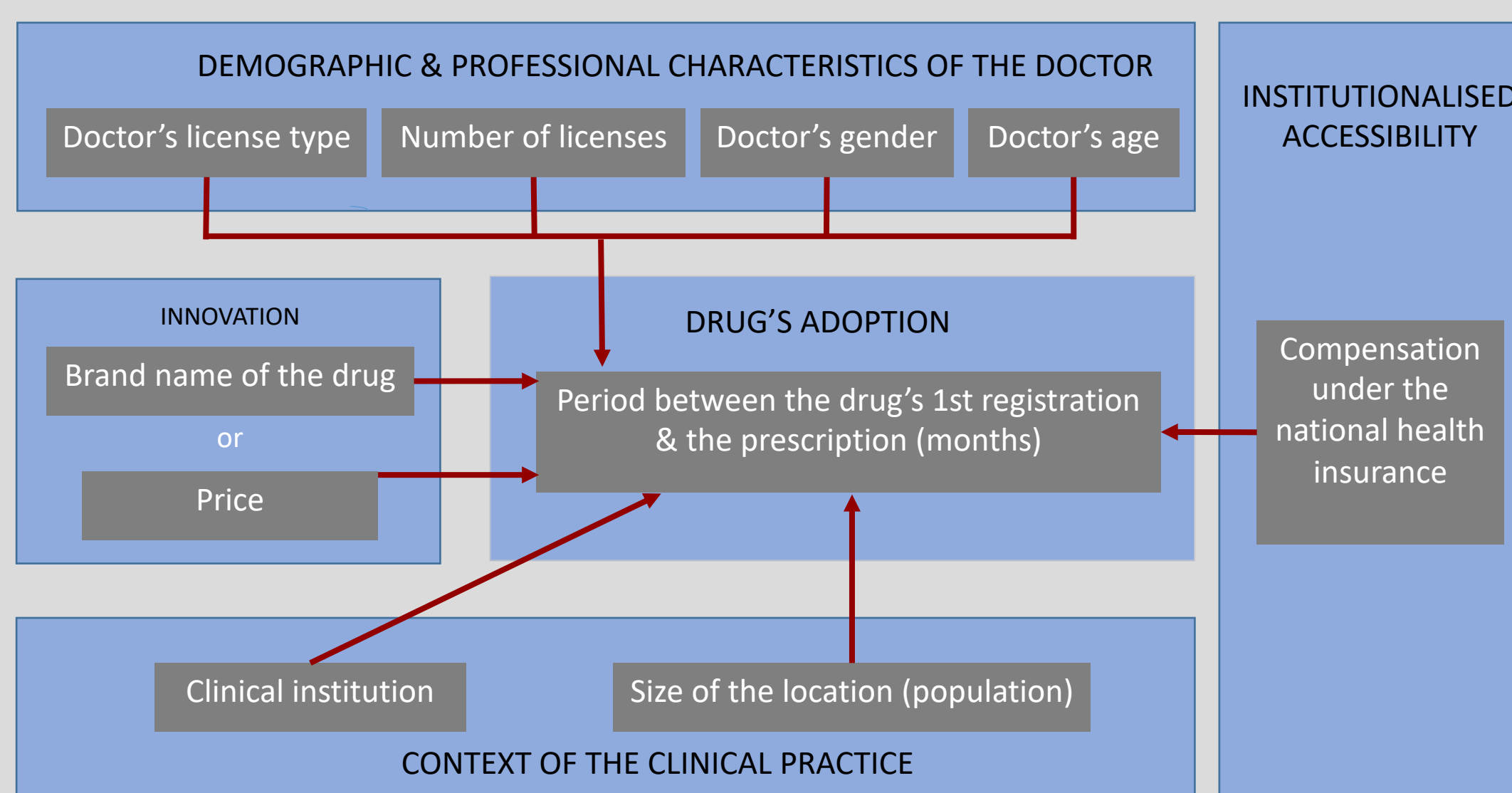
VARIABLES: National prescription data for 10 innovative drugs from 2018 to 2021, along with prescribers' demographic and professional traits like gender, age, specialty, and practice location.

THE ECONOMETRIC EQUATION of speed of innovation uptake (time between the first registration of the drug and the first prescription for it by each doctor, OLS):

$$\ln(\ln_{prp}) = \beta_0 + \beta_1 * age + \beta_2 * sq_{age} + \beta_3 * female + \beta_4 * family_{lic} + \beta_5 * spec_{family\;lic} + \beta_6 * no_{full\;lic} + \beta_7 * lic_{quant} + \beta_8 * over10_{inhab} + \beta_9 * less10k_{inhab} + \beta_{10} * abemaciclib + \beta_{11} * apalutmide + \beta_{12} * durvalumab + \beta_{13} * emicizumab + \beta_{14} * erenumab + \beta_{15} * frenezumab + \beta_{16} * ocrelizumab + \beta_{17} * upadacitinib + \beta_{18} * benralizumab + \beta_{19} * pac + \varepsilon \quad [1]$$

And

$$\ln(\ln_{prp}) = \beta_0 + \beta_1 * age + \beta_2 * sq_{age} + \beta_3 * female + \beta_4 * family_{lic} + \beta_5 * spec_{family\;lic} + \beta_6 * no_{full\;lic} + \beta_7 * lic_{quant} + \beta_8 * over10_{inhab} + \beta_9 * less10k_{inhab} + \beta_{10} * price + \beta_{19} * pac + \varepsilon \quad [2]$$

β_0 represents intercept (value of $\ln\_prp$ when all dependent variables equal 0)
$\beta_1, \beta_2.. \beta_n$ represent regression coefficients for the independent variables
ε represents error term

RESULTS

Hypothesis	Findings	Result
I.	Inclusion of the drug into the compensated drugs' list has a significant impact on the probability of the prescription on the innovative drug.	Accepted
II.	Both descriptive and regression analysis confirmed that price has an impact on the speed of innovative drugs' adoption.	Accepted
III.	Doctors with specialty license are faster to adopt innovative drugs. However, the significance of the doctor's age was confirmed only in one of the analysis and indicated that doctors in their 50's are faster to adopt innovative drugs compared to younger doctors	Partially accepted

PRESCRIPTIONS BEFORE & AFTER THE INCLUSION & THE AVERAGE DRUG PRICE DURING THE PERIOD OF 2018-2021*

Drug	Period before reimburs., months	No of prescr. before reimb.	No of prescr. after reimb.	Average drug price, Eur
Abemaciclib	29	0	120	1632
Apalutamide	35	0	12	3008
Benralizumab	45	8	167	1994
Durvalumab	35	0	23	616
Emicizumab	45	2	73	2271
Erenumab	39	8	970	418
Ertugliflozin	31	7	39	32
Fremanezumab	31	26	368	419
Ocrelizumab	37	11	167	5093
Upadacitinib	23	0	83	625

*Doctors in top 5 largest cities have issued 78% of all prescriptions for the innovative drugs during that period.

IMPACT COEFFICIENT ESTIMATES FOR STATISTICALLY SIGNIFICANT RESULTS

	10 drugs (9 drugs against ertugliflozin)	9 drugs (8 drugs against ertugliflozin)	10 drugs (price)	9 drugs (price)
# of Observations	1778	1669	1778	1669
	Coefficient	Coefficient	Coefficient	Coefficient
Const	2.9***	2.98***	3.2***	3.3***
Age			−0.006**	−0.009***
sq_age			0.00006**	0.0008***
Female				
Lic_quant			−0.08**	−0.09***
Family_lic	0.04***	0.04***	0.06***	0.05***
Spec_family_lic			0.13***	0.15***
No_full_lic	0.08***	0.08***	0.11***	0.12***
over10k_inhab				
less10k_inhab				
abemaciclib	0.25***	0.25***		
apalutamide	0.21***	0.22***		
benralizumab	0.31***	0.31***		
durvalumab	0.16***	0.17***		
emicizumab	0.22***	0.22***		
erenumab	0.22***	0.22***		
fremanezumab	0.1***	0.11***		
ocrelizumab	0.26***			
upadacitinib	−0.22***	−0.22***		
pac	0.42***	0.37***	0.44***	0.39***
Price			0.00003***	0.00008***

	3 cheapest drugs	3 most expensive drugs
# of Observations	1276	166
	Coefficient	Coefficient
Const	3.1***	2.5***
Age	−0.006**	
sq_Age	0.00006**	
Lic_quant		
Family_lic	0.05***	
No_full_lic	0.16***	
Spec_family_lic		
Price	0.0005***	0,00003**
pac	0.34***	0.65***

INSIGHTS

DEMOGRAPHIC & PROFESSIONAL CHARACTERISTICS
- Doctors in the two largest cities- Vilnius and Kaunas- prescribed almost 63% of all 10 innovative drugs from 2018 to 2021, followed by other 3 cities, covering almost all remaining prescriptions (out of 352 cities and towns in Lithuania).
- No doctors' gender impact was captured for the speed of technological innovation adoption.
- Doctors in their 50s were the fastest in innovative drug adoption in Lithuania.
- The results strongly suggest doctors' reliance on the professional networks and the importance of personal experience in determine their willingness to adopt innovative drugs. Further research is needed to validate these insights.

PRICE & GOVERNMENT
- Higher prices delay drugs' adoption. The research reveals embedded institutional patterns to delay the adoption of expensive innovative drugs.
- The drug's compensation status has a significant impact on the innovative drug's uptake by doctors, with a coefficient reaching 0.65.

DRAWBACKS & RECOMMENDATIONS FOR FURTHER RESEARCH
Social and demographic factors of patients could not be considered due to national limitations in access at the time of the data collection.
Qualitative study of the results would provide additional information on the interplay of institutional and personal factors in adoption of innovative drugs in Lithuania.
Further research would benefit from the inclusion of:
- Data on other prescriptions for the same patients by the same doctors;
- Patients' health data.
Replication of the model using similar data from other countries could help to:
- Identify universal patterns and differences behind technological innovation dissemination in national healthcare systems;
- Understand the interdependencies of innovation diffusion process on the micro and meso levels.

REFERENCES

Bourke, J., & Roper, S. (2012). In with the new: The determinants of prescribing innovation by general practitioners in ireland. *The European Journal of Health Economics : HEPAC : Health Economics in Prevention and Care, 13*(4), 393-407. 10.1007/s10198-011-0311-5

Dubé, L., Jha, S., Faber, A., Struben, J., London, T., Mohapatra, A., Drager, N., Lannon, C., Joshi, P. K., & McDermott, J. (2014). Convergent innovation for sustainable economic growth and affordable universal health care: Innovating the way we innovate. *Annals of the New York Academy of Sciences, 1331*, 119-141. 10.1111/nyas.12548

EFPIA Patients W.A.I.T. Indicator 2021 Survey (2022.07). EFPIA. https://www.efpia.eu/media/676539/efpia-patient-wait-indicator_update-july-2022_final.pdf

Goldman, D. P., Shang, B., Bhattacharya, J., Garber, A. M., Hurd, M., Joyce, G. F., Lakdawalla, D. N., Panis, C., & Shekelle, P. G. (2005). Consequences of health trends and medical innovation for the future elderly. *Health Affairs (Project Hope), 24 Suppl 2*(Suppl 2), W5R5-17. 10.1377/hlthaff.w5.r5

Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., A'Court, C., Hinder, S., Fahy, N., Procter, R., & Shaw, S. (2017). Beyond adoption: A new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *Journal of Medical Internet Research, 19*(11), e367. 10.2196/jmir.8775

Greving, J. P., Denig, P., van der Veen, W. J., Beltman, F. W., Sturkenboom, M. C. J. M., & Haaijer-Ruskamp, F. M. (2006). Determinants for the adoption of angiotensin II receptor blockers by general practitioners. Social Science & Medicine (1982), 63(11), 2890-2898. 10.1016/j.socscimed.2006.07.019

Heinrich, C. J., & Cummings, G. R. (2014). Adoption and diffusion of evidence-based addiction medications in substance abuse treatment. Health Services Research, 49(1), 127-152. 10.1111/1475-6773.12093

Kozyrskyj, A., Raymond, C., & Racher, A. (2007). Characterizing early prescribers of newly marketed drugs in canada: A population-based study. European Journal of Clinical Pharmacology, 63(6), 597-604. 10.1007/s00228-007-0277-5

Méndez, S. J., Scott, A., & Zhang, Y. (2021). Gender differences in physician decisions to adopt new prescription drugs. Social Science & Medicine, 277, 113886. 10.1016/j.socscimed.2021.113886

Steffensen, F. H., Sørensen, H. T., & Olesen, F. (1999). Diffusion of new drugs in Danish general practice. Family Practice, 16(4), 407-413. 10.1093/fampra/16.4.407

Tamblyn, R., McLeod, P., Hanley, J. A., Girard, N., & Hurley, J. (2003). Physician and practice characteristics associated with the early utilization of new prescription drugs. Medical Care, 41(8), 895-908. http://www.jstor.org/stable/3768086