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# Identification of influenza urban transmission patterns by geographical, epidemiological and whole genome sequencing data: Study protocol.

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**Abstract (words 281):**

*Introduction*: Urban transmission patterns of influenza viruses are complex and poorly understood, and multiple factors may play a critical role in modifying transmission. Whole genome sequencing (WGS) allows the description of patient-to-patient transmissions at highest resolution. The aim of this study is to explore urban transmission patterns of influenza viruses in high detail by combining geographical, epidemiological, and immunological data with WGS data.

*Methods and Analysis*: The study is performed at the University Hospital Basel, University Children's Hospital Basel, and a network of pediatricians and family doctors in the Canton of Basel-City, Switzerland. The retrospective study part includes an analysis of PCR-confirmed influenza cases from 2013 to 2018. The prospective study parts include (i) a household survey regarding influenza-like illness (ILI) and vaccination against influenza during the 2015/2016 season; (ii) an analysis of influenza viruses collected during the 2016/2017 season using WGS - viral genomic sequences are compared to determine genetic relatedness and transmissions; and (iii) measurement of influenza-specific antibody titers against all vaccinated and circulated strains during the 2016/2017 season from healthy individuals, allowing to monitor herd immunity across urban quarters. Survey data and PCR-confirmed cases are linked to data from the Statistics Office of the Canton Basel-City and visualized using geo-information-system (GIS) mapping. WGS data will be analyzed in the context of patient epidemiological data using phylodynamic analyses, and the obtained herd immunity for each quarter.

Profound knowledge on the key geographical, epidemiological and immunological factors influencing urban influenza transmission will help to develop effective counter measurements.

*Ethics and dissemination*: The study is registered (clinicaltrials.gov; NCT03010007 on 22nd December 2016) and approved by the regional ethics committee as an observational study (EKNZ project ID 2015–363 and 2016-01735). It is planed to present the results at conferences and publish the data in scientific journals.

**Strength and limitations:**

- **Strength:**
  - To date largest study on influenza transmission in a city
  - high resolution and granularity of demographic, epidemiological and geographical data
  - linkage of multiple dataset
  - analysis over several consecutive years
- **Limitations:**
  - not all Influenza infections can be captured in a study
  - survey may introduce bias: selection of the population replied
  - antibody titers only covers a part of the city

## Introduction (words: 4234)

Seasonal influenza is associated with substantial morbidity, mortality, and healthcare costs. Transmission of influenza has been explored with various methods and techniques (1-3). Whole genome sequencing (WGS) has the highest possible technical resolution for molecular typing of viruses and is increasingly used to understand and monitor transmission events of influenza viruses. Recently, WGS technology helped to explore important aspects of transmissions within households (4), hospitals (5-7), university campuses (8), and between countries (9). However, most studies lack crucial details on the epidemiological and demographic context of the infected patients and therefore cannot provide sufficient in-depth knowledge on risk factors for and pathways of transmission. Understanding pathogen transmission from patient-to-patient, especially within the urban context, may inform public health interventions targeting specific transmission chains.

Urban transmission clusters have not yet been explored in detail. The impact of host and environment factors within a city may greatly vary depending of the scale e.g. direct person-to-person, within an urban quarter, within and between countries, and around the globe. Within cities, multiple factors may entertain transmission, such as population densities, available living space per person, usage of public transport, social economic structures and behaviors, age, vaccine rates, and herd immunity. Urban quarters often vary greatly in some of those factors. Therefore, the differences accumulating within urban quarters may allow us to study the impact of geographical, social and demographic factors in the context of urban transmission of influenza. So far, only a few epidemiological studies have conceptualized these “geographic area” variables for influenza focused transmission and vaccine research (10-14).

Combining detailed population related data with high-resolution WGS-based typing of influenza viruses may allow us to profoundly understand factors entertaining urban influenza transmission within the microenvironments of a city. Based on the generated knowledge, targeted public health policies can be informed. Furthermore, these findings may also be translated to other transmissible diseases. In this article, we describe in detail the study design of a three-year research project funded by the Swiss National Science Foundation (www.snsf.ch) to explore urban influenza transmission.

## Aims and objectives

The main objective of this project is to explore the transmission patterns of influenza within a city. Geographical, epidemiological, microbiological, and immunological factors are analyzed to explain urban transmission patterns.

The *specific aims of the retrospective study* parts are:

- Analyzing PCR-confirmed influenza cases (seasons 2013/2014 to 2017/2018)
  - (i) Accessing PCR-confirmed influenza cases from various institutions across Basel.
  - (ii) Visualizing the frequency and spread of incidences with the help of point pattern and other analytical techniques including georeferencing individual cases.
  - (iii) Analysis of influenza cases by mapping incidences with demographic data from the Statistical Office of the Canton Basel-City.

The *specific aims of the prospective study* parts are:

- Household survey (season 2015/2016)
  (i) Conducting household surveys within 10 urban quarters.
  (ii) Determination of the influenza like illness (ILI) rate on individual and urban quarters levels, and exploring factors associated with ILI.
  (iii) Determination of influenza vaccine rate on individual and urban quarters levels, and exploring factors associated with influenza vaccine rates.
  (iv) Linkage and analysis of data from the household survey with demographic data from the Statistics Office of the Canton Basel-Basel e.g. population density.

- Transmission study
  (i) Building a prospective biobank of PCR-confirmed influenza patients including nasopharyngeal swabs, serum and blood samples.
  (ii) Sequencing of influenza viruses using WGS and performing phylogenetic analysis, revealing the relatedness of viral strains from individuals within Basel, as well as the relatedness of Basel sequences to foreign sequences obtained from public available databases.
  (iii) Analysis of transmission patterns in association with clinical, demographic, immunological, and geographical data.

- Influenza-specific antibody titers
  (i) Determination of influenza-specific humoral immunity of healthy individuals and translating the titers to herd immunity levels within urban quarters during the influenza season.

**Patient and public involvement**

The study proposal was evaluated by the local ethical committee, reflecting a detailed evaluation of patient rights in conducting research. In the survey the public was informed via the questionnaire and in the influenza transmission study patients will be informed according to the laws and regulation of the Swiss Human Research Act including the previously mentioned evaluation by the local ethical committee. As this is a study protocol for an observational epidemiological study no intervention was planed. All study participants in the prospective study parts received information material about the study purpose, aims and what will happen with the data collected.

**Methods/ Design**

*Setting.* In November 2015 the City of Basel had a total of 176'950 inhabitants distributed over 19 urban quarters. An estimated five percent of the population are thought to be infected with influenza viruses annually. The University Hospital Basel and the University Children Hospital Basel are tertiary academic institutions with more than 500'000 adult and 100'000 pediatric outpatient consultations annually. Both hospitals provide emergency department services during influenza seasons. The University Hospital Basel recruited adult patients and the University Children Hospital recruited pediatric patients for this study. In addition, a network of 24 pediatricians and family doctors also recruited patients (see below). Some of the data and samples were received from Viollier, a private laboratory providing its services to a large part of private practices within the City of Basel.

*Study design.* The observational descriptive study consists of retrospective and prospective parts that are performed at the previously mentioned institutions. **Figure 1** provides an overview on the different study elements.

A. Retrospective Studies:

*A1. PCR-confirmed influenza cases.*

For this study part, we collect all PCR-confirmed cases from the laboratory and clinical information systems of the University Hospital Basel, the University Children Hospital, and the Viollier diagnostic laboratory for the influenza seasons 2013/2014 to 2017/2018 with daily resolution. Data from influenza diagnostic services of nasopharyngeal swabs and additional respiratory material is available since 2013. For all PCR-confirmed Influenza A and B cases, further information is accessed e.g. age at infection, gender, and residential address. From the Statistics Office of the Canton Basel-City, additional data on the specific housing block is available e.g. population density, net income, and living space. The cases are mapped and areas with high occurrence identified using kernel densities (see below).

B. Prospective Studies

*B1. Household survey.*

We designed a household survey for the influenza season 2015/2016 in order to collect data on influenza-like illness and influenza vaccination. **Figure 2** shows in which urban quarters we distributed 30,000 questionnaires. We chose to study the level of official urban quarters, rather to postcode, as all the data from the Statistics Office of the Canton Basel-City was available at that level. In addition, the areas covered by postcodes and boundaries of official urban quarters do not correspond, making the use of data based on the postcode level unsuitable for the analysis of urban quarters. The distribution of questionnaires started in April 2016 when the incidence rate of the influenza cases dropped below official reported endemic threshold levels.

*Participants and sample size.* We used the probability-proportional-to-size (PPS) sampling as a basis to plan the survey, as each quarter's base population varies as well as the systematic equal probability of selection (EPS) sampling method within each quarter, so that each household had an equal probability of being selected. Both sampling methods account for the heterogeneity of urban quarters. In order to gain insights into community variation in attitudes, beliefs and behaviors on influenza vaccination from a representative sample, the survey was distributed in ten selected urban quarters (**Figure 2**) of Basel, which displayed a great variety in terms of socio-demographic and -economic and building structures. Everyone not living in one of the ten selected urban quarters was excluded from the survey.

We calculated the *number of responses needed* (n) to make the data representative with the following equation:

$$n \geq \frac{N}{1 + \frac{(N-1)e^2}{K^2 V(1-V)}}$$

N = Households by urban quarter; e = sampling error 5%; K = 1,96 confidence level (90%=1.64; 95%=1.96; 99%=2.58); V = distribution of responses (50%)

We calculate the number of necessary questionnaires to be distributed per quarter by using the amount of responses needed per quarter, assuming a response rate of 12% (**Table 1)**. The questionnaire is translated into the six most commonly spoken languages (German, English, Italian, Serbo-Croatian, Albanian, and Turkish). Distribution is according to the three most commonly spoken language per quarter based on data from the Statistics Office of the Canton Basel-City (**Table 2**). Every household received a German questionnaire. The full-length English version of the questionnaire can be found in the online supplementary material (**supplementary material 1**), and a German version in the supplementary material (**supplementary material 2**).

*Variables.* A total of 54 questions are included in the survey covering the following topics: (a) Influenza-like illnesses and vaccination, (b) aspects of urban environment, (c) information collection about health, and (d) person related data.

*B2. Influenza transmission using whole genome sequencing.*

In this project part, patients with ILI were recruited, and confirmed Influenza viruses are sequenced using WGS (15). This allows us to determine the phylogeny and transmission interference within urban quarters of the city in the context of particular demographic, geographical and microbiological factors.

*Participants and recruitment.* All patients with suspected ILI seen at one of the study sites are qualified to participate. The inclusion criteria for ILI are: recent anamnestic fever, coughing, myalgia, arthralgia, and sudden onset of disease. Patients (or parents in the case of children) are informed about the study and asked for a written informed consent. Then respiratory samples, mainly nasopharyngeal swabs, are collected. Patients are recruited at 15 study sites distributed throughout the city. The samples are delivered on the same day to the Clinical Microbiology laboratory for immediate sample processing and PCR testing.

*Strain collection and influenza diagnostics.* For the influenza season 2016/2017, all positive and negative samples are collected and stored at -80°C. In addition, additional influenza positive samples from the study season 2016/2017 are provided from a private diagnostic laboratory (Viollier AG, Allschwil, Switzerland). Both laboratories used the FluXpress (Cepheid), which allows the (semi-)quantitative determination of influenza A, influenza B, and respiratory syncytial virus (RSV). Serial isolates from the same patients are also collected and stored until WGS workup.

*Additional samples.* In addition to the nasopharyngeal swab for influenza, we also collect the following materials: whole blood (EDTA) samples for analysis of host genetics and serum samples for measurement of HIA titers as previously described (Kaufmann L et al. JOVE 2017) against vaccine and circulating influenza strains.

*Additional data*. Patient data from influenza cases were merged with metadata from the Statistics Office of the Canton Basel-City. In addition, the patients were provided with two questionnaires. The first one covers the most recent events during ILI of the last few days, the second one focuses on the behavior while being ill. Patient are instructed to send the second questionnaire two weeks after the ILI episode.

*Whole genome sequencing of viruses.* We use a molecular epidemiological approach to characterize the collected influenza viruses from individual patients with the highest possible resolution. The sequencing procedure has been described in detail (15). Briefly, all samples from ILI patients are analyzed by influenza specific PCRs. PCR-confirmed samples are further processed: first, RNA is extracted from nasopharyngeal swab/fluid; then reverse transcription and PCR is used to amplify all eight RNA viral segments; then PCR products are sequenced with high coverage using a MiSeq system (Illumina).

*B3. Determination of herd immunity in health individuals.*

*Participants and recruitment.* Blood donors from the local Swiss Red Cross blood donation center living in Basel are recruited for this study part. All blood donors included are above the age of 18 years and lived in Basel. At two time-points, before and after the 2016/2017 influenza season, serum samples are provided to determine antibody titers. The time between serum collections was three to nine months. In addition, the vaccine status is documented with a questionnaire.

*Measurement of antibody titers.* Antibody titers are determined as previously described (16). Briefly, antibody titers are determined using the hemagglutination inhibition (HI) assay against the following viruses: Influenza A/Hong Kong/4801/2014 (H3N2); Influenza A/California/7/2009 (H1N1); Influenza B/Brisbane/60/2008; and Influenza B/Phuket/3073/2013. HI titers of ≥1:40 are considered as seroprotection against this particular virus strain. The predominant virus in the 2016/2017 influenza season is Influenza A/HongKong/H3N2. Within an urban quarter, the seroprotective titer is expressed as percentage of the measured population.

**Quantitative data analyses and modelling**

*A Retrospective study*

*General aspects of GIS mapping.* By including the spatial environment of the urban districts, the study aims to understand whether spatial spreading patterns of influenza coincide significantly with aspects of the urban environment and/or the socioeconomic structure. Influenza incidences and relevant aspects of the urban environment are visualized in ArcGIS (Esri, Switzerland) and combined with oblique aerial photography of urban quarters that are structured differently in terms of the built environment. GIS-assisted analyses of the spatial distribution and spreading of influenza incidences blended with block level statistical data from the Statistics Office of the Canton Basel-City are designed to determine close contact environments e.g. infrastructure in the quarter, population density, living density, housing density. In addition, we can determine the urban social structure such as age distribution, social life situations, education status, migration background, housing and living arrangements, that may be related to higher occurrences of influenza cases. The possible association between influenza cases and relevant environmental factors are then analyzed with spatial statistics. Thus, it can be determined, for example, if the number of influenza cases is higher in densely built, densely populated areas, and in areas with certain age structures.

*Data processing, GIS mapping for the Canton Basel-City.* All maps are generated using ArcGIS (Version 10.3). The base-map showing individual statistical blocks/urban quarters/cantonal boundaries was obtained from the “Office for Geoinformatics, City of Basel“ (download via Geoshop). It should be noted that, while for the City of Basel, the road network

defines the boundaries of the statistical blocks in most cases, this is not the case outside the city boundaries. Due to the small size of the individual statistical blocks, their street patterns are not displayed, allowing the presentation of the statistical data as truthfully as possible. ArcGIS allows the georeferencing of individual living addresses by using the tool “Geocode Addresses”. The resulting shapefile indicates each influenza case with an individual point feature which can be classified according to added attributes like influenza type, month or week of examination. However, for data protection and ethical reasons, individual cases are not displayed with the address of residence, but only at the at the statistical block level.

*Kernel densities.* Kernel density estimation is a fundamental data smoothing method where inferences about the population are made, based on a finite data sample. The kernel density tool (ArcGIS) calculates the density of features (here influenza cases) in a certain area and generates a surface for each feature. Then the values of all overlaying kernel surfaces are summed up for each raster cell, resulting in a raster data set showing the kernel density. The kernel density are calculated for the influenza datasets of seasons 2013/2014, 2014/2015, 2015/2016, 2016/2017, and 2017/2018, as well as for the influenza cases of all seasons at once. The resulting raster dataset are reclassified into five shares (5 for highest, 1 for lowest values) based on Jenks natural breaks. This raster dataset is then converted into polygon features using the raster-to-feature tool in order to allow more options in terms of cartography (raster datasets can only be displayed in uniform/blank colors; no outlines or hatching possible).

*B1. Household survey*

The data from the questionnaires is documented in a database (SPSS version 25). A codebook for each variable was determined. Next, we perform a data cleansing, rejecting incompletely filled out questionnaires from the system at entry. Then, a thorough data cleaning and editing process is carried out including harmonization of codes, words and terms given in free answers, and recoding such answers into new codes and labels, thus creating new standardized variables from the original data. This includes identifying incomplete data and assigning missing values, detecting and correcting coarse data or removing inaccurate records from the database. The data cleaning also involves validity checks, i.e. validating and correcting values against a prespecified list of possible options (such as value labels). The coding is checked for each variable for the entire database in respect to the hierarchical order and determine if certain variables should be recoded. As the questionnaires are uniquely identified by urban quarters, and an identification number which is also entered into the data entry mask, we can compare original questionnaire data to data entered in the statistics program and thereby crosscheck cases that seem to be inconsistent with codes used.

*Data classification.* From variables such as date of birth, a new variable is created which defines age groups. From the two variables persons per household and square meters per household, a new variable is created which uses stated square meters per person to give an indication of residential density. Socioeconomic factors of all postal-code districts of the city of Basel will be summarized as counts (medians and interquartile ranges) for continuous variables and proportions and percentages for categorical variables. Responses of all participants will be summarized as counts (medians and interquartile ranges) for continuous variables and proportions and percentages for categorical variables and summarized for each postal-code district.

*Data enhancement and appendices.* The data set is also enhanced by additional information e.g. we analyze the variable of the self-stated medication of the respondents and classified it according to the Anatomical Therapeutic Chemical Classification (ATC) system used by the WHO. Thereby study participants can be classified into a risk group and non-risk group for influenza, according to their ATC-Level. The gained information is entered as new variables. We also include the location of a surveyed person within the urban quarter. This information is obtained from surveyed persons who precisely locate their place of residence on a map or by roughly indicating their location within a grid map of the city that we developed for this purpose. Locations are georeferenced and added to the data set.

*Data quality.* The data cleaning and harmonization procedure yields a data set that is accurate, complete and consistent, that allows us to go back to original source data (questionnaires), accounts for incomplete or missing values, and that conforms with data handling and anonymity requirements required by Swiss data protection laws and the regulations of the Ethics Commissions.

*Data analysis.*

Various demographic, epidemiological and geographical variables will be compared regarding the outcome variables. The primary outcomes of the household survey are (i) reported ILI and (ii) reported influenza vaccine status. Variables and endpoint data was descriptively analyzed using SPSS (version 25), Stata (version 15.1), and Prism (7.0d, 2017; www.graphpad.com). Data will be shown as median and interquartile ranges for continuous data and absolute numbers and percentage for categorical data. The statistical methods used to estimate an association between the variables are based on studies with similar topics (17-21).

*Analytical analysis.*

Comparisons between different postal-code areas: Different socioeconomic measures will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables. Summary measures of individual risk factors for influenza will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables. Outcome variables will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables.

Individual risk factors and postal-code district related socioeconomic factors and their associations with ILI: Relative risks for ILI will be estimated by Poisson regression with robust error variance. To deal with possible confounding, all variables found to differ significantly in univariable analyses between participants with and without ILI will be included in the multivariable, multilevel mixed-effects generalized linear model.

Individual risk factors and postal-code district related socioeconomic factors and their associations with influenza-vaccination: Relative risks for influenza vaccination will be estimated by Poisson regression with robust error variance. To deal with possible confounding, all variables found to differ significantly in univariable analyses between participants with and without influenza vaccination will be included in the multivariable, multilevel mixed-effects generalized linear model.

Model checking: The Pearson and deviance goodness-of-fit tests will be performed to assess the fit of the data to a Poisson distribution in the final regression models. Furthermore, the distributions of the deviance residuals will be analysed.

Sensitivity analyses: The final regression models will be repeated after exclusion of outliers in the dataset and with changing some of the underlying baseline assumptions (depends on the variables to be included).

*B2. Influenza transmission.*

The combined analysis of the viral sequencing data, the metadata from the Statistics Office of the Canton Basel-City, and the two questionnaires is done using phylodynamic methods. The data collected in the questionnaires filled out by the patients is cleaned up and processed analog to the data in B1.

In phylodynamics the transmission chain between hosts is reconstructed using the sequenced influenza genomes. We assume that two hosts with very similar viral genomes are close to each other in the transmission chain, whereas two hosts, which have very distanced viral genomes are far apart in the transmission chain. The reconstructed transmission chain is typically incomplete, as we cannot capture every single case in a city and the direction of transmission is not fully clear. We employ and extend the available phylodynamic framework within BEASTv2 (22) to allow the transmission rate to depend on host factors such as age, family status, or socio-economic characteristics. We aim to quantify the transmission rates as a function of the host factors. Intuitively, if say many adults cluster in the phylogeny, this indicates frequent ongoing transmission between adults, while if adults occur in children clades, this indicates frequent transmission from children to adults.

*B3. Determination of herd immunity in health individuals.*

The herd immunity estimates per urban quarter as percentage above a sero-protection threshold is visualized using GIS mapping as previously described. The distribution of herd immunities in urban quarters will be correlated with incidence rates of influenza and transmission patterns.

**Strength & limitations**

*Retrospective PCR-confirmed influenza cases.* From 2013 to 2018 all available cases are included. However, the included PCR-confirmed cases do not represent every single influenza case in the city. Many cases either presented at a family physician not participating in our study, or did not receive a diagnosis to confirm the viral infections. The number of ILI cases in the population is estimated to be 4-5% by the Federal Office of Public Health (www.bag.ch) – this would correspond to between 7000 and 8700 cases in the city of Basel. Based on our experience from the emergency department, around 50% of ILI cases can be attributed to Influenza viruses. Therefore, we would expect around 3500 to 4300 PCR-confirmed influenza cases. To capture every single case of influenza will not be possible.

*Prospective household survey.* Given the distribution of the foreign-born or persons in the urban quarter who speak other languages than German (Table 2), the Basel Cantonal Statistics Office provides the total number of households to be surveyed and the number of

households that should receive questionnaires in the major foreign languages (Table 3). Nevertheless, a language bias is likely induced into the questionnaire as not every spoken language could be captured with the questionnaire. Data entry and data handling errors can almost be excluded. In population (census) surveys performed by the Federal Office of Statistics of Switzerland, a 6% error margin is usually expected.
Finally, for logistic and cost reasons, we cannot distribute the household survey to all 19 official urban quarters but focus our questionnaire on 10 selected quarters. Although this might induce a certain selection bias, we feel that the included quarters reflect the diversity similar in a representative number. Also, the questionnaires distributed and received per quarters allows us to perform a statistical representative analysis.

*Prospective study of influenza transmission.* The prospective trial aims to include as many influenza infected patients as possible. The recruitment is distributed at sites with large influenza case numbers. However, recruitment may have introduced a certain bias of study participants. Some patients will not present at a physician or emergency ward and therefore will not be diagnosed but still contribute to the transmission chain. This may be particularly true for children, where PCR-based influenza diagnostics is rarely used.

*Prospective measurement of antibody titers in healthy individuals.* The measurement of herd immunity per quarter is based on the recruitment of healthy blood donors. The study participants may not reflect the average citizen of Basel.

## Discussion

Profound knowledge on the key geographical, epidemiological and immunological factors influencing influenza transmission in a city will significantly help to develop effective counter measurements. The project is performed during the several subsequent years and large interconnected datasets are collected. The retrospective study parts clearly will show typical bias of a retrospective analysis such as missing data. In the prospective study part, the questionnaire may have a reply bias in the sense that influenza and vaccine interested people are more likely to respond. In addition, during patient recruitment not all influenza cases will be captured by the study. In the prospective study part, we include patients with influenza-like illness and use in a second step a PCR to confirm an influenza infection. However, as with the retrospective study, not all patients with influenza infection can be captured within a city as only symptomatic and patients presenting at the family doctor will be included.

## Ethics and dissemination

The study is approved by the regional ethics committee as observational study (EKNZ project ID 2015–363 and 2016-01735). The study is registered at clinicaltrials.gov (NCT03010007 on 22nd December 2016). The results of this study will be published in peer-reviewed medical journals.

We plan to present the results of this research project at national and international scientific meetings. We aim to publish our results in open-access journals so they are widely available to interested international audiences. We aim to make our sequencing data available to the research community so that distribution of viruses can be assessed on both a national and international level.

**List of abbreviations**

WGS, whole genome sequencing

PCR, polymerase chain reaction

ILI, influenza-like illness

GIS, geographic information system

519 **Tables**

**Table 1. Representative sample of the household survey.** [1] The necessary number of questionnaires was calculated with an expected response rate of 12% and, due to statistical calculations, this means more households should have received a questionnaire than there actually are in Kleinhüningen. Source: Population Statistics 2014, Canton Basel-City

| Urban quarter | No. of private households in the quarter (N) | Minimum required returns (n) | No. of necessary distributed questionnaires (if 12% response rate) |
|---|---|---|---|
| Am Ring | 5456 | 359 | 2991 |
| Gundeldingen | 10085 | 370 | 3084 |
| Bruderholz | 4038 | 351 | 2924 |
| Bachletten | 6710 | 363 | 3028 |
| Gotthelf | 3764 | 349 | 2906 |
| Iselin | 8860 | 368 | 3069 |
| St. Johann | 9180 | 369 | 3073 |
| Matthäus | 8012 | 367 | 3055 |
| Klybeck | 3506 | 346 | 2886 |
| Kleinhüningen[1] | 1291 | 296 | 2469 |
| Total of 10 urban district | 60902 | 3538 | 29485 |

**Table 2. Distribution of foreign-born population and foreign languages in the urban district of Basel.** Population and foreign-born population were determined for November 2015. Number of private households was determined for 2014. Official language Montenegro: a.o. regional Serbo-Croatian and Albanian; Serbia: Serbo-Croatian; Kosovo: Albanian, Serbo-Croatian, Turkish.

| Urban district | Population | Number of private households | Foreign born pop. | Foreign population by citizenship as a percentage of all foreigners in the urban quarter (March 2015) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Largest segment of the foreign population | Second largest segment | Third largest segment | Fourth largest segment |
| Am Ring | 10666 | 5456 | 3636 | Germany (27%) | Italy (10.3%) | Spain (5.9%) | United Kingdom (4.7%) |
| Gundeldingen | 18917 | 10085 | 7497 | Germany (20.5%) | Turkey (14.9%) | Italy (12.7%) | Serbia, Montenegro, Kosovo (9.8%) |
| Bruderholz | 9068 | 4038 | 2098 | Germany (32.6%) | Italy (11.8%) | UK (7.5%) | France (5.2%) |
| Bachletten | 13549 | 6710 | 2918 | Germany (32.3%) | Italy (13.2%) | Spain (5.2%) | United Kingdom (4.9%) |
| Gotthelf | 6883 | 3764 | 1910 | Germany (32.2%) | Italy (12.5%) | Turkey (4.9%) | Spain (4.9%) |
| Iselin | 16595 | 8860 | 6092 | Germany (18.3%) | Italy (15%) | Turkey (12.6%) | Serbia, Montenegro, Kosovo (7%) |
| St. Johann | 18835 | 9180 | 8245 | Germany (17.2%) | Turkey (12.2%) | Italy (10.8%) | Portugal (8.7%) |
| Matthäus | 16303 | 8012 | 8403 | Germany (17%) | Italy (10.8%) | Turkey (10.6%) | Serbia, Montenegro, Kosovo (10.5%) |
| Klybeck | 7331 | 3506 | 3813 | Turkey (16.7%) | Italy (15.5%) | Germany 11.3%) | Serbia, Montenegro, Kosovo (10.9%) |
| Kleinhüningen | 2900 | 1291 | 1553 | Italy (15.7%) | Germany (14.5%) | Turkey (14.3%) | Serbia, Montenegro, Kosovo (10.5%) |
| **Total** | 121047 | 60902 | 46165 | | | | |

**Table 3. Number of households to be surveyed in selected urban quarters and languages provided.**

| | Number of private households | Questionnaires needed when return rate 12% | German, English, Italian | Serbo-Croatian | Albanian | Turkish | Household / questionnaire ratio | Distribution Each household | Every other household | Every third household |
|---|---|---|---|---|---|---|---|---|---|---|
| Kleinhüningen | 1291 | 2469 | x | x | x | x | 0,52 | x | | |
| Klybeck | 3506 | 2886 | x | x | x | x | 1,21 | x | | |
| Matthäus | 8012 | 3055 | x | x | x | x | 2,62 | | x | |
| St. Johann | 9180 | 3073 | x | | | x | 2,99 | | | x |
| Iselin | 8860 | 3069 | x | x | x | x | 2,89 | | | x |
| Gotthelf | 3764 | 2906 | x | | | | 1,30 | x | | |
| Am Ring | 5456 | 2991 | x | | | | 1,82 | | x | |
| Bachletten | 6710 | 3028 | x | | | | 2,22 | | x | |
| Gundeldingen | 10085 | 3084 | x | x | x | x | 3,27 | | | x |
| Bruderholz | 4038 | 2924 | x | | | | 1,38 | x | | |
| Total | | | 29485 | 14563 | 14563 | 20542 | | | | |

## Figures

## Figure legends

**Figure 1. Study overview.** Retrospective analysis of PCR-confirmed cases and household survey. Prospective collection of influenza virus isolates for WGS analysis and measurement of hemagglutination inhibition assay (HIA) titers from serum of healthy donors.

**Figure 2. Urban quarters of the Canton of Basel-City included into the household survey.** The 10 selected urban quarters are highlighted, selected on influenza incidences and known socioeconomic differences. Base map data: Department of construction and traffic of the Canton Basel-City, land charge register, specialist department for geoinformatics.

**Figure 1.**

**Figure 2.**

## Declarations

*Ethics approval and consent to participate:* The study is approved by the regional ethical review board (Project-ID 2015–363 and 2016-01735).

*Consent for publication:* Written informed consent is provided by every patient or legal representative.

*Availability of data and material:* Data analysis is ongoing, however, we will publish all WGS data of the patient in public repositories for WGS data. Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

*Competing interests:* None

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*Author contributions:* AE, MB, RSS and TS planned the study and reviewed the paper. AE drafted the first version paper. DW, DMM, and HMBSS advised on sequencing methodology. DW, HMBSS, TS, and NM advised on phylogenetic analysis and reviewed the paper. NA, MB, JB (Geography) generate GIS maps. AE, DB, YH, ER, OD, MN, AZ, STS, CHN, AB, NR, and NM provide data and samples. AE, NG, CS, TV, RSS planned and conducted the questionnaire. DV, DL, MS organized biobanking, CS, MB, TV, MS, NG, NAS, TS, RSS performed data entry.

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- Dr. Gordon and Dr. Landolt, Clara
- Dr. Buess, Am Ring

**References:**


1. Stockton J, Ellis JS, Saville M, Clewley JP, Zambon MC. Multiplex PCR for typing and subtyping influenza and respiratory syncytial viruses. J Clin Microbiol. 1998;36(10):2990-5.
2. Thai PQ, Mai le Q, Welkers MR, Hang Nle K, Thanh le T, Dung VT, et al. Pandemic H1N1 virus transmission and shedding dynamics in index case households of a prospective Vietnamese cohort. J Infect. 2014;68(6):581-90.
3. Ziegler T, Hall H, Sanchez-Fauquier A, Gamble WC, Cox NJ. Type- and subtype-specific detection of influenza viruses in clinical specimens by rapid culture assay. J Clin Microbiol. 1995;33(2):318-21.
4. McCrone JT, Woods RJ, Martin ET, Malosh RE, Monto AS, Lauring AS. Stochastic processes constrain the within and between host evolution of influenza virus. Elife. 2018;7.
5. Houghton R, Ellis J, Galiano M, Clark TW, Wyllie S. Haemagglutinin and neuraminidase sequencing delineate nosocomial influenza outbreaks with accuracy equivalent to whole genome sequencing. J Infect. 2017;74(4):377-84.
6. Pagani L, Thomas Y, Huttner B, Sauvan V, Notaridis G, Kaiser L, et al. Transmission and effect of multiple clusters of seasonal influenza in a Swiss geriatric hospital. J Am Geriatr Soc. 2015;63(4):739-44.
7. Valley-Omar Z, Nindo F, Mudau M, Hsiao M, Martin DP. Phylogenetic Exploration of Nosocomial Transmission Chains of 2009 Influenza A/H1N1 among Children Admitted at Red Cross War Memorial Children's Hospital, Cape Town, South Africa in 2011. PLoS One. 2015;10(11):e0141744.
8. Virk RK, Gunalan V, Lee HK, Inoue M, Chua C, Tan BH, et al. Molecular Evidence of Transmission of Influenza A/H1N1 2009 on a University Campus. PLoS One. 2017;12(1):e0168596.
9. Ghedin E, Sengamalay NA, Shumway M, Zaborsky J, Feldblyum T, Subbu V, et al. Large-scale sequencing of human influenza reveals the dynamic nature of viral genome evolution. Nature. 2005;437(7062):1162-6.
10. Bloom-Feshbach K, Alonso WJ, Charu V, Tamerius J, Simonsen L, Miller MA, et al. Latitudinal variations in seasonal activity of influenza and respiratory syncytial virus (RSV): a global comparative review. PLoS One. 2013;8(2):e54445.
11. Sammon CJ, McGrogan A, Snowball J, de Vries CS. Factors associated with uptake of seasonal and pandemic influenza vaccine among clinical risk groups in the UK: an analysis using the General Practice Research Database. Vaccine. 2012;30(14):2483-9.
12. Tamerius JD, Shaman J, Alonso WJ, Bloom-Feshbach K, Uejio CK, Comrie A, et al. Environmental predictors of seasonal influenza epidemics across temperate and tropical climates. PLoS Pathog. 2013;9(3):e1003194.
13. Walter D, Bohmer MM, Heiden M, Reiter S, Krause G, Wichmann O. Monitoring pandemic influenza A(H1N1) vaccination coverage in Germany 2009/10 - results from thirteen consecutive cross-sectional surveys. Vaccine. 2011;29(23):4008-12.
14. Yu H, Alonso WJ, Feng L, Tan Y, Shu Y, Yang W, et al. Characterization of regional influenza seasonality patterns in China and implications for vaccination strategies: spatio-temporal modeling of surveillance data. PLoS Med. 2013;10(11):e1001552.

15. Wuthrich D, Lang D, Muller NF, Neher RA, Stadler T, Egli A. Evaluation of two workflows for whole genome sequencing-based typing of influenza A viruses. J Virol Methods. 2019;266:30-3.
16. Kaufmann L, Syedbasha M, Vogt D, Hollenstein Y, Hartmann J, Linnik JE, et al. An Optimized Hemagglutination Inhibition (HI) Assay to Quantify Influenza-specific Antibody Titers. J Vis Exp. 2017(130).
17. Vaux S, Van Cauteren D, Guthmann JP, Le Strat Y, Vaillant V, de Valk H, et al. Influenza vaccination coverage against seasonal and pandemic influenza and their determinants in France: a cross-sectional survey. BMC Public Health. 2011;11:30.
18. Raude J, Setbon M. Predicting the lay preventive strategies in response to avian influenza from perceptions of the threat. PLoS One. 2011;6(9):e24943.
19. Bohmer MM, Walter D, Muters S, Krause G, Wichmann O. Seasonal influenza vaccine uptake in Germany 2007/2008 and 2008/2009: results from a national health update survey. Vaccine. 2011;29(27):4492-8.
20. Bohmer MM, Walter D, Krause G, Muters S, Gosswald A, Wichmann O. Determinants of tetanus and seasonal influenza vaccine uptake in adults living in Germany. Hum Vaccin. 2011;7(12):1317-25.
21. Dunlop S, Coyte PC, McIsaac W. Socio-economic status and the utilisationof physicians' services: results from the Canadian National Population Health Survey. Social Science & Medicine. 2000;51:123-33.
22. Bouckaert R, Heled J, Kuhnert D, Vaughan T, Wu CH, Xie D, et al. BEAST 2: a software platform for Bayesian evolutionary analysis. PLoS Comput Biol. 2014;10(4):e1003537.

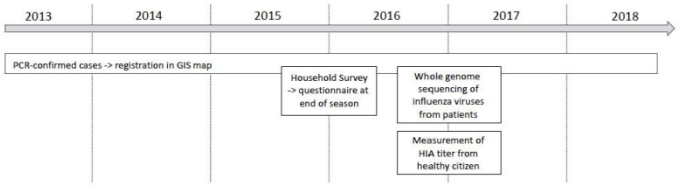



Figure 1. Study overview. Retrospective analysis of PCR-confirmed cases and household survey. Prospective collection of influenza virus isolates for WGS analysis and measurement of hemagglutination inhibition assay (HIA) titers from serum of healthy donors.

338x190mm (108 x 90 DPI)

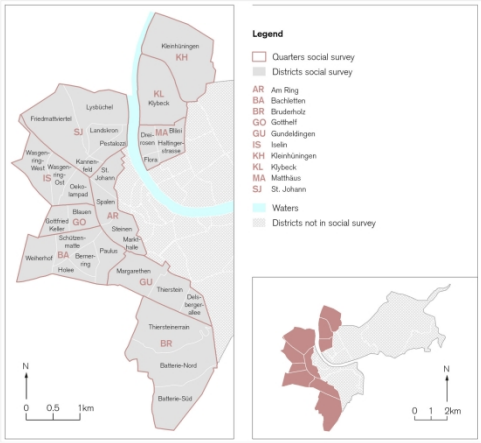



Figure 2. Urban quarters of the Canton of Basel-City included into the household survey. The 10 selected urban quarters are highlighted, selected on influenza incidences and known socioeconomic differences. Base map data: Department of construction and traffic of the Canton Basel-City, land charge register, specialist department for geoinformatics.

338x190mm (300 x 300 DPI)

Universität Basel | Departement Umweltwissenschaften | Humangeographie Stadt- und Regionalforschung | Universitätsspital Basel | Departement Biomedizin Basel | ETH Zürich

# Befragung zu Grippeerkrankungen in der Stadt Basel

Im Rahmen eines **Forschungsprojekts zu Grippeerkrankungen in der Stadt Basel** führen wir eine **Befragung in ausgewählten Basler Quartieren** durch.

Die Teilnahme an der Umfrage dauert circa 15 Minuten und ist freiwillig. **Ihre Anonymität wird gewährleistet.** Wir bitten Sie, diese Broschüre mit Ihrem ausgefüllten Fragebogen bis zum 1. Mai 2016 mit dem vorfrankierten Rückumschlag zurückzusenden.

Teilnehmende Personen können an einem Gewinnspiel teilnehmen **(Apple Laptop im Wert von CHF 2500.- und zwei Pro Innerstadt-Gutscheine im Wert von je CHF 500.-).** Siehe Ende des Fragebogens. Vielen Dank für Ihre Mitwirkung.

## A. Grippe und Erkältung

**A.1. Waren Sie in diesem Winter oder Frühling stark erkältet?**

☐1 nein *(falls nein, bitte weiter mit Frage A6)* ☐2 ja, mehrfach ☐3 ja, einmal

Falls **ja**, in welchem/n Monat(en): _____

Falls **ja**, wie viele Tage waren Sie dadurch im Alltag deutlich eingeschränkt? _____

**A.2. Welche Beschwerden hatten Sie?** (*Mehrfachnennungen möglich*)

☐1 Fieber (über 38 Grad) ☐3 Muskel- und Gliederschmerzen ☐5 Husten ☐7 Halsschmerzen ☐9 laufende Nase

☐2 Durchfall ☐4 starke Müdigkeit ☐6 Kopfschmerzen ☐8 starkes Krankheitsgefühl

**A.3. Ist sonst noch jemand mit den gleichen Beschwerden (Grippe/Erkältung) in Ihrem näheren Umfeld krank gewesen?**

☐1 nein ☐2 ja ☐3 weiss nicht

Falls **ja,** Personen (*Mehrfachnennungen möglich*):

☐1 in der Familie ☐2 bei der Arbeit ☐3 in der Nachbarschaft ☐4 im Freundeskreis ☐5 im Verein

**A.4. Haben Sie wegen der Erkältungs-Beschwerden eine Fachperson aufgesucht?**

☐1 nein ☐2 ja

Falls **ja**, wo?

☐1 Arztpraxis ☐2 Spital ☐3 Apotheke ☐4 andere, und zwar: _____

**A.5. Haben Sie zur Behandlung der Erkältung Medikamente eingenommen?**

☐1 nein ☐2 ja

Falls **ja,** haben Sie Tamiflu erhalten?

☐1 ja ☐2 nein

**A.6. Haben Sie sich im Herbst/Winter 2015/16 gegen Grippe impfen lassen?**

☐1 nein ☐2 ja

Falls **ja**, wo: ☐1 Arztpraxis ☐2 Apotheke ☐3 Spital ☐4 woanders, und zwar: _____

Falls **ja**, in welchem Monat? _____

Falls **nein**: Warum haben Sie sich nicht geimpft? (Bitte kreuzen Sie alle relevanten Punkte an)

☐1 Ich weiss nicht, warum ich mich impfen lassen sollte.
☐2 Ich wollte eigentlich, aber habe es dann doch nicht getan.
☐3 Ich glaube nicht an die Wirkung der Impfung.
☐4 Eine richtige Grippe stärkt mein Immunsystem mehr und der Schutz hält länger.
☐5 Das ist mir zu teuer.
☐6 Ich stärke meine Abwehr mit anderen Mitteln.
☐7 Freunde/Angehörige haben schlechte Erfahrungen damit gemacht.
☐8 Ich scheue mich vor den Nebenwirkungen.
☐9 Spritzen sind mir unangenehm.
☐10 Die Impfung wurde mir von Fachpersonen (Arzt/Apotheker) nicht empfohlen.
☐11 Anderer Grund, und zwar: _____

Falls **ja**: Warum haben Sie sich geimpft? (Bitte kreuzen Sie alle relevanten Punkte an)

☐1 Ich möchte keine Grippe bekommen.
☐2 Ich möchte nicht bei der Arbeit fehlen.
☐3 Ich habe Freunde/Angehörige, die ich vor der Grippe schützen möchte.
☐4 Die Impfung wurde mir von Angehörigen/Freunden empfohlen.
☐5 Die Impfung wurde mir am Arbeitsplatz empfohlen.
☐6 Die Impfung wurde mir von Fachpersonen (Arzt/Apotheker) empfohlen.
☐7 Anderer Grund, und zwar: _____

**A.7. Falls Sie sich dieses Jahr gegen Grippe geimpft haben, geben Sie Ihre Erfahrungen auf einer Skala von 1 (sehr negativ) bis 10 (sehr positiv) an:**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

sehr negativ sehr positiv

Falls **positive** Erfahrungen, welche: _____

Falls **negative** Erfahrungen, welche: _____

**A.8. Lassen Sie sich regelmässig gegen Grippe impfen?**

☐1 nein ☐2 ja

Falls **ja**, seit wie vielen Jahren: _____

**A.9. Haben Sie in der Vergangenheit andere vom Arzt empfohlene Impfungen für sich selbst oder für Ihre Kinder abgelehnt?**

☐1 nein, nie ☐2 ja, aber nur gewisse Impfungen ☐3 ja, alle Impfungen

**A.10. Wie schätzen Sie Ihren allgemeinen Gesundheitszustand auf einer Skala von 1 (sehr negativ) bis 10 (sehr positiv) ein?**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

sehr negativ sehr positiv

**A.11. Haben Sie eine Hausärztin oder einen Hausarzt?**

☐1 nein ☐2 ja

**A.12. Haben Sie chronische Krankheiten, wegen denen Sie täglich Medikamente einnehmen müssen (mindestens seit 6 Monaten)?**

☐1 nein ☐2 ja

Falls **ja,** welche Medikamente:_____

**A.13. Rauchen Sie?**

☐1 nein ☐2 ja, gelegentlich ☐3 ja, täglich (Anzahl Päckchen pro Tag)_____ ☐4 keine Angabe

**A.14. Trinken Sie Alkohol?**

☐1 nein ☐2 ja, gelegentlich ☐3 ja, täglich ☐4 keine Angabe

**A.15. Für wie wichtig halten Sie folgende Massnahmen um einer Grippe vorzubeugen?**

| | wichtig | eher wichtig | neutral | eher unwichtig | unwichtig | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Impfen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Händewaschen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesundheits-Checkup beim Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesunde Ernährung** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Regelmässige körperliche Aktivität** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Sonstige** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

sonstige, und zwar: _____

**A.16. Wie gut setzen Sie folgende Massnahmen Ihrer Meinung nach im Alltag um?**

| | sehr gut | gut | mittelmässig | schlecht | sehr schlecht | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Impfen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Händewaschen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesundheits-Checkup beim Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesunde Ernährung** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Regelmässige körperliche Aktivität** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Sonstige** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

## B. Aspekte der städtischen Umwelt

**B.1. Wie oft benutzen Sie die folgenden Verkehrsmittel?**

| | täglich | mehrmals die Woche | mehrmals im Monat | seltener | nie | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| Auto, Motorrad, Roller | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Öffentliche Verkehrsmittel (Bus, Tram, Bahn) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Fahrrad | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| zu Fuss | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| anderes | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

anderes, und zwar: _____

**B.2. Wie oft unternehmen Sie folgende Aktivitäten?**

| | täglich | mehrmals die Woche | mehrmals im Monat | seltener | nie | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| Einkaufen in Einkaufshäusern (Coop, Migros, etc.) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Kino | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Restaurant/ Café/ Bar | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Kulturelle Veranstaltungen | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Sportveranstaltungen/spiele | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

**B.3. Mit wie vielen Personen haben Sie an einem regulären Wochentag schätzungsweise Kontakt (Arbeitsumfeld, Familie, Freunde, Vereine)?**

☐1 0-10 ☐2 10-50 ☐3 50-100 ☐4 mehr als 100

**B.4. Falls Sie erwerbstätig sind, haben Sie bei Ihrer Arbeit häufigen Kontakt mit anderen Menschen?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.5. Arbeiten Sie im Gesundheitswesen mit Patientenkontakt (Medizinal- oder Pflegefachperson)?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.6. Arbeiten Sie mit Kindern (Kindergarten, Spielgruppe, Kindertagesstätte, Schule etc.)?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.7. Befindet sich Ihr Arbeitsplatz in einem Grossraumbüro bzw. in einem Raum mit vielen Menschen?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.8. Fühlen Sie sich in Ihrem Wohnumfeld schädlichen Umwelteinflüssen ausgesetzt? (zum Beispiel: Abgase, Feinstaub, Elektrosmog, Lärm etc.)**

☐1 nein ☐2 ja ☐3 keine Angabe

Wenn **ja**, welchen:_____

**B.9. Haben Sie diesen Herbst/Winter Personen im Spital oder Altersheim besucht?**

☐1 nein ☐2 ja

Wenn **ja**, wie oft:

☐1 1-4 mal ☐2 mehr als 5mal ☐3 Ich besuche regelmässig Personen in Gesundheitseinrichtungen.

**B.10. Betreuen Sie regelmässig pflegebedürftige Angehörige zu Hause?**

☐1 nein ☐2 ja

**B.11. Leben Sie mit Personen zusammen, die an einer chronischen Erkrankung leiden?**

☐1 nein ☐2 ja

# C. Informationsbeschaffung über Gesundheitsfragen

**C.1. Woher beziehen Sie Ihre Informationen zu Gesundheitsthemen?** (*Mehrfachnennungen möglich*)

☐1 Ärztin / Arzt
☐2 Apotheke
☐3 Soziales Umfeld (Freunde, Bekannte, Familie etc.)
☐4 Religiös-kulturelles Umfeld
☐5 Andere Informationsquelle und zwar:_____
☐6 TV
☐7 Radio
☐8 Zeitungen und Zeitschriften
☐9 Soziale Netzwerke
☐10 Internet, und zwar:
☐11 über Erfahrungsberichte anderer Personen
☐12 über offizielle Webseiten (Bundesamt für Gesundheit, Spital)
☐13 über andere Seiten: _____

☐14 Ich informiere mich nicht.

**C.2. Wie hilfreich finden Sie die angebotenen Informationen?**

| | sehr hilfreich | hilfreich | mittel | weniger hilfreich | gar nicht hilfreich | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Ärztin / Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Apotheke** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Soziales Umfeld (Freunde, Bekannte, Familie etc.)** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Religiös-kulturelles Umfeld** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **TV** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Radio** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Zeitungen und Zeitschriften** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Soziale Netzwerke** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Erfahrungsberichte im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Offizielle Seiten im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Andere Seiten im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Andere Informationsquelle** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

# D. Personenbezogene Angaben

**D.1. Geschlecht**
☐1 männlich ☐2 weiblich

**D.2. Geburtsjahr:**
_____

**D.3. Nationalität**
☐1 SchweizerIn ☐2 andere Nationalität: _____ ☐3 keine Angabe

**D.4. Wie lange wohnen Sie schon an Ihrem jetzigen Wohnort?**
☐1 bis zu 1 Jahr ☐3 mehr als 2 bis 5 Jahre ☐5 mehr als 10 bis 15 Jahre ☐7 keine Angabe
☐2 mehr als 1 bis 2 Jahre ☐4 mehr als 5 bis 10 Jahre ☐6 mehr als 15 Jahre

**D.5. Bitte schauen Sie sich die Karte Ihres Quartiers auf der letzten Seite an. In welchem Abschnitt wohnen Sie?**
Geben Sie dazu bitte die Koordinaten (Kombination von Buchstaben und Zahl auf der waagerechten bzw. senkrechten Achse) ein.
Abschnitt:_____

**D.6. Wohnstatus des Haushaltes, in dem Sie leben:**
☐1 Eigentumswohnung ☐3 Mietwohnung ☐5 Genossenschaftswohnung ☐7 anderes:_____
☐2 Eigenes Haus ☐4 Haus zur Miete ☐6 Altersresidenz/Altersheim ☐8 keine Angabe
Anzahl Quadratmeter der Wohnung/ des Hauses_____

**D.7. Wie viele Personen leben in Ihrem Haushalt / Wohngemeinschaft inklusive Ihnen?**
_____ Personen

**D.8. Wie viele Kinder leben in Ihrem Haushalt?**

| | 0 | 1 | 2 | 3 | mehr als 3 |
|---|---|---|---|---|---|
| **Kinder unter 7 Jahre alt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **Kinder über 7 Jahre alt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**D.9. Falls Sie Kinder unter 7 Jahre haben, werden diese auswärtig mit anderen Kindern betreut bzw. versorgt?**
☐1 nein ☐2 ja

**D.10. Wie setzt sich ihr Haushalt zusammen?**
☐1 Einpersonenhaushalt ☐3 (Ehe-)Paar mit Kind ☐5 Alleinerziehend mit Kind ☐7 keine Angabe
☐2 Wohngemeinschaft ☐4 (Ehe-)Paar ohne Kind ☐6 Sonstiges:_____

**D.11. Wo haben Sie Ihren höchsten Bildungsabschluss erworben?**
☐1 Obligatorische Schule
☐2 Berufslehre/-ausbildung, Berufsschule
☐3 Gymnasium
☐4 Höhere Berufsbildung (KV/Handelsschule, höhere Fachschule, Meister, Techniker)
☐5 Hochschule (ETH, Uni, FH, PH)
☐6 anderer Schulabschluss _____
☐7 keine Angabe

**D.12. Sind Sie aktuell erwerbstätig? (*Mehrfachnennungen möglich*)**
☐1 Vollzeit (mind. 90%) ☐3 SchülerIn/Lehrling/StudentIn ☐5 RentnerIn ☐7 Freiwilligenarbeit
☐2 Teilzeit/Nebenerwerb (<90%) ☐4 Hausfrau/Hausmann ☐6 zurzeit nicht erwerbstätig ☐8 keine Angabe

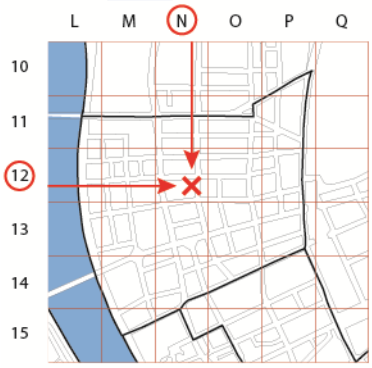
**D.13. Falls Sie erwerbstätig sind, welches ist Ihre aktuelle berufliche Stellung?**
☐1 Angestellter mit Führungsfunktion ☐2 Angestellter ohne Führungsfunktion ☐3 selbstständig

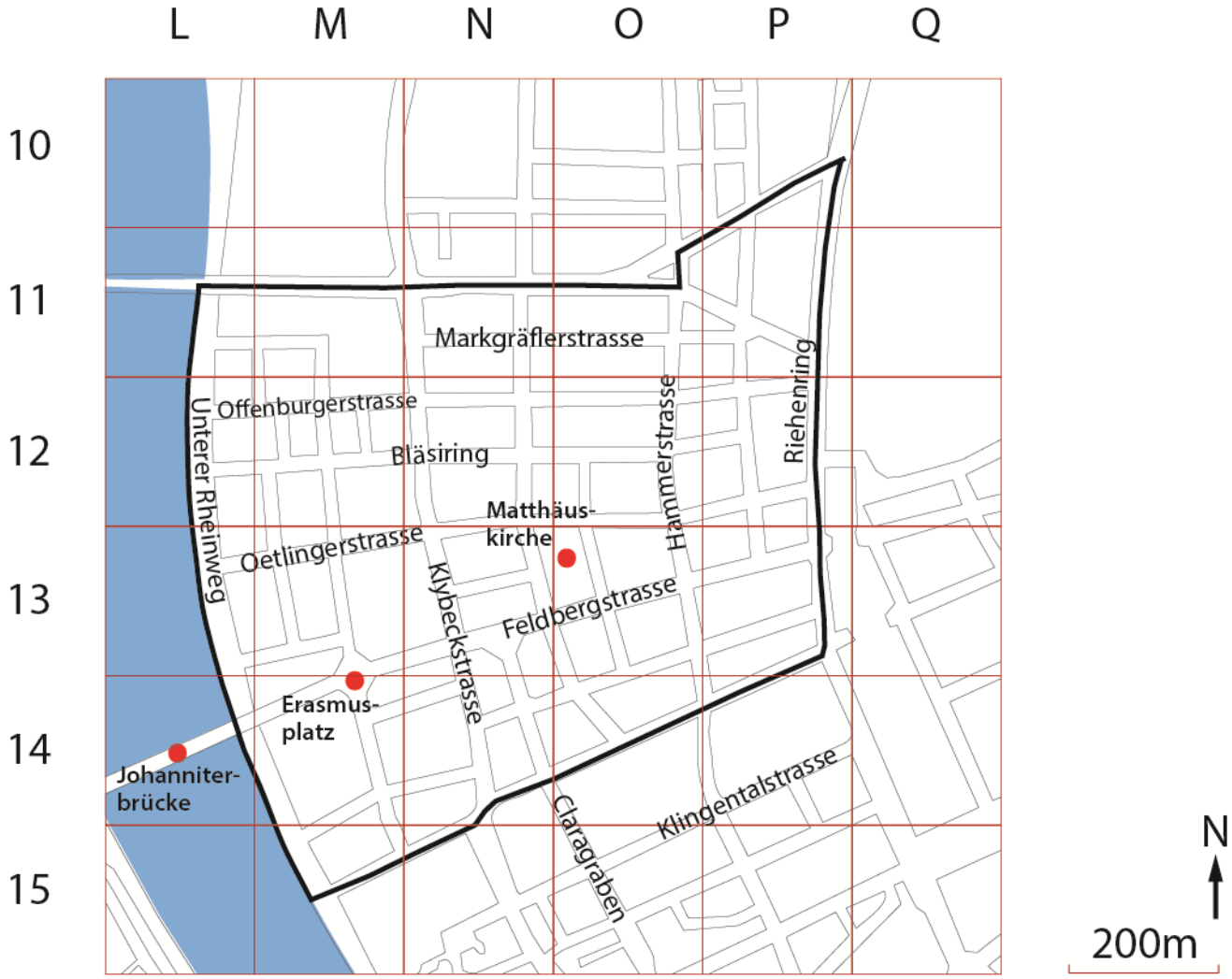
**D.14. Einkommenskategorie (Monatliches Brutto-Haushaltseinkommen)**
☐1 bis CHF 2000.- ☐3 4001-6000 CHF ☐5 8001-10‘000 CHF ☐7 > 15‘000 CHF
☐2 2001-4000 CHF ☐4 6001-8000 CHF ☐6 10‘001-15‘000 CHF ☐8 keine Angabe

**D.15. Wo arbeiten Sie? (Ort und Postleitzahl)**_____

**Karte zu Frage D5**
Bitte schauen Sie sich die Karte Ihres Quartiers an und zeichnen Sie auf der Karte ungefähr ein, wo Sie wohnen. Geben Sie dazu bitte die Koordinate (Kombination von Buchstaben und Zahl auf der waagerechten bzw. senkrechten Achse) an.

**Lesebeispiel (rechts)**
Sie wohnen an der Ecke Bläsiring / Müllheimerstrasse.
Antwort: N12




## Vielen Dank für Ihre Teilnahme.

**Falls Sie am Gewinnspiel für einen Apple Computer im Wert von CHF 2500.- und zwei Pro Innerstadt-Gutscheinen im Wert von je CHF 500.- teilnehmen möchten, können Sie hier Ihren Namen und Ihre Adresse angeben**:

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Universität Basel | Departement Umweltwissenschaften | Humangeographie Stadt- und Regionalforschung | Universitätsspital Basel | Departement Biomedizin Basel | ETH Zürich

# Questionnaire on Influenza in the City of Basel

Within the scope of the **research project on influenza in the city of Basel**, we are conducting a **survey in selected quarters of Basel**.

The participation in the survey takes approximately 15 minutes and is voluntary. **Your anonymity will be ensured**. We ask you to return this brochure with the completed questionnaire until 1st May 2016 with the postage-paid envelope.

Participants can partake in a lottery (**Apple Laptop worth CHF 2500.- and two "Pro Innerstadt"-coupons each worth CHF 500.-).** See end of questionnaire. Many thanks for your participation.

## A. Influenza and common cold

**A.1. Did you suffer from a strong cold this winter?**

☐1 no *(if no, please continue with question A6)* ☐2 yes, multiple times ☐3 yes, once

If **yes**, during which month(s): _____

If **yes**, how many days did it considerably impact your day-to-day life? _____

**A.2. Which grievances did you have?** (*multiple answers possible*)

☐1 temperature (over 38 degrees) ☐3 muscle and rheumatic pains ☐5 cough ☐7 sore throat ☐9 runny nose

☐2 diarrhoea ☐4 strong fatigue ☐6 headache ☐8 strong sense of illness

**A.3. Has anyone else in your proximity been suffering from the same grievances (influenza/cold) and fallen ill?**

☐1 no ☐2 yes ☐3 don´t know

If **yes,** people (*multiple answers possible*):

☐1 in the family ☐2 at work ☐3 in the neighbourhood ☐4 in the circle of friends ☐5 in the "Verein" (club)

**A.4. Did you contact an expert regarding the cold symptoms?**

☐1 no ☐2 yes

If **yes**, where?

☐1 medical practice ☐2 hospital ☐3 pharmacy ☐4 other, namely: _____

**A.5. Did you take medication to cure of the cold?**

☐1 no ☐2 yes

If **yes,** did you receive Tamiflu?

☐1 yes ☐2 no

**A.6. Did you get vaccinated in autumn/winter 2015/16 against Influenza?**

☐1 no ☐2 yes

If **yes**, where: ☐1 medical practice ☐2 pharmacy ☐3 hospital ☐4 other, namely: _____

If yes, during which month? _____

If **no**: Why did you not get a vaccination? (please mark all relevant points)

☐1 I don´t know why I should get vaccinated.
☐2 I wanted to, but then I ended up not doing it.
☐3 I don´t believe in the effect of the vaccination.
☐4 A real flu strengthens my immune system and the protection lasts longer.
☐5 It´s too expensive for me.
☐6 I strengthen my immune system with other means.
☐7 Friends/family have had negative experiences with it.
☐8 I´m afraid of the side effects.
☐9 I find needles unpleasant.
☐10 The vaccination was not recommended to me by experts (doctor/pharmacist).
☐11 other reason, namely: _____

If **yes**: Why did you get vaccinated? (please mark all relevant points)

☐1 I don´t want to get influenza.
☐2 I don´t want to be missing at work.
☐3 I have friends/family who I want to protect from influenza.
☐4 The vaccination was recommended to me by family/friends.
☐5 The vaccination was recommended to me at work.
☐6 The vaccination was recommended to me by experts (doctor/pharmacist) .
☐7 other reason, namely: _____



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**A.7. If you got vaccinated against influenza this year, state your experiences on a scale of 1 (very negative) to 10 (very positive):**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

very negative very positive

If **positive** experiences, which: _____

If **negative** experiences, which: _____

**A.8. Do you get vaccinated against influenza on a regular basis?**

☐1 no ☐2 yes

If **yes**, since how many years: _____

**A.9. In the past, have you refused other vaccinations which were recommended to you or your children by a doctor?**

☐1 no, never ☐2 yes, but only certain vaccinations ☐3 yes, all vaccinations

**A.10. How do you evaluate your general state of health on a scale from 1 (very negative) to 10 (very positive)?**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

very negative very positive

**A.11. Do you have a general practitioner?**

☐1 no ☐2 yes

**A.12. Do you have any chronic diseases due to which you have to take drugs on a daily basis (since at least 6 months)?**

☐1 no ☐2 yes

If **yes,** which drugs: _____

**A.13. Do you smoke?**

☐1 no ☐2 yes, sometimes ☐3 yes, daily (number of packets per day): _____ ☐4 not specified

**A.14. Do you drink alcohol?**

☐1 no ☐2 yes, sometimes ☐3 yes, daily ☐4 not specified

**A.15. How important do you regard the following measures to prevent influenza?**

| | important | rather important | neutral | rather unimportant | unimportant | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Vaccinating | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Washing hands | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Health check-up at the doctor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Healthy diet | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Regular physical activity | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

other, namely: _____

**A.16. How good do you implement the following measures into your day-to-day life?**

| | very good | good | average | bad | very bad | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Vaccinating | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Washing hands | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Health check-up at the doctor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Healthy diet | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Regular physical activity | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

# B. Aspects of city environment

**B.1. How often do you use the following means of transport?**

| | daily | several times per week | several times per month | rarely | never | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Car, motor cycle, motor scooter | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Public transport (bus, tram, train) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Bike | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| On foot | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

other, namely: _____

**B.2. How often do you undertake in the following activities?**

| | daily | several times per week | several times per month | rarely | never | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Shopping in supermarkets (Coop, Migros, etc.) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Cinema | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Restaurant/ café/ bar | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Cultural events | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Sporting events / games | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

**B.3. Approximately, with how many people do you have contact on a regular work day (work environment, family, friends, clubs)?**

☐1 0-10 ☐2 10-50 ☐3 50-100 ☐4 more than 100

**B.4. If you are working, do you have contact with other people?**

☐1 no ☐2 yes ☐3 no specification

**B.5. Do you work in the health sector with contact to patients (medical personnel or nurse)?**

☐1 no ☐2 yes ☐3 no specification

**B.6. Do you work with children (kindergarten, play group, day care, school etc.)?**

☐1 no ☐2 yes ☐3 no specification

**B.7. Is your workplace in an open-plan office or in a room with many people?**

☐1 no ☐2 yes ☐3 no specification

**B.8. Do you feel exposed to damaging environmental influences in your living environment? (e.g. emissions, fine dust, electric smog, noise etc.)**

☐1 no ☐2 yes ☐3 no specification

If **yes**, which:_____

**B.9. Have you visited people in hospital or an old people´s home this autumn/winter 2015/16?**

☐1 no ☐2 yes

If **yes**, how often:

☐1 1-4 times ☐2 more than 5 times ☐3 I regularly visit people in healthcare facilities.

**B.10. Do you regularly look after care-dependent family members at home?**

☐1 no ☐2 yes

**B.11. Do you live with people who suffer from a chronic disease?**

☐1 no ☐2 yes

# C. Procurement of Information on Health Questions

**C.1. From where do you procure your information on health questions?** (*multiple answers possible*)

☐1 doctor
☐2 pharmacy
☐3 social circle (friends, acquaintances, family etc.)
☐4 religio-cultural context
☐5 other source of information,
namely:_____

☐6 TV
☐7 radio
☐8 newspaper and magazines
☐9 social networks
☐10 internet, namely:
  ☐11 from experience reports of other people
  ☐12 from official websites (Federal Office of Public Health, hospital)
  ☐13 from other sites: _____

☐14 I don´t inform myself.

**C.2. How helpful do you find the information offered?**

| | very helpful | helpful | average | less helpful | not at all helpful | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| **Doctor** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Pharmacy** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Social circle (friends, acquaintances, family etc.)** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Religio-cultural context** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **TV** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Radio** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Newspaper and magazines** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Social networks** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Experience reports of other people on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Official websites on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Other websites on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Other sources of information** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |



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# D. Personal Data

**D.1. Gender**
☐1 male ☐2 female

**D.2. Year of birth:**
_____

**D.3. Nationality**
☐1 Swiss ☐2 other nationality: _____ ☐3 no specification

**D.4. How long have you been living at your current location?**
☐1 up to 1 year ☐3 more than 2 to 5 years ☐5 more than 10 to 15 years ☐7 no specification
☐2 more than 1 to 2 years ☐4 more than 5 to 10 years ☐6 more than 15 years

**D.5. Please look at the map of your quarter on the last page. In which segment do you live?** Please state the coordinates (a combination of a letter and a number on the horizontal respectively vertical axis).
Segment:_____

**D.6. Residential status of the household you are living in:**
☐1 owner-occupied flat ☐3 rental apartment ☐5 co-operative flat ☐7 other:_____
☐2 owner-occupied house ☐4 rental house ☐6 old people´s home ☐8 no specification
Number of square metres of the apartment/house: _____

**D.7. How many people live in your household / flat share including yourself?**
_____people

**D.8. How many children live in your household?**

| | 0 | 1 | 2 | 3 | More than 3 |
|---|---|---|---|---|---|
| **Children under 7 years old** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **Children over 7 years old** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**D.9. If you have children under 7 years old, are they being looked after externally together with other children?**
☐1 no ☐2 yes

**D.10. What is the structure of your household?**
☐1 one-person household ☐3 (married) couple with child ☐5 single parent with child ☐7 no specification
☐2 flat share ☐4 (married) couple without child ☐6 other:_____

**D.11. Where have you attained your educational qualification?**
☐1 compulsory school
☐2 vocational education / -training, trade school
☐3 gymnasium
☐4 higher vocational education (commercial college, higher professional school, foreman, technician)
☐5 institution of higher education (ETH, university, college, teacher training college)
☐6 other school qualification _____
☐7 no specification

**D.12. Are you currently employed? (*multiple answers possible*)**
☐1 full-time (min. 90%) ☐3 pupil/apprentice/student ☐5 pensioner ☐7 voluntary work
☐2 part-time/side job (<90%) ☐4 housewife/househusband ☐6 currently not employed ☐8 no specification

**D.13. If you are employed, what position do you hold?**
☐1 employee with management function ☐2 employee without management function ☐3 self-employed

**D.14. Category of income (monthly gross household income)**
☐1 up to CHF 2000 ☐3 4001-6000 CHF ☐5 8001-10‘000 CHF ☐7 > 15‘000 CHF
☐2 2001-4000 CHF ☐4 6001-8000 CHF ☐6 10‘001-15‘000 CHF ☐8 no specification

**D.15. Where do you work? (place and postcode):** _____

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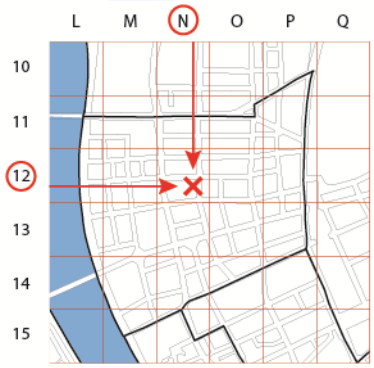
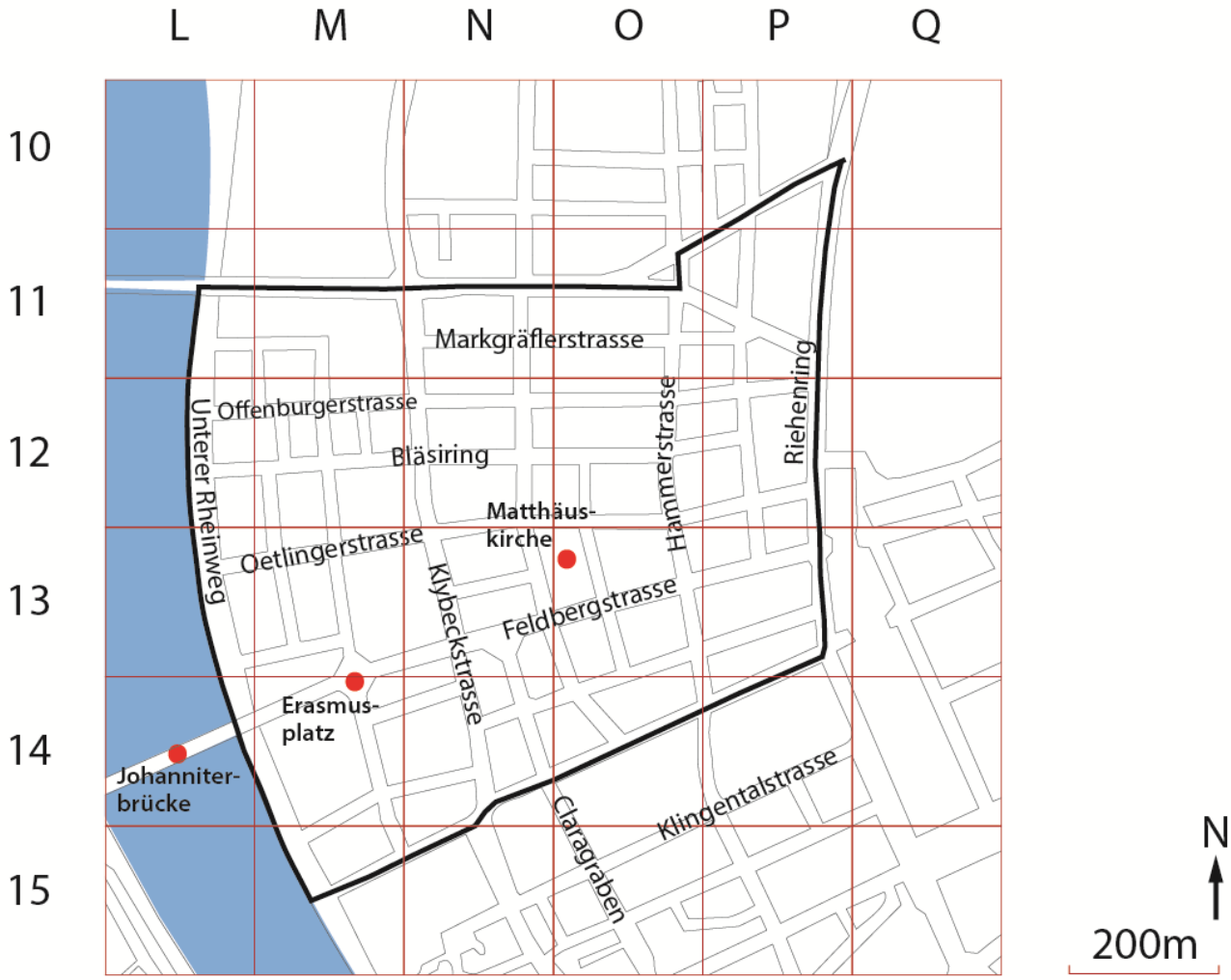
**Map for question D5**
Please look at the map of your quarter and mark the approximate location of your residence. Please state the coordinates (a combination of a letter and a number on the horizontal respectively vertical axis).

**Example (right)**
You live at the corner of Bläsiring / Müllheimerstrasse.
Answer: N12




## Thank you for your participation.

**If you would like to participate in the lottery for an Apple computer worth CHF 2500.- and two "Pro Innerstadt"-coupons each worth CHF 500.-, you can leave your name and address here**:

BMJ Open

# Identification of influenza urban transmission patterns by geographical, epidemiological and whole genome sequencing data: Protocol for an observational study.



| | |
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| Primary Subject Heading: | Epidemiology |
| Secondary Subject Heading: | Infectious diseases, Paediatrics, Respiratory medicine |
| Keywords: | transmission, whole genome sequencing, geography, questionnaire, influenza, study design |
| | |

# Identification of influenza urban transmission patterns by geographical, epidemiological and whole genome sequencing data: Protocol for an observational study.

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Short Title: Influenza transmission study: study design

Keywords: Study design, transmission, whole genome sequencing, geography, GIS maps, questionnaire, Influenza A, virus, typing, method

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**Abstract (words 281):**

*Introduction*: Urban transmission patterns of influenza viruses are complex and poorly understood, and multiple factors may play a critical role in modifying transmission. Whole genome sequencing (WGS) allows the description of patient-to-patient transmissions at highest resolution. The aim of this study is to explore urban transmission patterns of influenza viruses in high detail by combining geographical, epidemiological, and immunological data with WGS data.

*Methods and Analysis*: The study is performed at the University Hospital Basel, University Children's Hospital Basel, and a network of pediatricians and family doctors in the Canton of Basel-City, Switzerland. The retrospective study part includes an analysis of PCR-confirmed influenza cases from 2013 to 2018. The prospective study parts include (i) a household survey regarding influenza-like illness (ILI) and vaccination against influenza during the 2015/2016 season; (ii) an analysis of influenza viruses collected during the 2016/2017 season using WGS - viral genomic sequences are compared to determine genetic relatedness and transmissions; and (iii) measurement of influenza-specific antibody titers against all vaccinated and circulated strains during the 2016/2017 season from healthy individuals, allowing to monitor herd immunity across urban quarters. Survey data and PCR-confirmed cases are linked to data from the Statistics Office of the Canton Basel-City and visualized using geo-information-system (GIS) mapping. WGS data will be analyzed in the context of patient epidemiological data using phylodynamic analyses, and the obtained herd immunity for each quarter.

Profound knowledge on the key geographical, epidemiological and immunological factors influencing urban influenza transmission will help to develop effective counter measurements.

*Ethics and dissemination*: The study is registered (clinicaltrials.gov; NCT03010007 on 22nd December 2016) and approved by the regional ethics committee as an observational study (EKNZ project ID 2015–363 and 2016-01735). It is planed to present the results at conferences and publish the data in scientific journals.

**Strength and limitations:**

A first strength is, that to date this is the largest study on influenza transmission in a city. A second strength is, that it provides unprecedented high resolution and granularity of demographic, epidemiological and geographical data and that it links multiple dataset together. A third strength is that the analysis over several consecutive years.

A limitation of the study is, that not all Influenza infections can be captured in a city and also by this study design. A second limitation is that the survey part may introduce bias, based on the selection of the population who replied.

## Introduction (words: 4234)

Seasonal influenza is associated with substantial morbidity, mortality, and healthcare costs. Transmission of influenza has been explored with various methods and techniques (1-3). Whole genome sequencing (WGS) has the highest possible technical resolution for molecular typing of viruses and is increasingly used to understand and monitor transmission events of influenza viruses. Recently, WGS technology helped to explore important aspects of transmissions within households (4), hospitals (5-7), university campuses (8), and between countries (9). However, most studies lack crucial details on the epidemiological and demographic context of the infected patients and therefore cannot provide sufficient in-depth knowledge on risk factors for and pathways of transmission. Understanding pathogen transmission from patient-to-patient, especially within the urban context, may inform public health interventions targeting specific transmission chains.

Urban transmission clusters have not yet been explored in detail. The impact of host and environment factors within a city may greatly vary depending of the scale e.g. direct person-to-person, within an urban quarter, within and between countries, and around the globe. Within cities, multiple factors may entertain transmission, such as population densities, available living space per person, usage of public transport, social economic structures and behaviors, age, vaccine rates, and herd immunity. Urban quarters often vary greatly in some of those factors. Therefore, the differences accumulating within urban quarters may allow us to study the impact of geographical, social and demographic factors in the context of urban transmission of influenza. So far, only a few epidemiological studies have conceptualized these “geographic area” variables for influenza focused transmission and vaccine research (10-14).

Combining detailed population related data with high-resolution WGS-based typing of influenza viruses may allow us to profoundly understand factors entertaining urban influenza transmission within the microenvironments of a city. Based on the generated knowledge, targeted public health policies can be informed. Furthermore, these findings may also be translated to other transmissible diseases. In this article, we describe in detail the study design of a three-year research project funded by the Swiss National Science Foundation (www.snsf.ch) to explore urban influenza transmission.

## Aims and objectives

The main objective of this project is to explore the transmission patterns of influenza within a city. Geographical, epidemiological, microbiological, and immunological factors are analyzed to explain urban transmission patterns.

The *specific aims of the retrospective study* parts are:

- Analyzing PCR-confirmed influenza cases (seasons 2013/2014 to 2017/2018)
  - (i) Accessing PCR-confirmed influenza cases from various institutions across Basel.
  - (ii) Visualizing the frequency and spread of incidences with the help of point pattern and other analytical techniques including georeferencing individual cases.
  - (iii) Analysis of influenza cases by mapping incidences with demographic data from the Statistical Office of the Canton Basel-City.

The *specific aims of the prospective study* parts are:

- Household survey (season 2015/2016)
  (i) Conducting household surveys within 10 urban quarters.
  (ii) Determination of the influenza like illness (ILI) rate on individual and urban quarters levels, and exploring factors associated with ILI.
  (iii) Determination of influenza vaccine rate on individual and urban quarters levels, and exploring factors associated with influenza vaccine rates.
  (iv) Linkage and analysis of data from the household survey with demographic data from the Statistics Office of the Canton Basel-Basel e.g. population density.

- Transmission study
  (i) Building a prospective biobank of PCR-confirmed influenza patients including nasopharyngeal swabs, serum and blood samples.
  (ii) Sequencing of influenza viruses using WGS and performing phylogenetic analysis, revealing the relatedness of viral strains from individuals within Basel, as well as the relatedness of Basel sequences to foreign sequences obtained from public available databases.
  (iii) Analysis of transmission patterns in association with clinical, demographic, immunological, and geographical data.

- Influenza-specific antibody titers
  (i) Determination of influenza-specific humoral immunity of healthy individuals and translating the titers to herd immunity levels within urban quarters during the influenza season.

**Patient and public involvement**

The study proposal was evaluated by the local ethical committee, reflecting a detailed evaluation of patient rights in conducting research. In the survey the public was informed via the questionnaire and in the influenza transmission study patients will be informed according to the laws and regulation of the Swiss Human Research Act including the previously mentioned evaluation by the local ethical committee. As this is a study protocol for an observational epidemiological study no intervention was planed. All study participants in the prospective study parts received information material about the study purpose, aims and what will happen with the data collected.

**Methods/ Design**

*Setting.* In November 2015 the City of Basel had a total of 176'950 inhabitants distributed over 19 urban quarters. An estimated five percent of the population are thought to be infected with influenza viruses annually. The University Hospital Basel and the University Children Hospital Basel are tertiary academic institutions with more than 500'000 adult and 100'000 pediatric outpatient consultations annually. Both hospitals provide emergency department services during influenza seasons. The University Hospital Basel recruited adult patients and the University Children Hospital recruited pediatric patients for this study. In addition, a network of 24 pediatricians and family doctors also recruited patients (see below). Some of the data and samples were received from Viollier, a private laboratory providing its services to a large part of private practices within the City of Basel.

*Study design.* The observational descriptive study consists of retrospective and prospective parts that are performed at the previously mentioned institutions. **Figure 1** provides an overview on the different study elements.

A. Retrospective Studies:

*A1. PCR-confirmed influenza cases.*

For this study part, we collect all PCR-confirmed cases from the laboratory and clinical information systems of the University Hospital Basel, the University Children Hospital, and the Viollier diagnostic laboratory for the influenza seasons 2013/2014 to 2017/2018 with daily resolution. Data from influenza diagnostic services of nasopharyngeal swabs and additional respiratory material is available since 2013. For all PCR-confirmed Influenza A and B cases, further information is accessed e.g. age at infection, gender, and residential address. From the Statistics Office of the Canton Basel-City, additional data on the specific housing block is available e.g. population density, net income, and living space. The cases are mapped and areas with high occurrence identified using kernel densities (see below).

B. Prospective Studies

*B1. Household survey.*

We designed a household survey for the influenza season 2015/2016 in order to collect data on influenza-like illness and influenza vaccination. **Figure 2** shows in which urban quarters we distributed 30,000 questionnaires. We chose to study the level of official urban quarters, rather to postcode, as all the data from the Statistics Office of the Canton Basel-City was available at that level. In addition, the areas covered by postcodes and boundaries of official urban quarters do not correspond, making the use of data based on the postcode level unsuitable for the analysis of urban quarters. The distribution of questionnaires started in April 2016 when the incidence rate of the influenza cases dropped below official reported endemic threshold levels.

*Participants and sample size.* We used the probability-proportional-to-size (PPS) sampling as a basis to plan the survey, as each quarter's base population varies as well as the systematic equal probability of selection (EPS) sampling method within each quarter, so that each household had an equal probability of being selected. Both sampling methods account for the heterogeneity of urban quarters. In order to gain insights into community variation in attitudes, beliefs and behaviors on influenza vaccination from a representative sample, the survey was distributed in ten selected urban quarters (**Figure 2**) of Basel, which displayed a great variety in terms of socio-demographic and -economic and building structures. Everyone not living in one of the ten selected urban quarters was excluded from the survey.

We calculated the *number of responses needed* (n) to make the data representative with the following equation:

$$n \geq \frac{N}{1 + \frac{(N-1)e^2}{K^2 V(1-V)}}$$

N = Households by urban quarter; e = sampling error 5%; K = 1,96 confidence level (90%=1.64; 95%=1.96; 99%=2.58); V = distribution of responses (50%)

We calculate the number of necessary questionnaires to be distributed per quarter by using the amount of responses needed per quarter, assuming a response rate of 12% (**Table 1)**. The questionnaire is translated into the six most commonly spoken languages (German, English, Italian, Serbo-Croatian, Albanian, and Turkish). Distribution is according to the three most commonly spoken language per quarter based on data from the Statistics Office of the Canton Basel-City (**Table 2**). Every household received a German questionnaire. The full-length English version of the questionnaire can be found in the online supplementary material (**supplementary material 1**), and a German version in the supplementary material (**supplementary material 2**).

*Variables.* A total of 54 questions are included in the survey covering the following topics: (a) Influenza-like illnesses and vaccination, (b) aspects of urban environment, (c) information collection about health, and (d) person related data.

*B2. Influenza transmission using whole genome sequencing.*
In this project part, patients with ILI were recruited, and confirmed Influenza viruses are sequenced using WGS (15). This allows us to determine the phylogeny and transmission interference within urban quarters of the city in the context of particular demographic, geographical and microbiological factors.

*Participants and recruitment.* All patients with suspected ILI seen at one of the study sites are qualified to participate. The inclusion criteria for ILI are: recent anamnestic fever, coughing, myalgia, arthralgia, and sudden onset of disease. Patients (or parents in the case of children) are informed about the study and asked for a written informed consent. Then respiratory samples, mainly nasopharyngeal swabs, are collected. Patients are recruited at 15 study sites distributed throughout the city. The samples are delivered on the same day to the Clinical Microbiology laboratory for immediate sample processing and PCR testing.

*Strain collection and influenza diagnostics.* For the influenza season 2016/2017, all positive and negative samples are collected and stored at -80°C. In addition, additional influenza positive samples from the study season 2016/2017 are provided from a private diagnostic laboratory (Viollier AG, Allschwil, Switzerland). Both laboratories used the FluXpress (Cepheid), which allows the (semi-)quantitative determination of influenza A, influenza B, and respiratory syncytial virus (RSV). Serial isolates from the same patients are also collected and stored until WGS workup.

*Additional samples.* In addition to the nasopharyngeal swab for influenza, we also collect the following materials: whole blood (EDTA) samples for analysis of host genetics and serum samples for measurement of HIA titers as previously described (Kaufmann L et al. JOVE 2017) against vaccine and circulating influenza strains.

*Additional data*. Patient data from influenza cases were merged with metadata from the Statistics Office of the Canton Basel-City. In addition, the patients were provided with two questionnaires. The first one covers the most recent events during ILI of the last few days, the second one focuses on the behavior while being ill. Patient are instructed to send the second questionnaire two weeks after the ILI episode.

*Whole genome sequencing of viruses.* We use a molecular epidemiological approach to characterize the collected influenza viruses from individual patients with the highest possible resolution. The sequencing procedure has been described in detail (15). Briefly, all samples from ILI patients are analyzed by influenza specific PCRs. PCR-confirmed samples are further processed: first, RNA is extracted from nasopharyngeal swab/fluid; then reverse transcription and PCR is used to amplify all eight RNA viral segments; then PCR products are sequenced with high coverage using a MiSeq system (Illumina).

*B3. Determination of herd immunity in health individuals.*

*Participants and recruitment.* Blood donors from the local Swiss Red Cross blood donation center living in Basel are recruited for this study part. All blood donors included are above the age of 18 years and lived in Basel. At two time-points, before and after the 2016/2017 influenza season, serum samples are provided to determine antibody titers. The time between serum collections was three to nine months. In addition, the vaccine status is documented with a questionnaire.

*Measurement of antibody titers.* Antibody titers are determined as previously described (16). Briefly, antibody titers are determined using the hemagglutination inhibition (HI) assay against the following viruses: Influenza A/Hong Kong/4801/2014 (H3N2); Influenza A/California/7/2009 (H1N1); Influenza B/Brisbane/60/2008; and Influenza B/Phuket/3073/2013. HI titers of ≥1:40 are considered as seroprotection against this particular virus strain. The predominant virus in the 2016/2017 influenza season is Influenza A/HongKong/H3N2. Within an urban quarter, the seroprotective titer is expressed as percentage of the measured population.

**Quantitative data analyses and modelling**

*A Retrospective study*

*General aspects of GIS mapping.* By including the spatial environment of the urban districts, the study aims to understand whether spatial spreading patterns of influenza coincide significantly with aspects of the urban environment and/or the socioeconomic structure. Influenza incidences and relevant aspects of the urban environment are visualized in ArcGIS (Esri, Switzerland) and combined with oblique aerial photography of urban quarters that are structured differently in terms of the built environment. GIS-assisted analyses of the spatial distribution and spreading of influenza incidences blended with block level statistical data from the Statistics Office of the Canton Basel-City are designed to determine close contact environments e.g. infrastructure in the quarter, population density, living density, housing density. In addition, we can determine the urban social structure such as age distribution, social life situations, education status, migration background, housing and living arrangements, that may be related to higher occurrences of influenza cases. The possible association between influenza cases and relevant environmental factors are then analyzed with spatial statistics. Thus, it can be determined, for example, if the number of influenza cases is higher in densely built, densely populated areas, and in areas with certain age structures.

*Data processing, GIS mapping for the Canton Basel-City.* All maps are generated using ArcGIS (Version 10.3). The base-map showing individual statistical blocks/urban quarters/cantonal boundaries was obtained from the “Office for Geoinformatics, City of Basel“ (download via Geoshop). It should be noted that, while for the City of Basel, the road network

defines the boundaries of the statistical blocks in most cases, this is not the case outside the city boundaries. Due to the small size of the individual statistical blocks, their street patterns are not displayed, allowing the presentation of the statistical data as truthfully as possible. ArcGIS allows the georeferencing of individual living addresses by using the tool “Geocode Addresses”. The resulting shapefile indicates each influenza case with an individual point feature which can be classified according to added attributes like influenza type, month or week of examination. However, for data protection and ethical reasons, individual cases are not displayed with the address of residence, but only at the at the statistical block level.

*Kernel densities.* Kernel density estimation is a fundamental data smoothing method where inferences about the population are made, based on a finite data sample. The kernel density tool (ArcGIS) calculates the density of features (here influenza cases) in a certain area and generates a surface for each feature. Then the values of all overlaying kernel surfaces are summed up for each raster cell, resulting in a raster data set showing the kernel density. The kernel density are calculated for the influenza datasets of seasons 2013/2014, 2014/2015, 2015/2016, 2016/2017, and 2017/2018, as well as for the influenza cases of all seasons at once. The resulting raster dataset are reclassified into five shares (5 for highest, 1 for lowest values) based on Jenks natural breaks. This raster dataset is then converted into polygon features using the raster-to-feature tool in order to allow more options in terms of cartography (raster datasets can only be displayed in uniform/blank colors; no outlines or hatching possible).

*B1. Household survey*

The data from the questionnaires is documented in a database (SPSS version 25). A codebook for each variable was determined. Next, we perform a data cleansing, rejecting incompletely filled out questionnaires from the system at entry. Then, a thorough data cleaning and editing process is carried out including harmonization of codes, words and terms given in free answers, and recoding such answers into new codes and labels, thus creating new standardized variables from the original data. This includes identifying incomplete data and assigning missing values, detecting and correcting coarse data or removing inaccurate records from the database. The data cleaning also involves validity checks, i.e. validating and correcting values against a prespecified list of possible options (such as value labels). The coding is checked for each variable for the entire database in respect to the hierarchical order and determine if certain variables should be recoded. As the questionnaires are uniquely identified by urban quarters, and an identification number which is also entered into the data entry mask, we can compare original questionnaire data to data entered in the statistics program and thereby crosscheck cases that seem to be inconsistent with codes used.

*Data classification.* From variables such as date of birth, a new variable is created which defines age groups. From the two variables persons per household and square meters per household, a new variable is created which uses stated square meters per person to give an indication of residential density. Socioeconomic factors of all postal-code districts of the city of Basel will be summarized as counts (medians and interquartile ranges) for continuous variables and proportions and percentages for categorical variables. Responses of all participants will be summarized as counts (medians and interquartile ranges) for continuous variables and proportions and percentages for categorical variables and summarized for each postal-code district.

*Data enhancement and appendices.* The data set is also enhanced by additional information e.g. we analyze the variable of the self-stated medication of the respondents and classified it according to the Anatomical Therapeutic Chemical Classification (ATC) system used by the WHO. Thereby study participants can be classified into a risk group and non-risk group for influenza, according to their ATC-Level. The gained information is entered as new variables. We also include the location of a surveyed person within the urban quarter. This information is obtained from surveyed persons who precisely locate their place of residence on a map or by roughly indicating their location within a grid map of the city that we developed for this purpose. Locations are georeferenced and added to the data set.

*Data quality.* The data cleaning and harmonization procedure yields a data set that is accurate, complete and consistent, that allows us to go back to original source data (questionnaires), accounts for incomplete or missing values, and that conforms with data handling and anonymity requirements required by Swiss data protection laws and the regulations of the Ethics Commissions.

*Data analysis.*

Various demographic, epidemiological and geographical variables will be compared regarding the outcome variables. The primary outcomes of the household survey are (i) reported ILI and (ii) reported influenza vaccine status. Variables and endpoint data was descriptively analyzed using SPSS (version 25), Stata (version 15.1), and Prism (7.0d, 2017; www.graphpad.com). Data will be shown as median and interquartile ranges for continuous data and absolute numbers and percentage for categorical data. The statistical methods used to estimate an association between the variables are based on studies with similar topics (17-21).

*Analytical analysis.*

Comparisons between different postal-code areas: Different socioeconomic measures will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables. Summary measures of individual risk factors for influenza will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables. Outcome variables will be compared between the different postal-code districts by chi-square tests (or the Fisher's exact test, when appropriate) for categorical variables and by the Kruskal-Wallis-Test for continuous variables.

Individual risk factors and postal-code district related socioeconomic factors and their associations with ILI: Relative risks for ILI will be estimated by Poisson regression with robust error variance. To deal with possible confounding, all variables found to differ significantly in univariable analyses between participants with and without ILI will be included in the multivariable, multilevel mixed-effects generalized linear model.

Individual risk factors and postal-code district related socioeconomic factors and their associations with influenza-vaccination: Relative risks for influenza vaccination will be estimated by Poisson regression with robust error variance. To deal with possible confounding, all variables found to differ significantly in univariable analyses between participants with and without influenza vaccination will be included in the multivariable, multilevel mixed-effects generalized linear model.

Model checking: The Pearson and deviance goodness-of-fit tests will be performed to assess the fit of the data to a Poisson distribution in the final regression models. Furthermore, the distributions of the deviance residuals will be analysed.

Sensitivity analyses: The final regression models will be repeated after exclusion of outliers in the dataset and with changing some of the underlying baseline assumptions (depends on the variables to be included).

*B2. Influenza transmission.*

The combined analysis of the viral sequencing data, the metadata from the Statistics Office of the Canton Basel-City, and the two questionnaires is done using phylodynamic methods. The data collected in the questionnaires filled out by the patients is cleaned up and processed analog to the data in B1.

In phylodynamics the transmission chain between hosts is reconstructed using the sequenced influenza genomes. We assume that two hosts with very similar viral genomes are close to each other in the transmission chain, whereas two hosts, which have very distanced viral genomes are far apart in the transmission chain. The reconstructed transmission chain is typically incomplete, as we cannot capture every single case in a city and the direction of transmission is not fully clear. We employ and extend the available phylodynamic framework within BEASTv2 (22) to allow the transmission rate to depend on host factors such as age, family status, or socio-economic characteristics. We aim to quantify the transmission rates as a function of the host factors. Intuitively, if say many adults cluster in the phylogeny, this indicates frequent ongoing transmission between adults, while if adults occur in children clades, this indicates frequent transmission from children to adults.

*B3. Determination of herd immunity in health individuals.*

The herd immunity estimates per urban quarter as percentage above a sero-protection threshold is visualized using GIS mapping as previously described. The distribution of herd immunities in urban quarters will be correlated with incidence rates of influenza and transmission patterns.

**Strength & limitations**

*Retrospective PCR-confirmed influenza cases.* From 2013 to 2018 all available cases are included. However, the included PCR-confirmed cases do not represent every single influenza case in the city. Many cases either presented at a family physician not participating in our study, or did not receive a diagnosis to confirm the viral infections. The number of ILI cases in the population is estimated to be 4-5% by the Federal Office of Public Health (www.bag.ch) – this would correspond to between 7000 and 8700 cases in the city of Basel. Based on our experience from the emergency department, around 50% of ILI cases can be attributed to Influenza viruses. Therefore, we would expect around 3500 to 4300 PCR-confirmed influenza cases. To capture every single case of influenza will not be possible.

*Prospective household survey.* Given the distribution of the foreign-born or persons in the urban quarter who speak other languages than German (Table 2), the Basel Cantonal Statistics Office provides the total number of households to be surveyed and the number of

households that should receive questionnaires in the major foreign languages (Table 3). Nevertheless, a language bias is likely induced into the questionnaire as not every spoken language could be captured with the questionnaire. Data entry and data handling errors can almost be excluded. In population (census) surveys performed by the Federal Office of Statistics of Switzerland, a 6% error margin is usually expected.
Finally, for logistic and cost reasons, we cannot distribute the household survey to all 19 official urban quarters but focus our questionnaire on 10 selected quarters. Although this might induce a certain selection bias, we feel that the included quarters reflect the diversity similar in a representative number. Also, the questionnaires distributed and received per quarters allows us to perform a statistical representative analysis.

*Prospective study of influenza transmission.* The prospective trial aims to include as many influenza infected patients as possible. The recruitment is distributed at sites with large influenza case numbers. However, recruitment may have introduced a certain bias of study participants. Some patients will not present at a physician or emergency ward and therefore will not be diagnosed but still contribute to the transmission chain. This may be particularly true for children, where PCR-based influenza diagnostics is rarely used.

*Prospective measurement of antibody titers in healthy individuals.* The measurement of herd immunity per quarter is based on the recruitment of healthy blood donors. The study participants may not reflect the average citizen of Basel.

## Discussion

Profound knowledge on the key geographical, epidemiological and immunological factors influencing influenza transmission in a city will significantly help to develop effective counter measurements. The project is performed during the several subsequent years and large interconnected datasets are collected. The retrospective study parts clearly will show typical bias of a retrospective analysis such as missing data. In the prospective study part, the questionnaire may have a reply bias in the sense that influenza and vaccine interested people are more likely to respond. In addition, during patient recruitment not all influenza cases will be captured by the study. In the prospective study part, we include patients with influenza-like illness and use in a second step a PCR to confirm an influenza infection. However, as with the retrospective study, not all patients with influenza infection can be captured within a city as only symptomatic and patients presenting at the family doctor will be included.
We have recently finished the recruitment for the study and started with data analysis and manuscript writing. We expect that results will be available by end of 2019.

## Ethics and dissemination

The study is approved by the regional ethics committee as observational study (EKNZ project ID 2015–363 and 2016-01735). The study is registered at clinicaltrials.gov (NCT03010007 on 22nd December 2016). The results of this study will be published in peer-reviewed medical journals.

We plan to present the results of this research project at national and international scientific meetings. We aim to publish our results in open-access journals so they are widely available to interested international audiences. We aim to make our sequencing data available to the

research community so that distribution of viruses can be assessed on both a national and international level.

**List of abbreviations**

WGS, whole genome sequencing
PCR, polymerase chain reaction
ILI, influenza-like illness
GIS, geographic information system

## Tables

**Table 1. Representative sample of the household survey.** [1] The necessary number of questionnaires was calculated with an expected response rate of 12% and, due to statistical calculations, this means more households should have received a questionnaire than there actually are in Kleinhüningen. Source: Population Statistics 2014, Canton Basel-City

| Urban quarter | No. of private households in the quarter (N) | Minimum required returns (n) | No. of necessary distributed questionnaires (if 12% response rate) |
|---|---|---|---|
| Am Ring | 5456 | 359 | 2991 |
| Gundeldingen | 10085 | 370 | 3084 |
| Bruderholz | 4038 | 351 | 2924 |
| Bachletten | 6710 | 363 | 3028 |
| Gotthelf | 3764 | 349 | 2906 |
| Iselin | 8860 | 368 | 3069 |
| St. Johann | 9180 | 369 | 3073 |
| Matthäus | 8012 | 367 | 3055 |
| Klybeck | 3506 | 346 | 2886 |
| Kleinhüningen[1] | 1291 | 296 | 2469 |
| Total of 10 urban district | 60902 | 3538 | 29485 |

**Table 2. Distribution of foreign-born population and foreign languages in the urban district of Basel.** Population and foreign-born population were determined for November 2015. Number of private households was determined for 2014. Official language Montenegro: a.o. regional Serbo-Croatian and Albanian; Serbia: Serbo-Croatian; Kosovo: Albanian, Serbo-Croatian, Turkish.

| Urban district | Population | Number of private households | Foreign born pop. | Foreign population by citizenship as a percentage of all foreigners in the urban quarter (March 2015) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Largest segment of the foreign population | Second largest segment | Third largest segment | Fourth largest segment |
| Am Ring | 10666 | 5456 | 3636 | Germany (27%) | Italy (10.3%) | Spain (5.9%) | United Kingdom (4.7%) |
| Gundeldingen | 18917 | 10085 | 7497 | Germany (20.5%) | Turkey (14.9%) | Italy (12.7%) | Serbia, Montenegro, Kosovo (9.8%) |
| Bruderholz | 9068 | 4038 | 2098 | Germany (32.6%) | Italy (11.8%) | UK (7.5%) | France (5.2%) |
| Bachletten | 13549 | 6710 | 2918 | Germany (32.3%) | Italy (13.2%) | Spain (5.2%) | United Kingdom (4.9%) |
| Gotthelf | 6883 | 3764 | 1910 | Germany (32.2%) | Italy (12.5%) | Turkey (4.9%) | Spain (4.9%) |
| Iselin | 16595 | 8860 | 6092 | Germany (18.3%) | Italy (15%) | Turkey (12.6%) | Serbia, Montenegro, Kosovo (7%) |
| St. Johann | 18835 | 9180 | 8245 | Germany (17.2%) | Turkey (12.2%) | Italy (10.8%) | Portugal (8.7%) |
| Matthäus | 16303 | 8012 | 8403 | Germany (17%) | Italy (10.8%) | Turkey (10.6%) | Serbia, Montenegro, Kosovo (10.5%) |
| Klybeck | 7331 | 3506 | 3813 | Turkey (16.7%) | Italy (15.5%) | Germany 11.3%) | Serbia, Montenegro, Kosovo (10.9%) |
| Kleinhüningen | 2900 | 1291 | 1553 | Italy (15.7%) | Germany (14.5%) | Turkey (14.3%) | Serbia, Montenegro, Kosovo (10.5%) |
| **Total** | 121047 | 60902 | 46165 | | | | |

**Table 3. Number of households to be surveyed in selected urban quarters and languages provided.**

| | Number of private households | Questionnaires needed when return rate 12% | German, English, Italian | Serbo-Croatian | Albanian | Turkish | Household / questionnaire ratio | Distribution Each household | Every other household | Every third household |
|---|---|---|---|---|---|---|---|---|---|---|
| Kleinhüningen | 1291 | 2469 | x | x | x | x | 0,52 | x | | |
| Klybeck | 3506 | 2886 | x | x | x | x | 1,21 | x | | |
| Matthäus | 8012 | 3055 | x | x | x | x | 2,62 | | x | |
| St. Johann | 9180 | 3073 | x | | | x | 2,99 | | | x |
| Iselin | 8860 | 3069 | x | x | x | x | 2,89 | | | x |
| Gotthelf | 3764 | 2906 | x | | | | 1,30 | x | | |
| Am Ring | 5456 | 2991 | x | | | | 1,82 | | x | |
| Bachletten | 6710 | 3028 | x | | | | 2,22 | | x | |
| Gundeldingen | 10085 | 3084 | x | x | x | x | 3,27 | | | x |
| Bruderholz | 4038 | 2924 | x | | | | 1,38 | x | | |
| Total | | | 29485 | 14563 | 14563 | 20542 | | | | |

## Figures

## Figure legends

**Figure 1. Study overview.** Retrospective analysis of PCR-confirmed cases and household survey. Prospective collection of influenza virus isolates for WGS analysis and measurement of hemagglutination inhibition assay (HIA) titers from serum of healthy donors.

**Figure 2. Urban quarters of the Canton of Basel-City included into the household survey.** The 10 selected urban quarters are highlighted, selected on influenza incidences and known socioeconomic differences. Base map data: Department of construction and traffic of the Canton Basel-City, land charge register, specialist department for geoinformatics.

**Figure 1.**

**Figure 2.**

## Declarations

*Ethics approval and consent to participate:* The study is approved by the regional ethical review board (Project-ID 2015–363 and 2016-01735).

*Consent for publication:* Written informed consent is provided by every patient or legal representative.

*Availability of data and material:* Data analysis is ongoing, however, we will publish all WGS data of the patient in public repositories for WGS data. Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

*Competing interests:* None

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*Author contributions:* AE, MBa, RSS and TS planned the study and reviewed the paper. AE drafted the first version paper. DW, DMM, and HMBSS advised on sequencing methodology. DW, HMBSS, TS, and NM advised on phylogenetic analysis and reviewed the paper. NA, MB, JB (Geography) generate GIS maps. AE, DV, YH, ER, OD, MN, AZ, STS, CHN, AB, NR, and NM provide data and samples. AE, NG, CS, TV, RSS planned and conducted the questionnaire. DV, MS organized biobanking, CS, MB, TV, MS, NG, NAS, TS, RSS performed data entry.

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**References:**


1. Stockton J, Ellis JS, Saville M, Clewley JP, Zambon MC. Multiplex PCR for typing and subtyping influenza and respiratory syncytial viruses. J Clin Microbiol. 1998;36(10):2990-5.
2. Thai PQ, Mai le Q, Welkers MR, Hang Nle K, Thanh le T, Dung VT, et al. Pandemic H1N1 virus transmission and shedding dynamics in index case households of a prospective Vietnamese cohort. J Infect. 2014;68(6):581-90.
3. Ziegler T, Hall H, Sanchez-Fauquier A, Gamble WC, Cox NJ. Type- and subtype-specific detection of influenza viruses in clinical specimens by rapid culture assay. J Clin Microbiol. 1995;33(2):318-21.
4. McCrone JT, Woods RJ, Martin ET, Malosh RE, Monto AS, Lauring AS. Stochastic processes constrain the within and between host evolution of influenza virus. Elife. 2018;7.
5. Houghton R, Ellis J, Galiano M, Clark TW, Wyllie S. Haemagglutinin and neuraminidase sequencing delineate nosocomial influenza outbreaks with accuracy equivalent to whole genome sequencing. J Infect. 2017;74(4):377-84.
6. Pagani L, Thomas Y, Huttner B, Sauvan V, Notaridis G, Kaiser L, et al. Transmission and effect of multiple clusters of seasonal influenza in a Swiss geriatric hospital. J Am Geriatr Soc. 2015;63(4):739-44.
7. Valley-Omar Z, Nindo F, Mudau M, Hsiao M, Martin DP. Phylogenetic Exploration of Nosocomial Transmission Chains of 2009 Influenza A/H1N1 among Children Admitted at Red Cross War Memorial Children's Hospital, Cape Town, South Africa in 2011. PLoS One. 2015;10(11):e0141744.
8. Virk RK, Gunalan V, Lee HK, Inoue M, Chua C, Tan BH, et al. Molecular Evidence of Transmission of Influenza A/H1N1 2009 on a University Campus. PLoS One. 2017;12(1):e0168596.
9. Ghedin E, Sengamalay NA, Shumway M, Zaborsky J, Feldblyum T, Subbu V, et al. Large-scale sequencing of human influenza reveals the dynamic nature of viral genome evolution. Nature. 2005;437(7062):1162-6.
10. Bloom-Feshbach K, Alonso WJ, Charu V, Tamerius J, Simonsen L, Miller MA, et al. Latitudinal variations in seasonal activity of influenza and respiratory syncytial virus (RSV): a global comparative review. PLoS One. 2013;8(2):e54445.
11. Sammon CJ, McGrogan A, Snowball J, de Vries CS. Factors associated with uptake of seasonal and pandemic influenza vaccine among clinical risk groups in the UK: an analysis using the General Practice Research Database. Vaccine. 2012;30(14):2483-9.
12. Tamerius JD, Shaman J, Alonso WJ, Bloom-Feshbach K, Uejio CK, Comrie A, et al. Environmental predictors of seasonal influenza epidemics across temperate and tropical climates. PLoS Pathog. 2013;9(3):e1003194.
13. Walter D, Bohmer MM, Heiden M, Reiter S, Krause G, Wichmann O. Monitoring pandemic influenza A(H1N1) vaccination coverage in Germany 2009/10 - results from thirteen consecutive cross-sectional surveys. Vaccine. 2011;29(23):4008-12.
14. Yu H, Alonso WJ, Feng L, Tan Y, Shu Y, Yang W, et al. Characterization of regional influenza seasonality patterns in China and implications for vaccination strategies: spatio-temporal modeling of surveillance data. PLoS Med. 2013;10(11):e1001552.

15. Wuthrich D, Lang D, Muller NF, Neher RA, Stadler T, Egli A. Evaluation of two workflows for whole genome sequencing-based typing of influenza A viruses. J Virol Methods. 2019;266:30-3.
16. Kaufmann L, Syedbasha M, Vogt D, Hollenstein Y, Hartmann J, Linnik JE, et al. An Optimized Hemagglutination Inhibition (HI) Assay to Quantify Influenza-specific Antibody Titers. J Vis Exp. 2017(130).
17. Vaux S, Van Cauteren D, Guthmann JP, Le Strat Y, Vaillant V, de Valk H, et al. Influenza vaccination coverage against seasonal and pandemic influenza and their determinants in France: a cross-sectional survey. BMC Public Health. 2011;11:30.
18. Raude J, Setbon M. Predicting the lay preventive strategies in response to avian influenza from perceptions of the threat. PLoS One. 2011;6(9):e24943.
19. Bohmer MM, Walter D, Muters S, Krause G, Wichmann O. Seasonal influenza vaccine uptake in Germany 2007/2008 and 2008/2009: results from a national health update survey. Vaccine. 2011;29(27):4492-8.
20. Bohmer MM, Walter D, Krause G, Muters S, Gosswald A, Wichmann O. Determinants of tetanus and seasonal influenza vaccine uptake in adults living in Germany. Hum Vaccin. 2011;7(12):1317-25.
21. Dunlop S, Coyte PC, McIsaac W. Socio-economic status and the utilisationof physicians' services: results from the Canadian National Population Health Survey. Social Science & Medicine. 2000;51:123-33.
22. Bouckaert R, Heled J, Kuhnert D, Vaughan T, Wu CH, Xie D, et al. BEAST 2: a software platform for Bayesian evolutionary analysis. PLoS Comput Biol. 2014;10(4):e1003537.

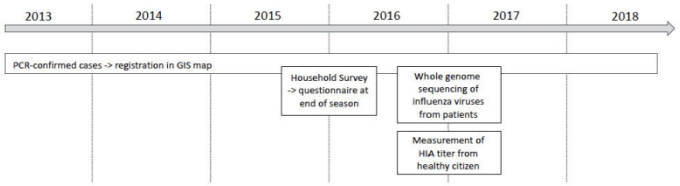


Figure 1. Study overview. Retrospective analysis of PCR-confirmed cases and household survey. Prospective collection of influenza virus isolates for WGS analysis and measurement of hemagglutination inhibition assay (HIA) titers from serum of healthy donors.

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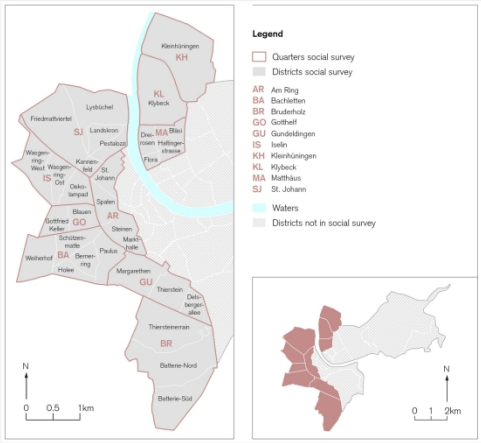



Figure 2. Urban quarters of the Canton of Basel-City included into the household survey. The 10 selected urban quarters are highlighted, selected on influenza incidences and known socioeconomic differences. Base map data: Department of construction and traffic of the Canton Basel-City, land charge register, specialist department for geoinformatics.

338x190mm (300 x 300 DPI)

Universität Basel | Departement Umweltwissenschaften | Humangeographie Stadt- und Regionalforschung | Universitätsspital Basel | Departement Biomedizin Basel | ETH Zürich

# Befragung zu Grippeerkrankungen in der Stadt Basel

Im Rahmen eines **Forschungsprojekts zu Grippeerkrankungen in der Stadt Basel** führen wir eine **Befragung in ausgewählten Basler Quartieren** durch.

Die Teilnahme an der Umfrage dauert circa 15 Minuten und ist freiwillig. **Ihre Anonymität wird gewährleistet.** Wir bitten Sie, diese Broschüre mit Ihrem ausgefüllten Fragebogen bis zum 1. Mai 2016 mit dem vorfrankierten Rückumschlag zurückzusenden.

Teilnehmende Personen können an einem Gewinnspiel teilnehmen **(Apple Laptop im Wert von CHF 2500.- und zwei Pro Innerstadt-Gutscheine im Wert von je CHF 500.-).** Siehe Ende des Fragebogens. Vielen Dank für Ihre Mitwirkung.

## A. Grippe und Erkältung

**A.1. Waren Sie in diesem Winter oder Frühling stark erkältet?**

☐1 nein *(falls nein, bitte weiter mit Frage A6)* ☐2 ja, mehrfach ☐3 ja, einmal

Falls **ja**, in welchem/n Monat(en): _____

Falls **ja**, wie viele Tage waren Sie dadurch im Alltag deutlich eingeschränkt? _____

**A.2. Welche Beschwerden hatten Sie?** (*Mehrfachnennungen möglich*)

☐1 Fieber (über 38 Grad) ☐3 Muskel- und Gliederschmerzen ☐5 Husten ☐7 Halsschmerzen ☐9 laufende Nase

☐2 Durchfall ☐4 starke Müdigkeit ☐6 Kopfschmerzen ☐8 starkes Krankheitsgefühl

**A.3. Ist sonst noch jemand mit den gleichen Beschwerden (Grippe/Erkältung) in Ihrem näheren Umfeld krank gewesen?**

☐1 nein ☐2 ja ☐3 weiss nicht

Falls **ja,** Personen (*Mehrfachnennungen möglich*):

☐1 in der Familie ☐2 bei der Arbeit ☐3 in der Nachbarschaft ☐4 im Freundeskreis ☐5 im Verein

**A.4. Haben Sie wegen der Erkältungs-Beschwerden eine Fachperson aufgesucht?**

☐1 nein ☐2 ja

Falls **ja**, wo?

☐1 Arztpraxis ☐2 Spital ☐3 Apotheke ☐4 andere, und zwar: _____

**A.5. Haben Sie zur Behandlung der Erkältung Medikamente eingenommen?**

☐1 nein ☐2 ja

Falls **ja,** haben Sie Tamiflu erhalten?

☐1 ja ☐2 nein

**A.6. Haben Sie sich im Herbst/Winter 2015/16 gegen Grippe impfen lassen?**

☐1 nein ☐2 ja

Falls **ja**, wo: ☐1 Arztpraxis ☐2 Apotheke ☐3 Spital ☐4 woanders, und zwar: _____

Falls **ja**, in welchem Monat? _____

Falls **nein**: Warum haben Sie sich nicht geimpft? (Bitte kreuzen Sie alle relevanten Punkte an)

☐1 Ich weiss nicht, warum ich mich impfen lassen sollte.
☐2 Ich wollte eigentlich, aber habe es dann doch nicht getan.
☐3 Ich glaube nicht an die Wirkung der Impfung.
☐4 Eine richtige Grippe stärkt mein Immunsystem mehr und der Schutz hält länger.
☐5 Das ist mir zu teuer.
☐6 Ich stärke meine Abwehr mit anderen Mitteln.
☐7 Freunde/Angehörige haben schlechte Erfahrungen damit gemacht.
☐8 Ich scheue mich vor den Nebenwirkungen.
☐9 Spritzen sind mir unangenehm.
☐10 Die Impfung wurde mir von Fachpersonen (Arzt/Apotheker) nicht empfohlen.
☐11 Anderer Grund, und zwar: _____

Falls **ja**: Warum haben Sie sich geimpft? (Bitte kreuzen Sie alle relevanten Punkte an)

☐1 Ich möchte keine Grippe bekommen.
☐2 Ich möchte nicht bei der Arbeit fehlen.
☐3 Ich habe Freunde/Angehörige, die ich vor der Grippe schützen möchte.
☐4 Die Impfung wurde mir von Angehörigen/Freunden empfohlen.
☐5 Die Impfung wurde mir am Arbeitsplatz empfohlen.
☐6 Die Impfung wurde mir von Fachpersonen (Arzt/Apotheker) empfohlen.
☐7 Anderer Grund, und zwar: _____

**A.7. Falls Sie sich dieses Jahr gegen Grippe geimpft haben, geben Sie Ihre Erfahrungen auf einer Skala von 1 (sehr negativ) bis 10 (sehr positiv) an:**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

sehr negativ sehr positiv

Falls **positive** Erfahrungen, welche: _____

Falls **negative** Erfahrungen, welche: _____

**A.8. Lassen Sie sich regelmässig gegen Grippe impfen?**

☐1 nein ☐2 ja

Falls **ja**, seit wie vielen Jahren: _____

**A.9. Haben Sie in der Vergangenheit andere vom Arzt empfohlene Impfungen für sich selbst oder für Ihre Kinder abgelehnt?**

☐1 nein, nie ☐2 ja, aber nur gewisse Impfungen ☐3 ja, alle Impfungen

**A.10. Wie schätzen Sie Ihren allgemeinen Gesundheitszustand auf einer Skala von 1 (sehr negativ) bis 10 (sehr positiv) ein?**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

sehr negativ sehr positiv

**A.11. Haben Sie eine Hausärztin oder einen Hausarzt?**

☐1 nein ☐2 ja

**A.12. Haben Sie chronische Krankheiten, wegen denen Sie täglich Medikamente einnehmen müssen (mindestens seit 6 Monaten)?**

☐1 nein ☐2 ja

Falls **ja,** welche Medikamente:_____

**A.13. Rauchen Sie?**

☐1 nein ☐2 ja, gelegentlich ☐3 ja, täglich (Anzahl Päckchen pro Tag)_____ ☐4 keine Angabe

**A.14. Trinken Sie Alkohol?**

☐1 nein ☐2 ja, gelegentlich ☐3 ja, täglich ☐4 keine Angabe

**A.15. Für wie wichtig halten Sie folgende Massnahmen um einer Grippe vorzubeugen?**

| | wichtig | eher wichtig | neutral | eher unwichtig | unwichtig | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Impfen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Händewaschen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesundheits-Checkup beim Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesunde Ernährung** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Regelmässige körperliche Aktivität** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Sonstige** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

sonstige, und zwar: _____

**A.16. Wie gut setzen Sie folgende Massnahmen Ihrer Meinung nach im Alltag um?**

| | sehr gut | gut | mittelmässig | schlecht | sehr schlecht | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Impfen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Händewaschen** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesundheits-Checkup beim Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Gesunde Ernährung** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Regelmässige körperliche Aktivität** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Sonstige** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

## B. Aspekte der städtischen Umwelt

**B.1. Wie oft benutzen Sie die folgenden Verkehrsmittel?**

| | täglich | mehrmals die Woche | mehrmals im Monat | seltener | nie | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| Auto, Motorrad, Roller | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Öffentliche Verkehrsmittel (Bus, Tram, Bahn) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Fahrrad | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| zu Fuss | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| anderes | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

anderes, und zwar: _____

**B.2. Wie oft unternehmen Sie folgende Aktivitäten?**

| | täglich | mehrmals die Woche | mehrmals im Monat | seltener | nie | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| Einkaufen in Einkaufshäusern (Coop, Migros, etc.) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Kino | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Restaurant/ Café/ Bar | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Kulturelle Veranstaltungen | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Sportveranstaltungen/spiele | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

**B.3. Mit wie vielen Personen haben Sie an einem regulären Wochentag schätzungsweise Kontakt (Arbeitsumfeld, Familie, Freunde, Vereine)?**

☐1 0-10 ☐2 10-50 ☐3 50-100 ☐4 mehr als 100

**B.4. Falls Sie erwerbstätig sind, haben Sie bei Ihrer Arbeit häufigen Kontakt mit anderen Menschen?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.5. Arbeiten Sie im Gesundheitswesen mit Patientenkontakt (Medizinal- oder Pflegefachperson)?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.6. Arbeiten Sie mit Kindern (Kindergarten, Spielgruppe, Kindertagesstätte, Schule etc.)?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.7. Befindet sich Ihr Arbeitsplatz in einem Grossraumbüro bzw. in einem Raum mit vielen Menschen?**

☐1 nein ☐2 ja ☐3 keine Angabe

**B.8. Fühlen Sie sich in Ihrem Wohnumfeld schädlichen Umwelteinflüssen ausgesetzt? (zum Beispiel: Abgase, Feinstaub, Elektrosmog, Lärm etc.)**

☐1 nein ☐2 ja ☐3 keine Angabe

Wenn **ja**, welchen:_____

**B.9. Haben Sie diesen Herbst/Winter Personen im Spital oder Altersheim besucht?**

☐1 nein ☐2 ja

Wenn **ja**, wie oft:

☐1 1-4 mal ☐2 mehr als 5mal ☐3 Ich besuche regelmässig Personen in Gesundheitseinrichtungen.

**B.10. Betreuen Sie regelmässig pflegebedürftige Angehörige zu Hause?**

☐1 nein ☐2 ja

**B.11. Leben Sie mit Personen zusammen, die an einer chronischen Erkrankung leiden?**

☐1 nein ☐2 ja

# C. Informationsbeschaffung über Gesundheitsfragen

**C.1. Woher beziehen Sie Ihre Informationen zu Gesundheitsthemen?** (*Mehrfachnennungen möglich*)

☐1 Ärztin / Arzt
☐2 Apotheke
☐3 Soziales Umfeld (Freunde, Bekannte, Familie etc.)
☐4 Religiös-kulturelles Umfeld
☐5 Andere Informationsquelle und zwar:_____
☐6 TV
☐7 Radio
☐8 Zeitungen und Zeitschriften
☐9 Soziale Netzwerke
☐10 Internet, und zwar:
☐11 über Erfahrungsberichte anderer Personen
☐12 über offizielle Webseiten (Bundesamt für Gesundheit, Spital)
☐13 über andere Seiten: _____

☐14 Ich informiere mich nicht.

**C.2. Wie hilfreich finden Sie die angebotenen Informationen?**

| | sehr hilfreich | hilfreich | mittel | weniger hilfreich | gar nicht hilfreich | weiss nicht | keine Angabe |
|---|---|---|---|---|---|---|---|
| **Ärztin / Arzt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Apotheke** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Soziales Umfeld (Freunde, Bekannte, Familie etc.)** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Religiös-kulturelles Umfeld** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **TV** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Radio** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Zeitungen und Zeitschriften** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Soziale Netzwerke** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Erfahrungsberichte im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Offizielle Seiten im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Andere Seiten im Internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Andere Informationsquelle** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

# D. Personenbezogene Angaben

**D.1. Geschlecht**
☐1 männlich ☐2 weiblich

**D.2. Geburtsjahr:**
_____

**D.3. Nationalität**
☐1 SchweizerIn ☐2 andere Nationalität: _____ ☐3 keine Angabe

**D.4. Wie lange wohnen Sie schon an Ihrem jetzigen Wohnort?**
☐1 bis zu 1 Jahr ☐3 mehr als 2 bis 5 Jahre ☐5 mehr als 10 bis 15 Jahre ☐7 keine Angabe
☐2 mehr als 1 bis 2 Jahre ☐4 mehr als 5 bis 10 Jahre ☐6 mehr als 15 Jahre

**D.5. Bitte schauen Sie sich die Karte Ihres Quartiers auf der letzten Seite an. In welchem Abschnitt wohnen Sie?**
Geben Sie dazu bitte die Koordinaten (Kombination von Buchstaben und Zahl auf der waagerechten bzw. senkrechten Achse) ein.
Abschnitt:_____

**D.6. Wohnstatus des Haushaltes, in dem Sie leben:**
☐1 Eigentumswohnung ☐3 Mietwohnung ☐5 Genossenschaftswohnung ☐7 anderes:_____
☐2 Eigenes Haus ☐4 Haus zur Miete ☐6 Altersresidenz/Altersheim ☐8 keine Angabe
Anzahl Quadratmeter der Wohnung/ des Hauses_____

**D.7. Wie viele Personen leben in Ihrem Haushalt / Wohngemeinschaft inklusive Ihnen?**
_____ Personen

**D.8. Wie viele Kinder leben in Ihrem Haushalt?**

| | 0 | 1 | 2 | 3 | mehr als 3 |
|---|---|---|---|---|---|
| **Kinder unter 7 Jahre alt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **Kinder über 7 Jahre alt** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**D.9. Falls Sie Kinder unter 7 Jahre haben, werden diese auswärtig mit anderen Kindern betreut bzw. versorgt?**
☐1 nein ☐2 ja

**D.10. Wie setzt sich ihr Haushalt zusammen?**
☐1 Einpersonenhaushalt ☐3 (Ehe-)Paar mit Kind ☐5 Alleinerziehend mit Kind ☐7 keine Angabe
☐2 Wohngemeinschaft ☐4 (Ehe-)Paar ohne Kind ☐6 Sonstiges:_____

**D.11. Wo haben Sie Ihren höchsten Bildungsabschluss erworben?**
☐1 Obligatorische Schule
☐2 Berufslehre/-ausbildung, Berufsschule
☐3 Gymnasium
☐4 Höhere Berufsbildung (KV/Handelsschule, höhere Fachschule, Meister, Techniker)
☐5 Hochschule (ETH, Uni, FH, PH)
☐6 anderer Schulabschluss _____
☐7 keine Angabe

**D.12. Sind Sie aktuell erwerbstätig? (*Mehrfachnennungen möglich*)**
☐1 Vollzeit (mind. 90%) ☐3 SchülerIn/Lehrling/StudentIn ☐5 RentnerIn ☐7 Freiwilligenarbeit
☐2 Teilzeit/Nebenerwerb (<90%) ☐4 Hausfrau/Hausmann ☐6 zurzeit nicht erwerbstätig ☐8 keine Angabe

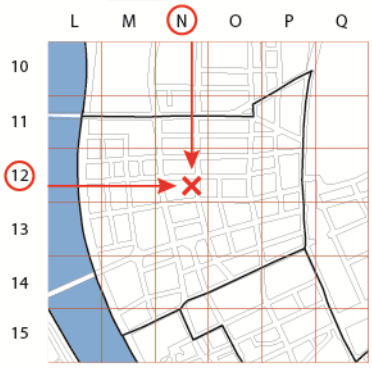
**D.13. Falls Sie erwerbstätig sind, welches ist Ihre aktuelle berufliche Stellung?**
☐1 Angestellter mit Führungsfunktion ☐2 Angestellter ohne Führungsfunktion ☐3 selbstständig

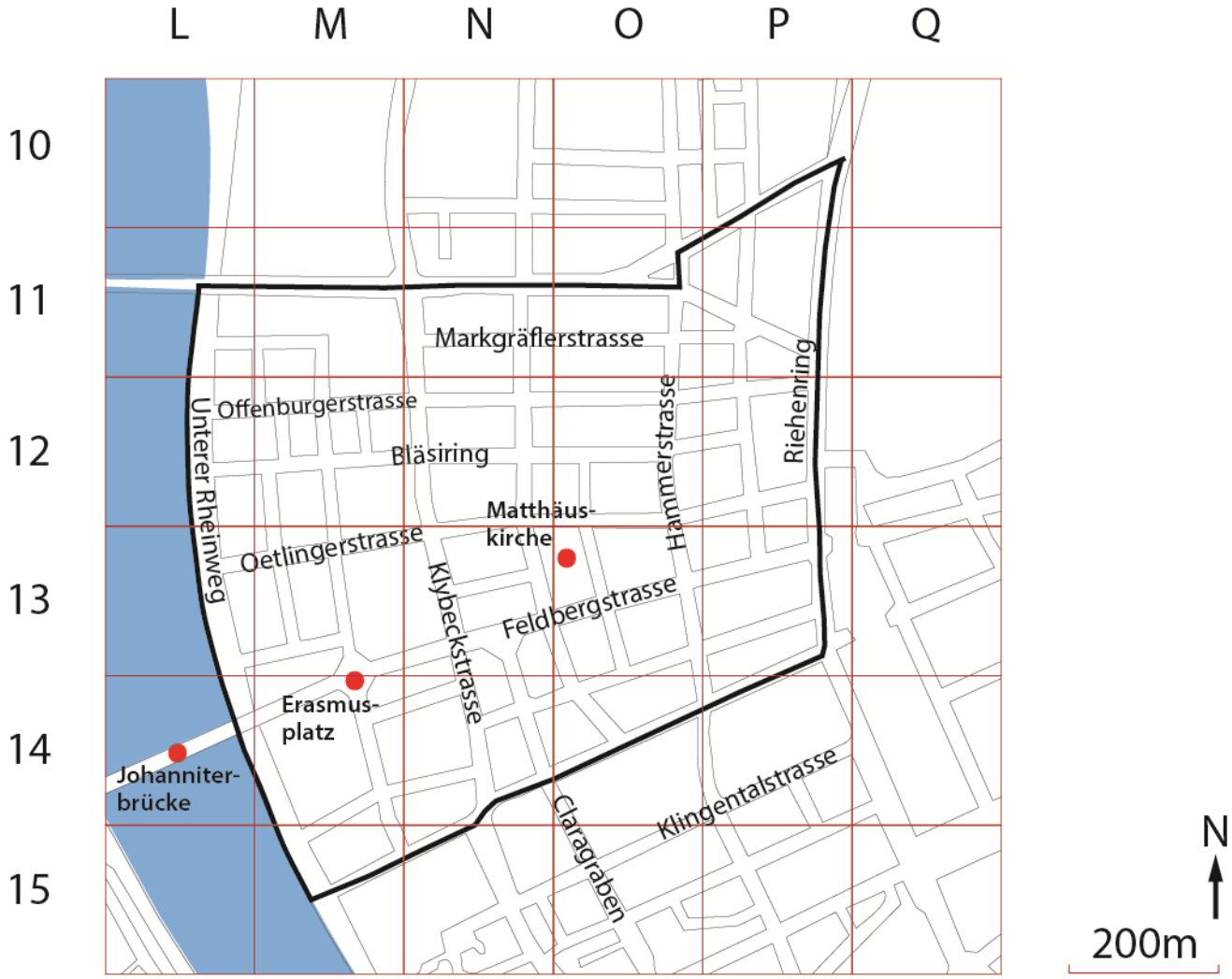
**D.14. Einkommenskategorie (Monatliches Brutto-Haushaltseinkommen)**
☐1 bis CHF 2000.- ☐3 4001-6000 CHF ☐5 8001-10‘000 CHF ☐7 > 15‘000 CHF
☐2 2001-4000 CHF ☐4 6001-8000 CHF ☐6 10‘001-15‘000 CHF ☐8 keine Angabe

**D.15. Wo arbeiten Sie? (Ort und Postleitzahl)**_____

**Karte zu Frage D5**
Bitte schauen Sie sich die Karte Ihres Quartiers an und zeichnen Sie auf der Karte ungefähr ein, wo Sie wohnen. Geben Sie dazu bitte die Koordinate (Kombination von Buchstaben und Zahl auf der waagerechten bzw. senkrechten Achse) an.

**Lesebeispiel (rechts)**
Sie wohnen an der Ecke Bläsiring / Müllheimerstrasse.
Antwort: N12




## Vielen Dank für Ihre Teilnahme.

**Falls Sie am Gewinnspiel für einen Apple Computer im Wert von CHF 2500.- und zwei Pro Innerstadt-Gutscheinen im Wert von je CHF 500.- teilnehmen möchten, können Sie hier Ihren Namen und Ihre Adresse angeben**:

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Universität Basel | Departement Umweltwissenschaften | Humangeographie Stadt- und Regionalforschung | Universitätsspital Basel | Departement Biomedizin Basel | ETH Zürich

# Questionnaire on Influenza in the City of Basel

Within the scope of the **research project on influenza in the city of Basel**, we are conducting a **survey in selected quarters of Basel**.

The participation in the survey takes approximately 15 minutes and is voluntary. **Your anonymity will be ensured**. We ask you to return this brochure with the completed questionnaire until 1st May 2016 with the postage-paid envelope.

Participants can partake in a lottery (**Apple Laptop worth CHF 2500.- and two "Pro Innerstadt"-coupons each worth CHF 500.-).** See end of questionnaire. Many thanks for your participation.

## A. Influenza and common cold

**A.1. Did you suffer from a strong cold this winter?**

☐1 no *(if no, please continue with question A6)* ☐2 yes, multiple times ☐3 yes, once

If **yes**, during which month(s): _____

If **yes**, how many days did it considerably impact your day-to-day life? _____

**A.2. Which grievances did you have?** (*multiple answers possible*)

☐1 temperature (over 38 degrees) ☐3 muscle and rheumatic pains ☐5 cough ☐7 sore throat ☐9 runny nose

☐2 diarrhoea ☐4 strong fatigue ☐6 headache ☐8 strong sense of illness

**A.3. Has anyone else in your proximity been suffering from the same grievances (influenza/cold) and fallen ill?**

☐1 no ☐2 yes ☐3 don´t know

If **yes,** people (*multiple answers possible*):

☐1 in the family ☐2 at work ☐3 in the neighbourhood ☐4 in the circle of friends ☐5 in the "Verein" (club)

**A.4. Did you contact an expert regarding the cold symptoms?**

☐1 no ☐2 yes

If **yes**, where?

☐1 medical practice ☐2 hospital ☐3 pharmacy ☐4 other, namely: _____

**A.5. Did you take medication to cure of the cold?**

☐1 no ☐2 yes

If **yes,** did you receive Tamiflu?

☐1 yes ☐2 no

**A.6. Did you get vaccinated in autumn/winter 2015/16 against Influenza?**

☐1 no ☐2 yes

If **yes**, where: ☐1 medical practice ☐2 pharmacy ☐3 hospital ☐4 other, namely: _____

If yes, during which month? _____

If **no**: Why did you not get a vaccination? (please mark all relevant points)

☐1 I don´t know why I should get vaccinated.
☐2 I wanted to, but then I ended up not doing it.
☐3 I don´t believe in the effect of the vaccination.
☐4 A real flu strengthens my immune system and the protection lasts longer.
☐5 It´s too expensive for me.
☐6 I strengthen my immune system with other means.
☐7 Friends/family have had negative experiences with it.
☐8 I´m afraid of the side effects.
☐9 I find needles unpleasant.
☐10 The vaccination was not recommended to me by experts (doctor/pharmacist).
☐11 other reason, namely: _____

If **yes**: Why did you get vaccinated? (please mark all relevant points)

☐1 I don´t want to get influenza.
☐2 I don´t want to be missing at work.
☐3 I have friends/family who I want to protect from influenza.
☐4 The vaccination was recommended to me by family/friends.
☐5 The vaccination was recommended to me at work.
☐6 The vaccination was recommended to me by experts (doctor/pharmacist) .
☐7 other reason, namely: _____



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**A.7. If you got vaccinated against influenza this year, state your experiences on a scale of 1 (very negative) to 10 (very positive):**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

very negative very positive

If **positive** experiences, which: _____

If **negative** experiences, which: _____

**A.8. Do you get vaccinated against influenza on a regular basis?**

☐1 no ☐2 yes

If **yes**, since how many years: _____

**A.9. In the past, have you refused other vaccinations which were recommended to you or your children by a doctor?**

☐1 no, never ☐2 yes, but only certain vaccinations ☐3 yes, all vaccinations

**A.10. How do you evaluate your general state of health on a scale from 1 (very negative) to 10 (very positive)?**

☐1 1 ☐2 2 ☐3 3 ☐4 4 ☐5 5 ☐6 6 ☐7 7 ☐8 8 ☐9 9 ☐10 10

very negative very positive

**A.11. Do you have a general practitioner?**

☐1 no ☐2 yes

**A.12. Do you have any chronic diseases due to which you have to take drugs on a daily basis (since at least 6 months)?**

☐1 no ☐2 yes

If **yes,** which drugs: _____

**A.13. Do you smoke?**

☐1 no ☐2 yes, sometimes ☐3 yes, daily (number of packets per day): _____ ☐4 not specified

**A.14. Do you drink alcohol?**

☐1 no ☐2 yes, sometimes ☐3 yes, daily ☐4 not specified

**A.15. How important do you regard the following measures to prevent influenza?**

| | important | rather important | neutral | rather unimportant | unimportant | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Vaccinating | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Washing hands | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Health check-up at the doctor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Healthy diet | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Regular physical activity | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

other, namely: _____

**A.16. How good do you implement the following measures into your day-to-day life?**

| | very good | good | average | bad | very bad | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Vaccinating | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Washing hands | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Health check-up at the doctor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Healthy diet | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Regular physical activity | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

# B. Aspects of city environment

**B.1. How often do you use the following means of transport?**

| | daily | several times per week | several times per month | rarely | never | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Car, motor cycle, motor scooter | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Public transport (bus, tram, train) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Bike | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| On foot | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

other, namely: _____

**B.2. How often do you undertake in the following activities?**

| | daily | several times per week | several times per month | rarely | never | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| Shopping in supermarkets (Coop, Migros, etc.) | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Cinema | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Restaurant/ café/ bar | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Cultural events | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| Sporting events / games | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |

**B.3. Approximately, with how many people do you have contact on a regular work day (work environment, family, friends, clubs)?**

☐1 0-10 ☐2 10-50 ☐3 50-100 ☐4 more than 100

**B.4. If you are working, do you have contact with other people?**

☐1 no ☐2 yes ☐3 no specification

**B.5. Do you work in the health sector with contact to patients (medical personnel or nurse)?**

☐1 no ☐2 yes ☐3 no specification

**B.6. Do you work with children (kindergarten, play group, day care, school etc.)?**

☐1 no ☐2 yes ☐3 no specification

**B.7. Is your workplace in an open-plan office or in a room with many people?**

☐1 no ☐2 yes ☐3 no specification

**B.8. Do you feel exposed to damaging environmental influences in your living environment? (e.g. emissions, fine dust, electric smog, noise etc.)**

☐1 no ☐2 yes ☐3 no specification

If **yes**, which:_____

**B.9. Have you visited people in hospital or an old people´s home this autumn/winter 2015/16?**

☐1 no ☐2 yes

If **yes**, how often:

☐1 1-4 times ☐2 more than 5 times ☐3 I regularly visit people in healthcare facilities.

**B.10. Do you regularly look after care-dependent family members at home?**

☐1 no ☐2 yes

**B.11. Do you live with people who suffer from a chronic disease?**

☐1 no ☐2 yes

# C. Procurement of Information on Health Questions

**C.1. From where do you procure your information on health questions?** (*multiple answers possible*)

☐1 doctor
☐2 pharmacy
☐3 social circle (friends, acquaintances, family etc.)
☐4 religio-cultural context
☐5 other source of information,
namely:_____

☐6 TV
☐7 radio
☐8 newspaper and magazines
☐9 social networks
☐10 internet, namely:
  ☐11 from experience reports of other people
  ☐12 from official websites (Federal Office of Public Health, hospital)
  ☐13 from other sites: _____

☐14 I don´t inform myself.

**C.2. How helpful do you find the information offered?**

| | very helpful | helpful | average | less helpful | not at all helpful | don´t know | no specification |
|---|---|---|---|---|---|---|---|
| **Doctor** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Pharmacy** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Social circle (friends, acquaintances, family etc.)** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Religio-cultural context** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **TV** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Radio** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Newspaper and magazines** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Social networks** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Experience reports of other people on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Official websites on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Other websites on the internet** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |
| **Other sources of information** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 | ☐7 |



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# D. Personal Data

**D.1. Gender**
☐1 male ☐2 female

**D.2. Year of birth:**
_____

**D.3. Nationality**
☐1 Swiss ☐2 other nationality: _____ ☐3 no specification

**D.4. How long have you been living at your current location?**
☐1 up to 1 year ☐3 more than 2 to 5 years ☐5 more than 10 to 15 years ☐7 no specification
☐2 more than 1 to 2 years ☐4 more than 5 to 10 years ☐6 more than 15 years

**D.5. Please look at the map of your quarter on the last page. In which segment do you live?** Please state the coordinates (a combination of a letter and a number on the horizontal respectively vertical axis).
Segment:_____

**D.6. Residential status of the household you are living in:**
☐1 owner-occupied flat ☐3 rental apartment ☐5 co-operative flat ☐7 other:_____
☐2 owner-occupied house ☐4 rental house ☐6 old people´s home ☐8 no specification
Number of square metres of the apartment/house: _____

**D.7. How many people live in your household / flat share including yourself?**
_____people

**D.8. How many children live in your household?**

| | 0 | 1 | 2 | 3 | More than 3 |
|---|---|---|---|---|---|
| **Children under 7 years old** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **Children over 7 years old** | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**D.9. If you have children under 7 years old, are they being looked after externally together with other children?**
☐1 no ☐2 yes

**D.10. What is the structure of your household?**
☐1 one-person household ☐3 (married) couple with child ☐5 single parent with child ☐7 no specification
☐2 flat share ☐4 (married) couple without child ☐6 other:_____

**D.11. Where have you attained your educational qualification?**
☐1 compulsory school
☐2 vocational education / -training, trade school
☐3 gymnasium
☐4 higher vocational education (commercial college, higher professional school, foreman, technician)
☐5 institution of higher education (ETH, university, college, teacher training college)
☐6 other school qualification _____
☐7 no specification

**D.12. Are you currently employed? (*multiple answers possible*)**
☐1 full-time (min. 90%) ☐3 pupil/apprentice/student ☐5 pensioner ☐7 voluntary work
☐2 part-time/side job (<90%) ☐4 housewife/househusband ☐6 currently not employed ☐8 no specification

**D.13. If you are employed, what position do you hold?**
☐1 employee with management function ☐2 employee without management function ☐3 self-employed

**D.14. Category of income (monthly gross household income)**
☐1 up to CHF 2000 ☐3 4001-6000 CHF ☐5 8001-10‘000 CHF ☐7 > 15‘000 CHF
☐2 2001-4000 CHF ☐4 6001-8000 CHF ☐6 10‘001-15‘000 CHF ☐8 no specification

**D.15. Where do you work? (place and postcode):** _____

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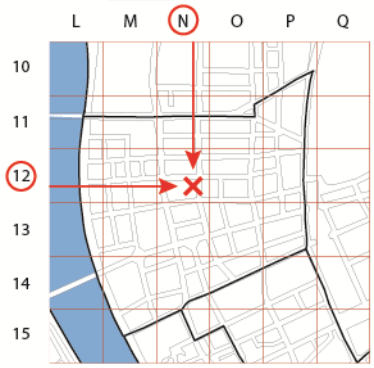
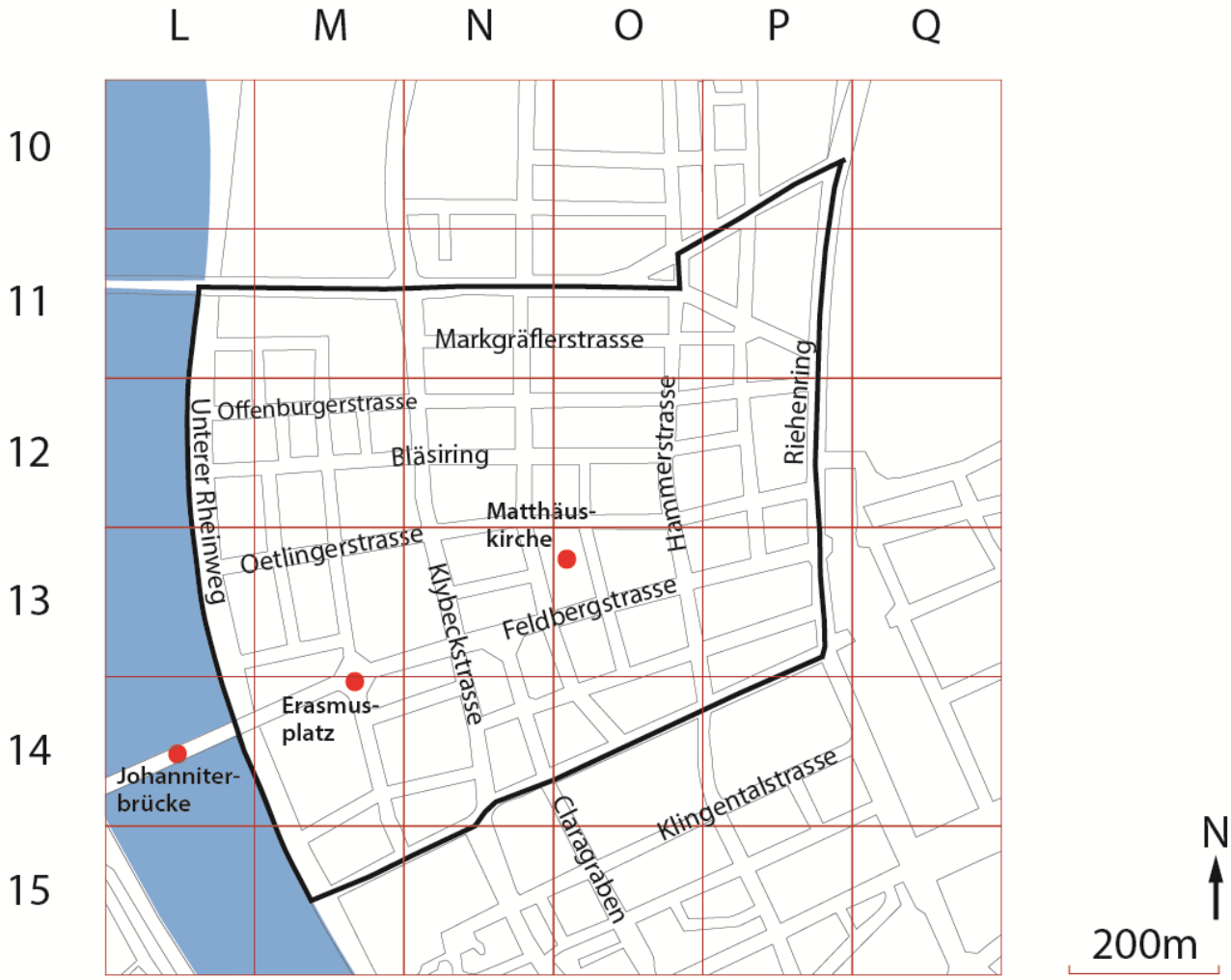
**Map for question D5**
Please look at the map of your quarter and mark the approximate location of your residence. Please state the coordinates (a combination of a letter and a number on the horizontal respectively vertical axis).

**Example (right)**
You live at the corner of Bläsiring / Müllheimerstrasse.
Answer: N12




## Thank you for your participation.

**If you would like to participate in the lottery for an Apple computer worth CHF 2500.- and two "Pro Innerstadt"-coupons each worth CHF 500.-, you can leave your name and address here**: