

# Untitled

Thomas Fischer

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# Introduction

# NRP - Overview

- ▶ Conducted by Swiss Diabetes Registry
- ▶ Longitudinal cohort study of Diabetes patients
- ▶ Ran from 2002 to 2012
- ▶ Intervention: tailored treatment guidelines for Diabetes patients
- ▶ Outcomes:
  - ▶ Healthcare accessibility and delivery (RQ1)
  - ▶ Individual and population health (RQ2)
  - ▶ Health care system outcomes and variation in care (RQ3)

## NRP - Intervention assignment regions

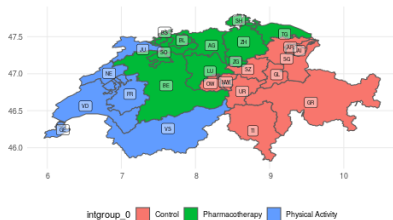


Figure 1: Treatment allocations

# Project responsibilities

- ▶ Andre Moser (Course administrator)
- ▶ Joël Meili (Project leader, RQ1)
- ▶ Xijin Chen (RQ2)
- ▶ Thomas Fischer (RQ3)

Healthcare accessibility and delivery (RQ1)

What are the positive and negative effects of the treatment protocol related to access and delivery of Diabetes care?

- ▶ First, establish a definition of access and delivery of health care
- ▶ Second, formulation of possible hypotheses
- ▶ Third, use the provided data set to analyze and try to evaluate the proposed hypotheses

# Access to Diabetes care

We used the five dimensions of health care that were proposed in the lecture where:

- ▶ **Availability:** is the relationship between supply and demand for health care services
- ▶ **Accessibility:** is the geographical proximity to health care providers
- ▶ **Accommodation:** is the relationship between how health care services are organized and the client's ability to accommodate these factors.
- ▶ **Affordability:** is the costs of health care services and the ability of a patient to cover
- ▶ **Acceptability:** is the patient's attitude towards the perceived characteristics of an intervention



## Delivery of Diabetes care

We used adherence to treatment guidelines as the definition to delivery of Diabetes care. In this example the NRP used an overall guideline score, which consists of the accrual of the following parameters:

- ▶ **HBA1C level <53 mmol/mol:** 12 points
- ▶ **HBA1C level <64 mmol/mol:** 8 points
- ▶ **HBA1C level <75 mmol/mol:** 5 points
- ▶ **three GP visits per year:** 10 points
- ▶ **physical activity:** 5 points
- ▶ **stop smoking:** 5 points

## Formulation of hypotheses - Access to Diabetes care

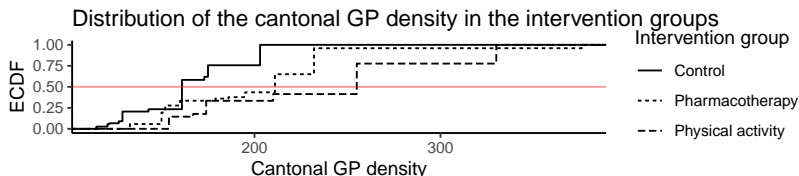
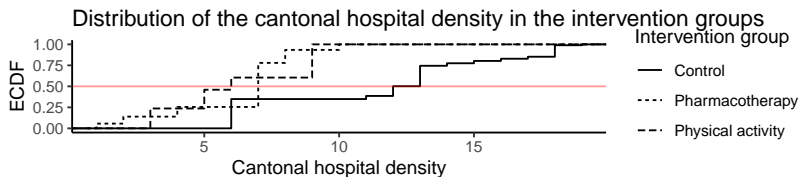
- ▶ The provided data only allowed for the analysis of the dimension of accessibility and affordability
- ▶ There was no data to analyze the development of the accessibility
  - ▶ Assumption: number of hospitals and GPs stayed relatively constant (short follow-up period)
- ▶ As there is intensified use of Metformin in the pharmacotherapy group we could expect that the affordability of Diabetes care is decreased as the costs increase
- ▶ Further, we thought that as the treatment groups receive additional recommendations regarding their health, we could expect that patients in the intervention groups are more health literate compared to control

## Formulation of hypotheses - Delivery of Diabetes care

- ▶ We expect the overall adherence to guidelines score to be increased in the intervention groups compared to control as the additional, specialized treatment should increase their overall well-being

## Analysis and results - Accessibility

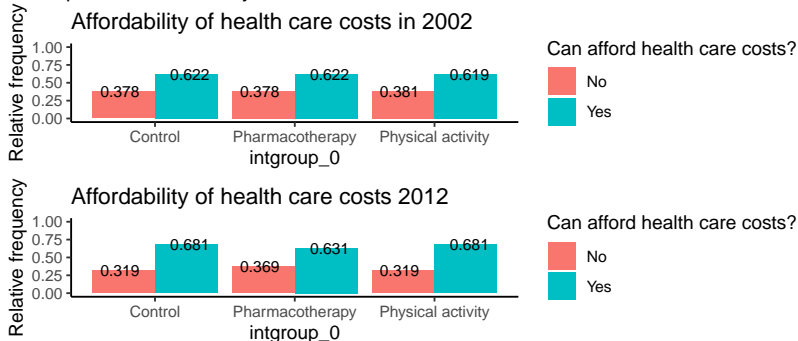
- ▶ The following figure shows that the accessibility to hospitals was larger in the control group than in the intervention groups
- ▶ However, the accessibility to GPs is larger in the intervention groups than in the control group
- ▶ We assume that the intervention groups were chosen in that manner to observe a strong effect in the intervention groups



## Analysis and results - Affordability

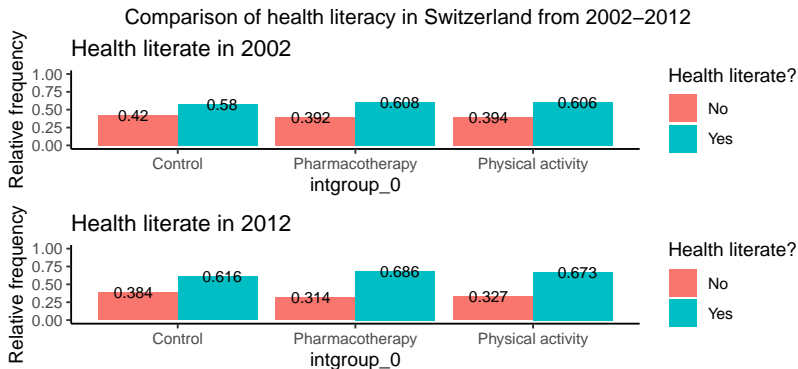
- ▶ We can see that the overall affordability of health care costs has increased from 2002 to 2012 in all three treatment groups
- ▶ Further, the proportional increase in the pharmacotherapy group is not as large as in the other two treatment groups
- ▶ As the affordability has also increased in the control group, we cannot conclude that the treatment protocol had a positive effect on the affordability of health care costs

Comparison of the ability to afford health care costs in Switzerland from 2002–2012



# Analysis and results - Health literacy A

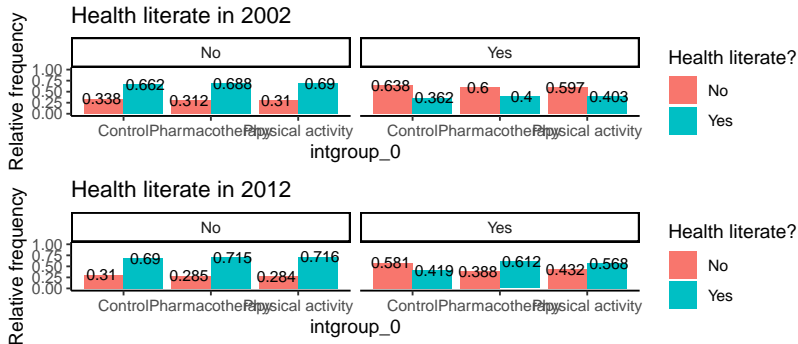
- ▶ We can see that the overall health literacy has improved in all three treatment groups
- ▶ However, the proportional growth is not as large in the control group as was to be expected



# Analysis and results - Health literacy B

- ▶ Further analysis shows that the treatment protocol was especially efficacious in persons with migration background
- ▶ We assume that they were not able to get proper treatment and that the additional recommendations have really helped those to improve their well-being who were not aware of additional treatment

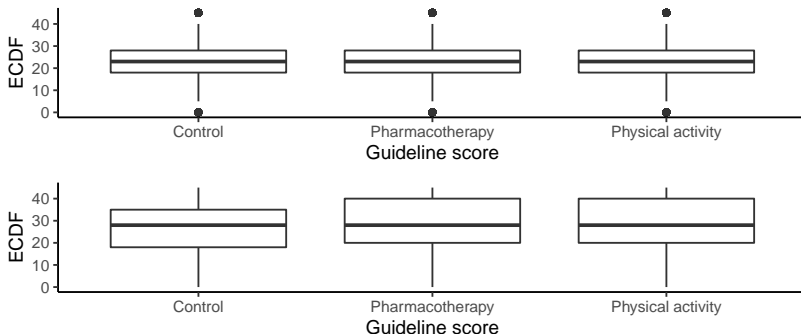
Comparison of health literacy in Switzerland from 2002–2012



## Analysis and results - Delivery

- ▶ The figure shows that the overall adherence has increased for all three treatment groups
- ▶ The assumed difference between the treatment group however is not substantial
- ▶ We assume that because of the information era that we are living in now, people live generally healthier now than in 2002

Comparison of adherence treatment guidelines in Switzerland from 2002–2012





# Conclusion

- ▶ We found it difficult to assess if the treatment protocol had a positive or negative influence on the access and delivery of Diabetes care
- ▶ We also think that it is probably difficult in general to measure variables that really contribute to the subject, especially in only 10 year-follow up period

Individual and population health (RQ2)

# Introduction

# Discussion

- ▶ Clinical guidelines intend to improve the quality of care.
- ▶ Can also introduce economic inefficiencies, and invite over-use.
- ▶ Signs of overtreatment than undertreated for diabetes.
- ▶ Guidelines need to be designed based on substantial evidence

Over-treatment can be defined as an unnecessary or over-use of treatment. It may lead to potential patient harms and excessive costs in health care. In this project, we have noticed that the use of intensive Glycemic control, Metformin has no positive result for patients, in terms of health-related quality of life, while the problem of adverse events is a big issue. The problem on the cost is also obvious. Alternatively, physical activities are more recommended in terms of clinical efficiency.

Health care system outcomes and variation in  
care (RQ3)

# Introduction

# Method

- ▶ Exploratory data analysis
- ▶ A linear regression model was used to estimate the intervention effect on QALY
- ▶ A log-linear regression model was used to estimate the intervention effect on cost per QALY
- ▶ Variability in care was evaluated graphically.

## Results - Observations from data analysis

- ▶ Intuition: inpatient treatments are expensive. Costs should therefore increase substantially with each hospitalisation
- ▶ In practice: cumulative costs were surprisingly low for some patients with comorbidities in 2002 and with CVD.
- ▶ This did not occur for patients without comorbidities in 2002 and with CVD
- ▶ This was still the case after removing data from patients who died between follow-ups
- ▶ There were no observable differences between the intervention regions
- ▶ Indication for the existence of a (unknown to us) source of variation



# Results - Quality of care

	Model 1	Model 2	Model 3	Model 4
(Intercept)	5.317*** (0.019)	5.291*** (0.020)	-0.709*** (0.014)	5.394*** (0.010)
age65_0>= 65 years	-1.009*** (0.007)	-1.009*** (0.007)	-0.562*** (0.003)	-0.575*** (0.003)
female_0Female	0.076*** (0.006)	0.076*** (0.006)	-0.000 (0.003)	-0.000 (0.003)
pa_0Moderate-High	1.111*** (0.007)	1.112*** (0.007)	1.082*** (0.003)	1.121*** (0.003)
metformin_0Yes	-0.192*** (0.007)	-0.192*** (0.007)	-0.205*** (0.003)	-0.211*** (0.003)
comorb1_0Yes	0.015* (0.007)	0.015* (0.007)	0.024*** (0.003)	0.025*** (0.004)
hrqol_0	1.492*** (0.028)	1.493*** (0.028)	1.451*** (0.013)	1.460*** (0.014)
intgroup_0Pharmacotherapy		0.001 (0.008)	-0.001 (0.004)	-0.001 (0.004)
intgroup_0Physical Activity		0.090*** (0.009)	0.083*** (0.004)	0.085*** (0.004)
obstime			0.612*** (0.001)	
R <sup>2</sup>	0.475	0.476	0.887	0.761
Adj. R <sup>2</sup>	0.475	0.476	0.887	0.761
Num. obs.	102949	102949	102949	96604
RMSE	0.945	0.944	0.439	0.437

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$

Table 1: Statistical models

## Results - Quality of care

- ▶ Strong evidence for a negative association between the age and metformin treatments with QALY
- ▶ Effect is effectively outbalanced by physical activity and baseline health-related quality of life
- ▶ Strong evidence for a positive effect of physical activity protocol, but questionable practical significance
- ▶ No evidence for any effect of pharmacotherapy protocol on QALY.
- ▶ Effect estimates stable for different model specifications (adjusting for obstime, excluding dead patients)

# Results - Cost-effectiveness of care

	Model 1	Model 2	Model 3
(Intercept)	7.176*** (0.007)	7.140*** (0.011)	6.593*** (0.007)
age65_0>= 65 years	0.204*** (0.009)	0.204*** (0.009)	0.139*** (0.005)
pa_0Moderate-High	-0.301*** (0.008)	-0.301*** (0.008)	-0.106*** (0.005)
comorb1_0Yes	0.003 (0.016)	0.004 (0.016)	-0.591*** (0.010)
gastroad_0Yes	0.002 (0.017)	0.003 (0.017)	0.536*** (0.011)
deathYes	-0.505*** (0.015)	-0.505*** (0.015)	-0.259*** (0.009)
metformin_0Yes	0.206*** (0.010)	0.206*** (0.010)	0.214*** (0.006)
hrqolcat_0Yes	-0.036*** (0.010)	-0.036*** (0.010)	-0.028*** (0.006)
intgroup_0Pharmacotherapy		0.037*** (0.010)	0.042*** (0.006)
intgroup_0Physical Activity		0.056*** (0.011)	0.060*** (0.007)
log(hosp + 1)			2.824*** (0.007)
R <sup>2</sup>	0.042	0.043	0.646
Adj. R <sup>2</sup>	0.042	0.043	0.646
Num. obs.	102949	102949	102949
RMSE	1.149	1.149	0.699

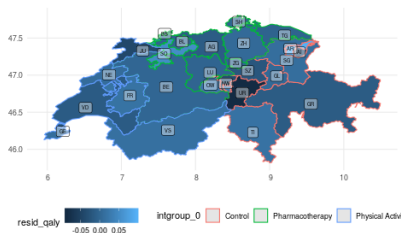
\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$

Table 2: Statistical models

## Results - Cost-effectiveness of care

- ▶ log-linear model: coefficients not as straightforward to interpret (Potential limitation of this approach)
- ▶ Costs per qaly increase with age and metformin treatment, and decrease with physical activity and baseline HrQOL

## Results - Variation in care



## Results - Variation in care

- ▶ Quality of health-care appears to be higher in french-speaking cantons
- ▶ QALY was higher than expected in Appenzell-Ausserrhoden
- ▶ QALY was lower than expected in Uri

## Results - Variation in care

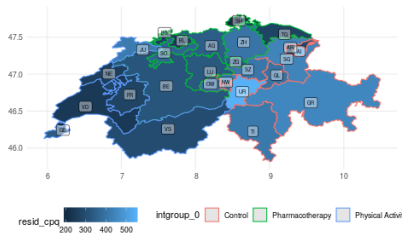


Figure 3: Average residual CPQ

## Results - Variation in care

- ▶ Predicted cost per QALY was closest to the truth in french-speaking cantons (except Jura), Schaffhausen, Basel, Thurgau, and Appenzell Ausserrhoden.
- ▶ Jura, Uri, and Appenzell-Innerrhoden had larger CPQ on average than predicted by our model.

## Discussion - Health care outcomes

- ▶ The physical activity protocol was the most beneficial in terms of QALY
- ▶ The pharmacotherapy protocol did not yield a significant benefit compared to the control.
- ▶ Both treatment protocols were less cost-effective than the control (increased costs per QALY).
- ▶ Results are in line with those of similar studies (such as Herman [2015]).
- ▶ Hospdens marginally significant for QALY, and no evidence for an effect on cost per QALY.



## Discussion - Variation in care

- ▶ Some cantons performed worse *ceteris paribus* than their peers
- ▶ Canton Uri had worse QALY and CPQ on average than we would have expected based on our results.
- ▶ Large difference between Appenzell-Innerrhoden and Ausserrhoden
- ▶ Results could indicate that intercantonal competition is also a factor.

## Discussion - Limitations

- ▶ Lack of randomization: interventions assigned to patients by canton of residence. Hence, our results are only observational
- ▶ Lack of information about medical history of individual patients (potentially to protect patient privacy).
- ▶ Relatively long follow-up time may be appropriate to study properties of the health care system, but much can change in 10 years for a patient.

## Discussion - Implications of findings

- ▶ Cost-benefit analysis indicates that neither treatment protocol should be implemented from an economic perspective
- ▶ However: substantial increase in QALY for physical activity group
- ▶ Future research should explore the effectiveness of physical activity protocol in a randomized trial / N-of-1 trials

William Herman. The cost-effectiveness of diabetes prevention: results from the diabetes prevention program and the diabetes prevention program outcomes study. *Clinical Diabetes and Endocrinology*, 2015.