

## **Title: Utilizing Artificial Intelligence (AI) to Monitor the Quality of Infection Therapy: Integrating CaseMix and Clinical Data to Enhance Care Quality**

### **Introduction**

CaseMix data is widely employed to develop specific quality indicators for monitoring healthcare quality. In Australia, the Hospital-acquired Complications (HAC) system is established, while Germany utilizes the Inpatient Quality Indicator (IQI) classification, with similar systems implemented in nearly every country that employs CaseMix for activitybased funding.

Despite these methodologies, certain questions necessitate additional clinical data. A critical area is Antimicrobial Stewardship (AMS), given that microbial resistance poses a global threat and the rational use of antibiotics is essential. Infectious disease (ID) specialists remain scarce in hospitals, and current AMS programs typically rely on cumulative analyses of antibiotic prescriptions, complemented by ward rounds. However, cumulative analyses do not provide insights into the specific infections for which drugs were prescribed, and ward rounds are time-consuming and lack broader applicability across wards, departments, or hospitals.

Our current research focuses on integrating CaseMix data, clinical information, and medication data using AI to enhance prescription quality. We have initiated a pilot project with a hospital in Germany.

### **Methods**

We utilize CaseMix data to extract information on infections and bacteria, as well as resistance patterns, through the Infection Grouper (IMR). After grouping patients by IMR, each patient is associated with one or more infection episodes. Next, we link laboratory and antibiotic prescription data to these infection episodes. Using AI (ChatGPT), we convert local therapy guidelines into machine-readable formats.

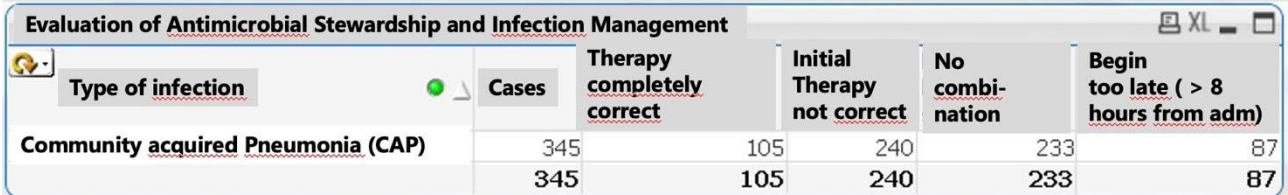
Subsequently, we conduct an algorithmic analysis of all prescriptions to assess whether treatments are guideline-compliant and appropriate. Typical quality indicators include:

- Timely initiation of therapy (within 1-8 hours after admission)
- Guideline-adherent initial therapy (correct substance, dosage, and application)
- Consideration of microbiology results
- Appropriate duration of therapy

## Results

This approach enables us to analyze specific infections, such as Community-Acquired Pneumonia (CAP), using an extensive dataset. We gain insights into length of stay, patient outcomes, and other economic results relative to the quality of antibiotic prescriptions. Furthermore, we can evaluate whether the antibiotic treatments align with guidelines.

The picture shows an overview:



The screenshot displays a software interface with a table titled "Evaluation of Antimicrobial Stewardship and Infection Management". The table has the following columns: "Type of infection", "Cases", "Therapy completely correct", "Initial Therapy not correct", "No combination", and "Begin too late (> 8 hours from adm)". The data row for "Community acquired Pneumonia (CAP)" shows 345 cases, with 105 correct, 240 incorrect, 233 no combination, and 87 starting too late. A second row repeats the total counts for each category.

Type of infection	Cases	Therapy completely correct	Initial Therapy not correct	No combination	Begin too late (> 8 hours from adm)
Community acquired Pneumonia (CAP)	345	105	240	233	87
	345	105	240	233	87

The integration of AI allows for the adaptation of the system to local guidelines.

## Discussion/Conclusions

To our knowledge, this is the first tool that combines CaseMix and clinical data for infection analysis. Each hospital has distinct therapy guidelines, often tailored to local resistance patterns. By leveraging AI to process these guidelines and convert them into machinereadable tables, we facilitate the adaptation of analytics to local practices across different hospitals.

Preliminary comparisons with patient records indicate a high validity of the automatically generated assessments. However, validation of AI-generated results on a larger cohort by trained ID specialists is still required.

We created an analysis screen to assess results on a patient level:

## Patient-level analysis

Fall						
Geschl.	Alter	Auf-Datum	Auf-Grund	Ent-Datum	Ent-Grund	Beat.-h
w	79	22.01.2023 11:02	0101	27.01.2023 13:26	012	0

DRG											
DRG	Text	VWD	uGVD	MVD	oGVD	PCCL	eff. KG	Kat. KG	Eff. Erlös	Kat. Erlös	LK
E79C	Infektionen und Entzündungen der Atmungsorgane ohne komplexe Diagnose, ohne äußerst schwere CC oder ein B...	5	1	6,6	14	0	0,605	0,605	2.420,43€	2.420,43€	UM

Diagnosen			Labor		
HD/ND	ICD	Text	LABZ_D	LAB	LABZ
HD	J18.1	Lobärpneumonie, nicht näher bezeichnet	22.01.2023	CRP	13,11
ND	I10.90	Essentielle Hypertonie, nicht näher bezeichnet. Ohne Angabe ei...	22.01.2023	LEUCO	14,60
	Z11	Spezielle Verfahren zur Untersuchung auf infektiöse und parasit...	23.01.2023	CRP	10,32
			23.01.2023	LEUCO	10,50
			23.01.2023	PCT-Q	0,40
			23.01.2023	S-LE...	
			23.01.2023	UUE	
			26.01.2023	CRP	2,09
			26.01.2023	LEUCO	7,80

Antibiose							
Start	Ende	Applikati...	Bezeichnung	Verordnungstext	ATC Code	Medikament	Chemische Gruppe
22.01.2023 13:30:00	23.01.2023 12:00:00	peroral	AZI-TEVA® 500 mg Filmtabletten	Anwendung: 1-0-0 Stk...	J01FA10	Azithromycin	Makrolide
22.01.2023 13:30:00	27.01.2023 13:26:00	intravenös	Ampicillin/Subactam Kabi 2000 mg/...	Anwendung: 1-1-1-0 Stk...	J01CR01	Ampicillin und Beta-Lactamase-Inhibitoren	Kombinationen von Pe...

A 79 year old Lady is admitted to hospital for 5 days

The laboratory values strongly suggest a bacterial infection

The PDx is Pneumonia → CAP

She receives guideline adherent therapy

CRP as main infection parameter goes down nicely and we can discharge her 😊

In conclusion, the use of AI-generated assessments in infection management has the potential to deliver comprehensive results swiftly, thus conserving valuable clinician time.