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The care pathway of patients hospitalized for influenza before admission to nursing home during the epidemic seasons of 2017-2018 and 2018-2019 in France

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Context and objectives of the Valorem study

Nursing home admissions during influenza epidemics

20,000 hospitalizations each year due to **influenza**

Primarily impacts **patients aged 65 and above**

About 1% of elderly patients hospitalized due to influenza subsequently require admission to a nursing home[1]

What is the **impact of influenza** on **elderly patients' care pathway** before admission into a nursing home?

STUDY OBJECTIVES

- **Sociodemographic characteristics and clinical profiles description** of patients
- **Care pathways' identification** prior to admission into a nursing home

1) Bernard-Stoecklin S. Fardeau de la grippe en France métropolitaine : bilan des données de surveillance des épidémies de 2011-2012 à 2021-2022. www.santepubliquefrance.fr;

Study design

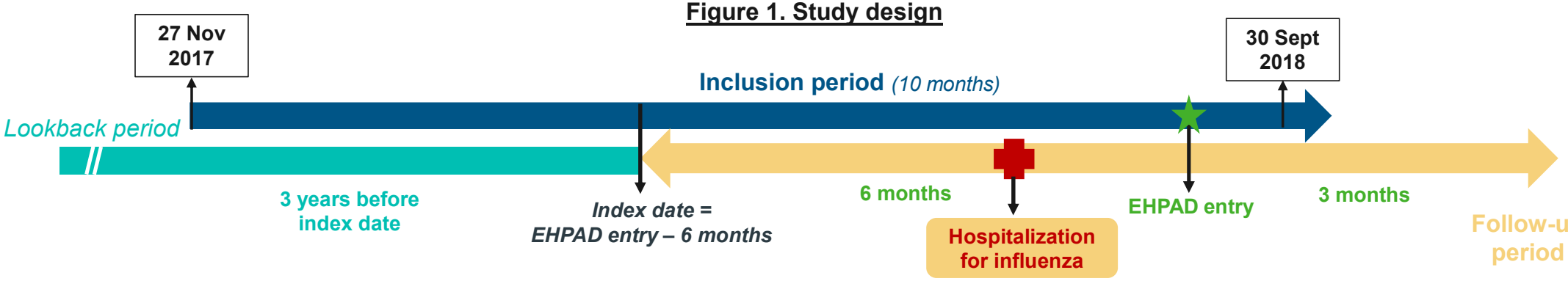
Focus on the 2017-18 epidemic season

Study conducted on the **National Health Data System (SNDS)** database and the **registry of Medico-Social Care (ESM)** – extraction period from 1st Nov 2014 to 31st Dec 2019

1. **Patients aged ≥65 admitted to a nursing home (NH)** between 27th Nov. 2017 and 30th Sept. 2018
2. With a **hospitalization due to influenza*** in the 6 months **before admission to a NH**

**MSO hospitalization with main, related of associated diagnosis for influenza (ICD10: J09-11)*

Figure 1. Study design



Search for comorbidities

Description of patient care pathway

- Influenza vaccination
- Healthcare resource utilization

Patients' characteristics

Patients with a hospitalization for influenza before admission to a nursing home

Figure 2. Patients' selection

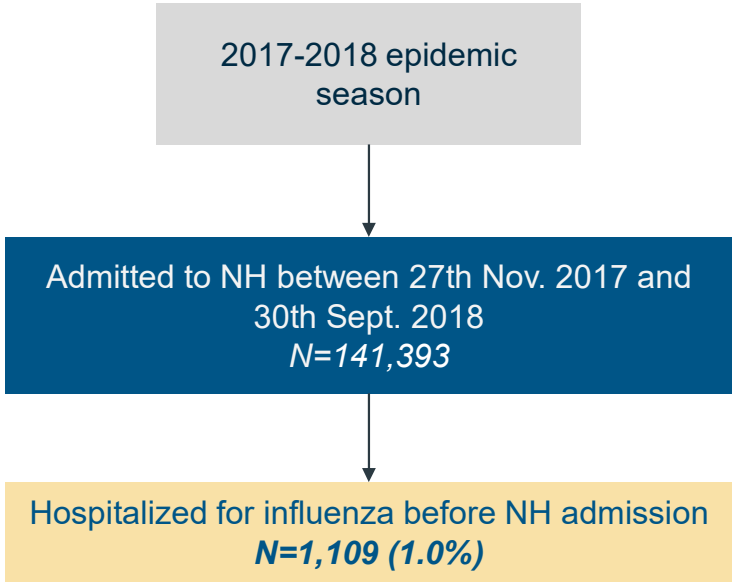


Table 1. Patients' characteristics

Age, median	87
Female, n (%)	723 (65.2)
Vaccination for influenza, n (%)	622 (56.1)
Death in the 3 months following admission, n (%)	117 (10.6)
At least one comorbidity (all-cause), n (%)	804 (72.6)
Cardiovascular	508 (45.8)
Respiratory	222 (20.0)
During the follow-up period	
At least one visit to GP or a specialist, n (%)	1,086 (97.9)
*Median number**	8
At least one MSO hospitalization, n (%)	1,109 (100)
*Median duration**	14
At least one SSR hospitalization, n (%)	643 (58.0)
*Median duration**	39

*among patients who experience the event during their follow-up

State Sequence Analysis (SSA) to build care pathways of elderly before nursing home admission

Care pathway as a sequence of events

- Analysis of the **consumed healthcare resources** (*events*)
- Discretization of the sequences with **weekly time stamps**

Example of a sequence of events

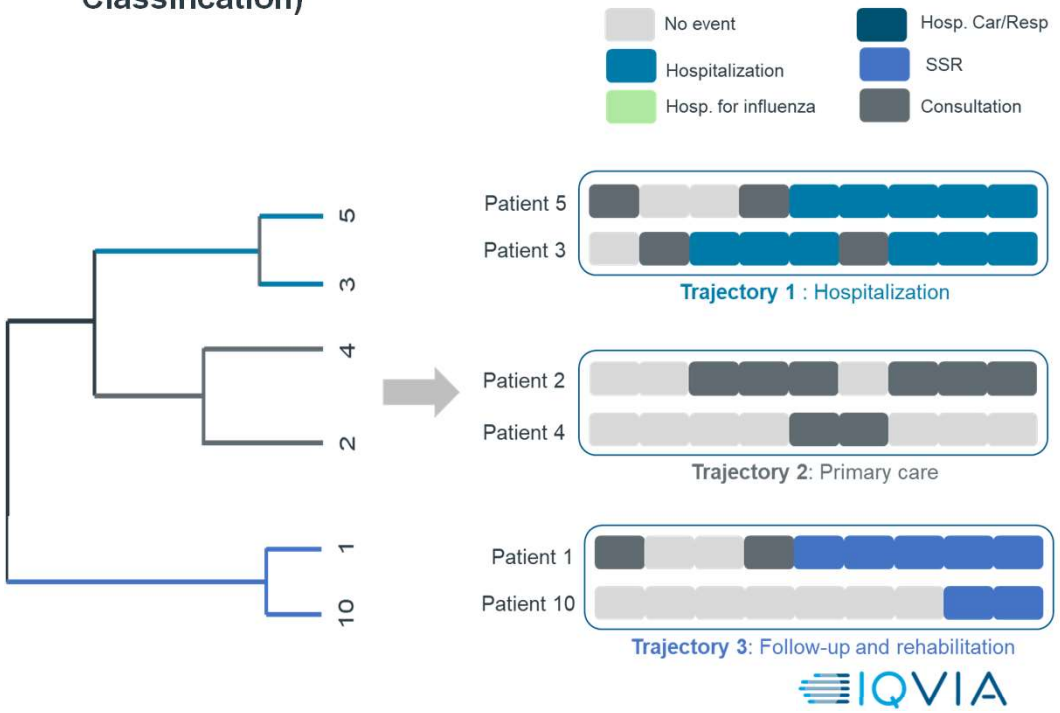
Time: W1 W2 W3 W4 W5

Hierarchical list of events arranged in order of importance for building the care pathways

1. Influenza vaccination
2. Emergency room visits without hospitalization
3. Hospitalization for influenza
4. MSO cardiac/respiratory hospitalization
5. MSO hospitalization (all-cause)
6. SSR hospitalization (all-cause)
7. GP or special consultation
8. *Ehpad entry (specific)*
9. Absence of event

Building a care pathway typology

- **Optimal Matching method** is used to evaluate the **similarities between *sequences***
- Use of a **clustering algorithm (Hierarchical Ascendant Classification)**

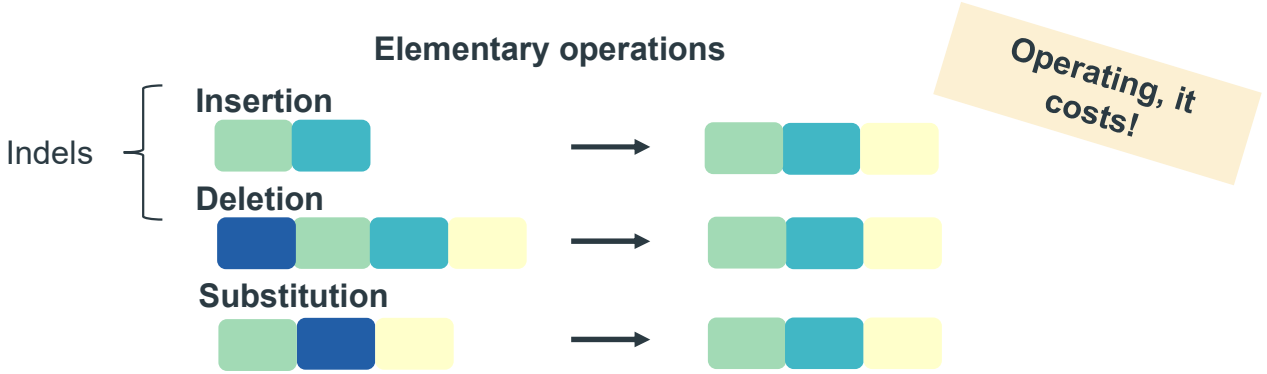


The concept of Optimal Matching

Assessing sequence similarity for cluster grouping

Principle of the method

- We **define elementary operations**, inspired by Bioinformatics (DNA mutations), and we assign a **cost** to each one



- **Distances between 2 patients = sum of the costs** of the minimal operations necessary to make the 2 sequences identical

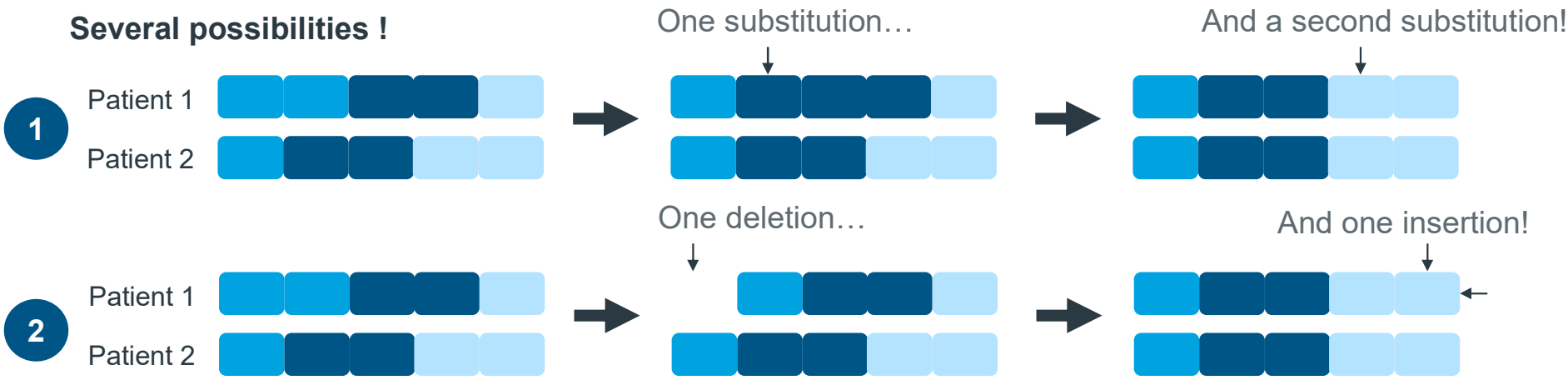
How do we make these two sequences identical?

The concept of Optimal Matching

Example of distance calculation between two sequences

How do we go from patient 1 to patient 2 ?

Several possibilities !



But which transformation do we choose between these two options?

- ✓ It depends on the **choice** of the **system of costs** – can be set **manually** or **automatically derived** from the data
- ✓ We choose the **minimal cost** as the **final *distance*** between the 2 patients

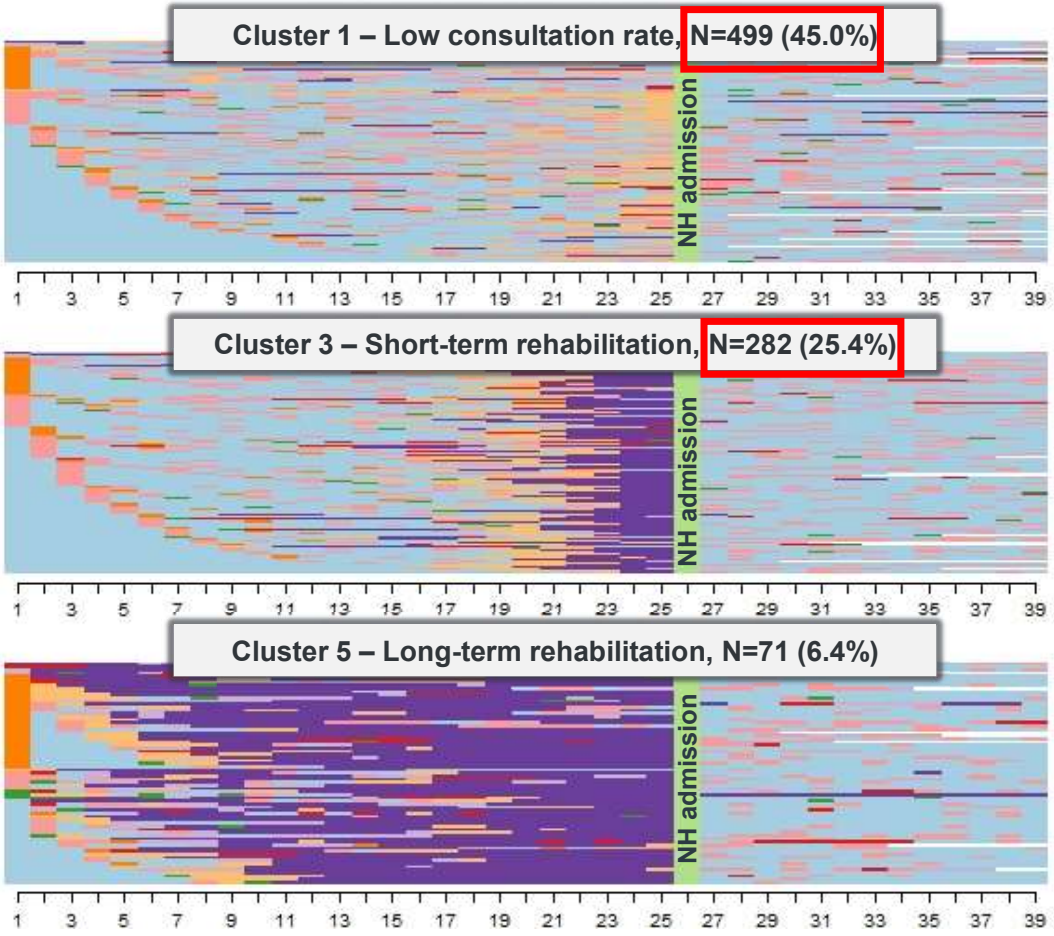
Example of costs

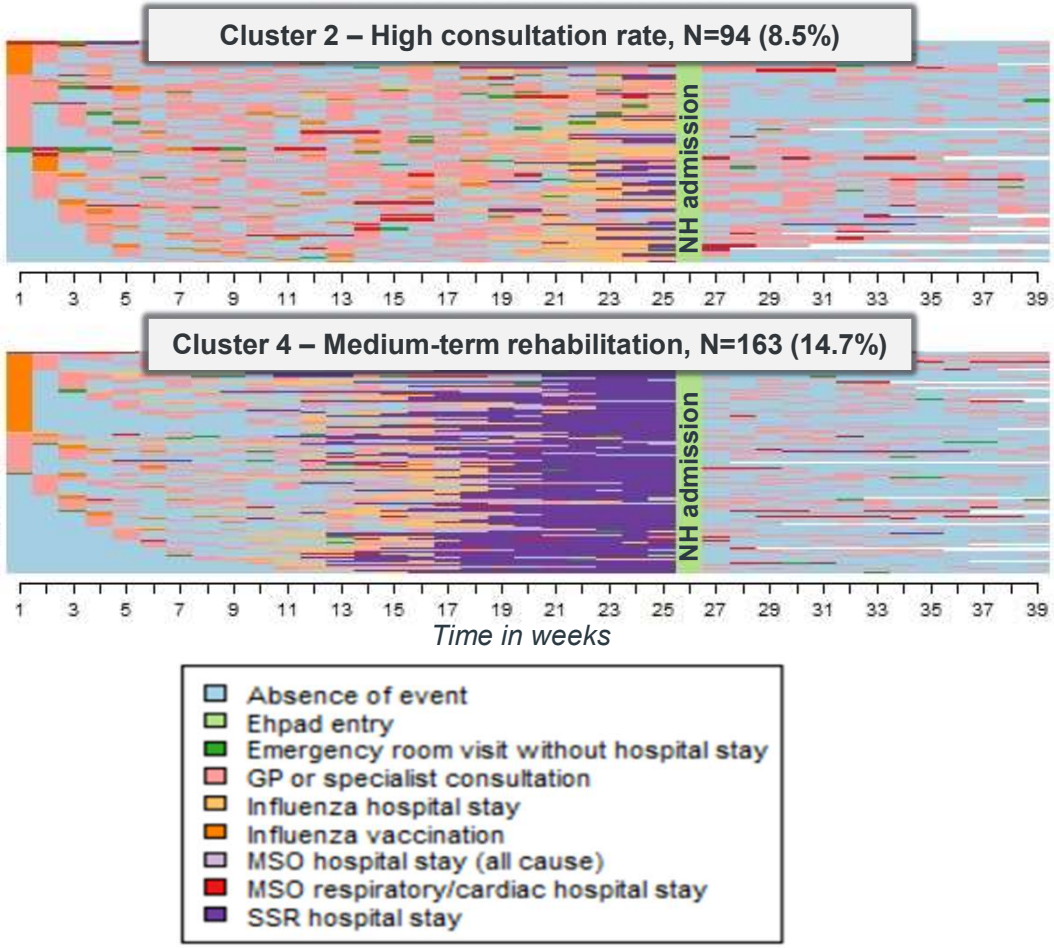
Indels	Substitution
0.5	1

1. 2 substitutions → **cost = 2**
2. 1 deletion + 1 insertion → **cost = 1**

Clusters of care pathways in patients hospitalized for influenza

Figure 3. Index plot visualization of the clusters





NH: Nursing Home
Epidemic season 2017-18

Summary of descriptive analysis for identified clusters

Table 2. Patients' characteristics in each cluster

Characteristics, n (%)	Cluster 1 – Low consultation rate, n=499 (45%)	Cluster 2 – High consultation rate, n=94 (8.5%)	Cluster 3 – Short-term rehabilitation, n=282 (25.4%)	Cluster 4 –Medium-term rehabilitation, n=163 (14.7%)	Cluster 5 – Long-term rehabilitation, n=71 (6.4%)
Age, median	87	88	87	87,5	88
Vaccination for influenza	282 (56.5)	**65 (69.1)**	156 (55.3)	**83 (50.9)**	**36 (50.7)**
Death in the 3 months following admission	49 (9.8)	11 (11.7)	30 (10.6)	20 (12.3)	≤10
At least one comorbidity (all-cause)	345 (69.1)	**75 (79.8)**	208 (73.8)	124 (76.1)	52 (73.2)
During the follow-up period					
At least one visit to GP or a specialist	490 (98.2)	94 (100.0)	276 (97.9)	158 (96.9)	68 (95.8)
Median number*	8	**17**	7	7,5	5,5
At least one SSR hospitalization	101 (20.2)	35 (37.2)	273 (96.8)	163 (100.0)	71 (100.0)
Median duration*	21	21	**32**	**61**	**111**

*among patients who experience the event during their follow-up

>50% with an influenza hospitalization followed by rehabilitation (SSR) before NH admission

Conclusion

Method

- This is the **1st study employing State Sequence Analysis (SSA) and Optimal Matching** to analyze **longitudinal care-pathways in elderly hospitalized for influenza before NH institutionalization** in a context of epidemic season
- **SSA** coupled with **Optimal Matching** is a great tool to :
  - ❖ Cluster patients with **similar care pathways**
  - ❖ **Allow for a simplified way to visualize the main different pathways**

Results

- **Cluster analysis** revealed that:
  - ❖ The **patient care pathways are driven by either SSR or the rate of consultations**
  - ❖ A **higher rate of comorbidities** among patients with **many consultations**
- After influenza hospitalization, **>50% of patients were managed in a rehabilitation unit** (SSR hospitalization) suggesting that influenza may lead to loss of functionality and dependance, promoting NH admission

Limits

- **Causal inference** between influenza hospitalization and NH admission **remains to be assessed**