



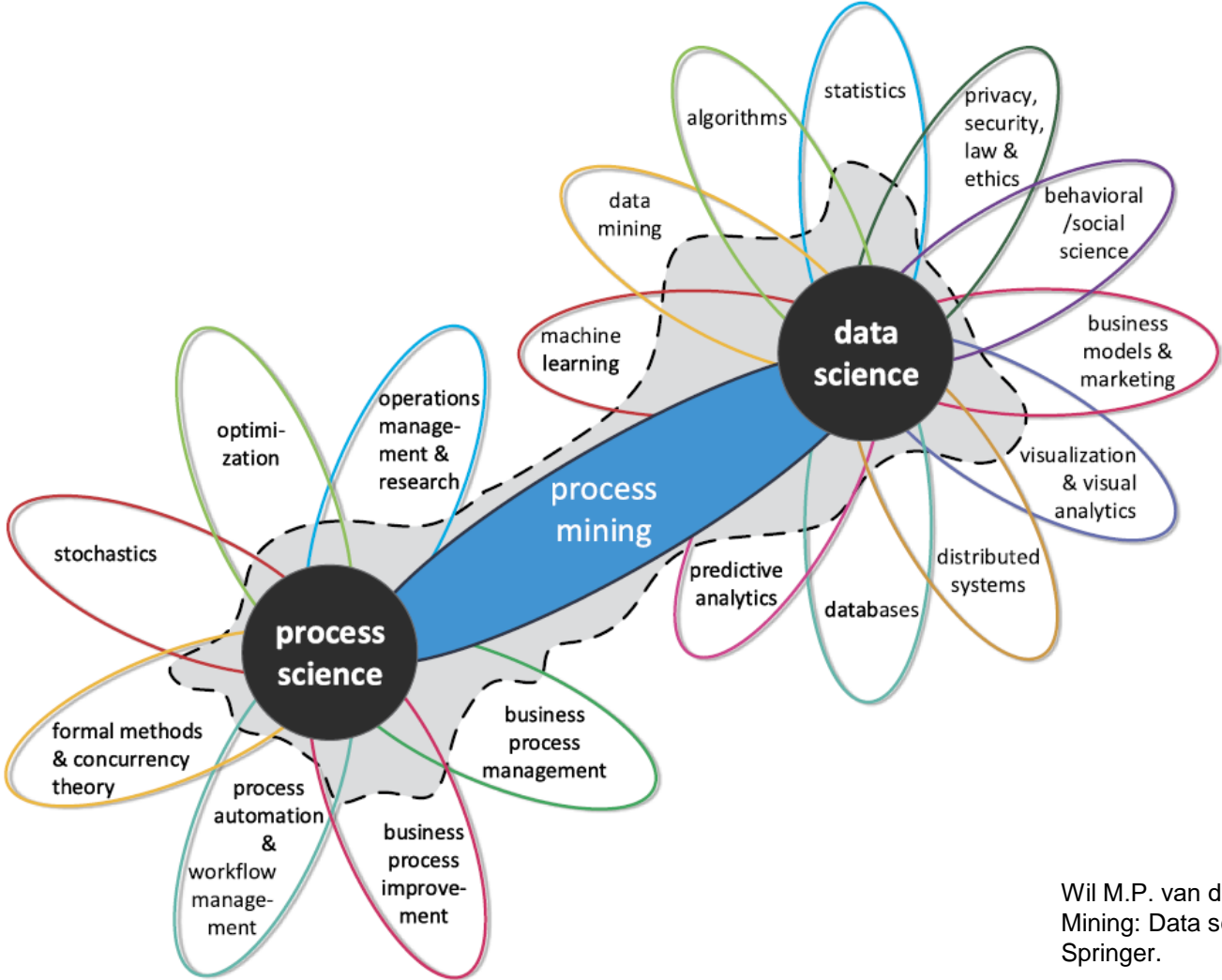
Analyzing Medical Data with Process Mining: a COVID-19 Case Study

Marco Pegoraro, Madhavi Bangalore Shankara Narayana, Elisabetta Benevento,
Wil M.P. van der Aalst, Lukas Martin, Gernot Marx

12th Workshop on Applications of Knowledge-Based Technologies in Business
June 14th 2021



Process mining



Wil M.P. van der Aalst. "Process Mining: Data science in action." Springer.

Event log

Case id	Event id	Properties				...
		Timestamp	Activity	Resource	Cost	
1	35654423	30-12-2010:11.02	register request	Pete	50	...
	35654424	31-12-2010:10.06	examine thoroughly	Sue	400	...
	35654425	05-01-2011:15.12	check ticket	Mike	100	...
	35654426	06-01-2011:11.18	decide	Sara	200	...
	35654427	07-01-2011:14.24	reject request	Pete	200	...
2	35654483	30-12-2010:11.32	register request	Mike	50	...
	35654485	30-12-2010:12.12	check ticket	Mike	100	...
	35654487	30-12-2010:14.16	examine casually	Pete	400	...
	35654488	05-01-2011:11.22	decide	Sara	200	...
	35654489	08-01-2011:12.05	pay compensation	Ellen	200	...
3	35654521	30-12-2010:14.32	register request	Pete	50	...
	35654522	30-12-2010:15.06	examine casually	Mike	400	...
	35654524	30-12-2010:16.34	check ticket	Ellen	100	...
	35654525	06-01-2011:09.18	decide	Sara	200	...
	35654526	06-01-2011:12.18	reinitiate request	Sara	200	...
	35654527	06-01-2011:13.06	examine thoroughly	Sean	400	...
	35654530	08-01-2011:11.43	check ticket	Pete	100	...
	35654531	09-01-2011:09.55	decide	Sara	200	...
	35654533	15-01-2011:10.45	pay compensation	Ellen	200	...

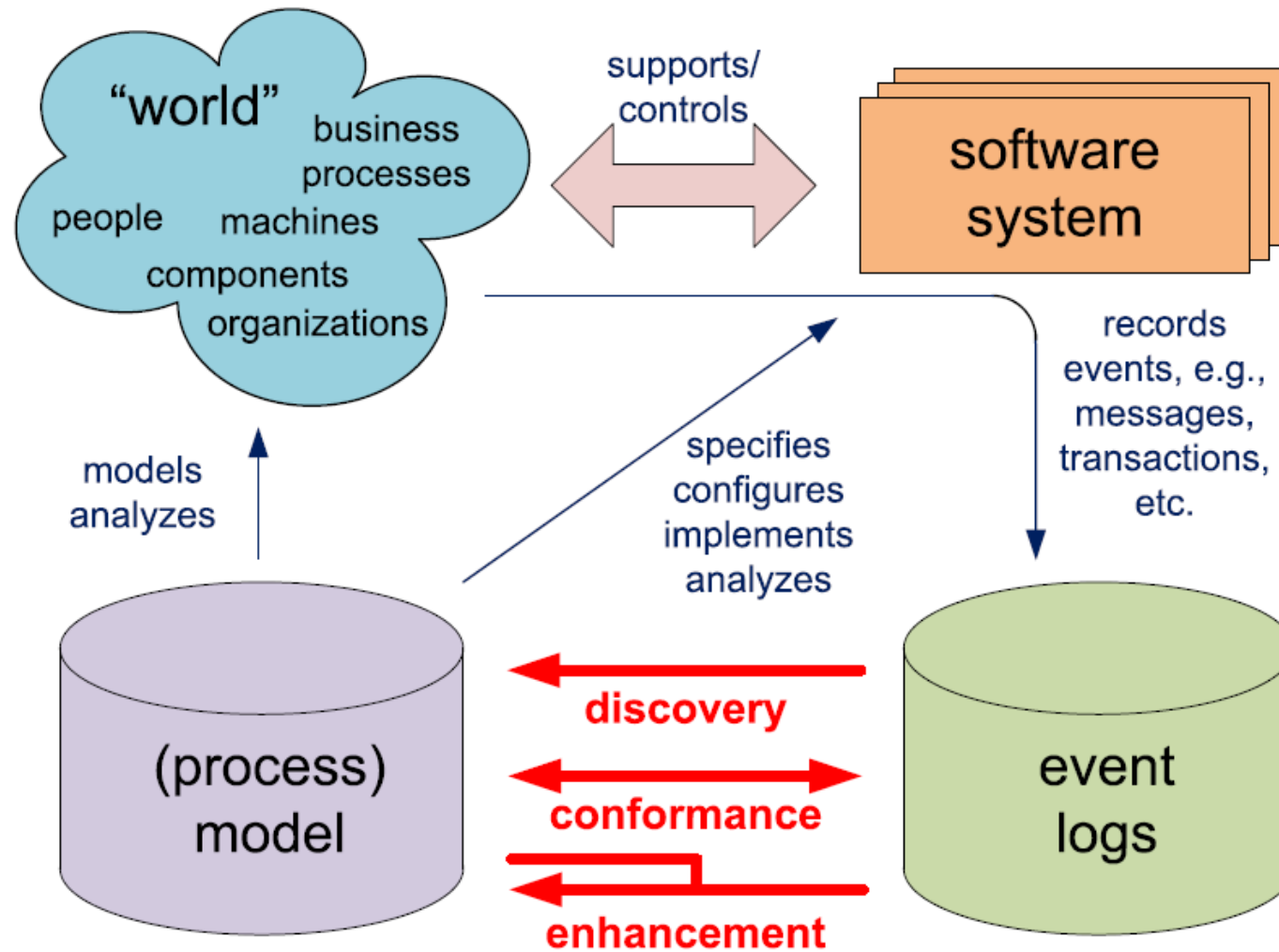
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Process mining



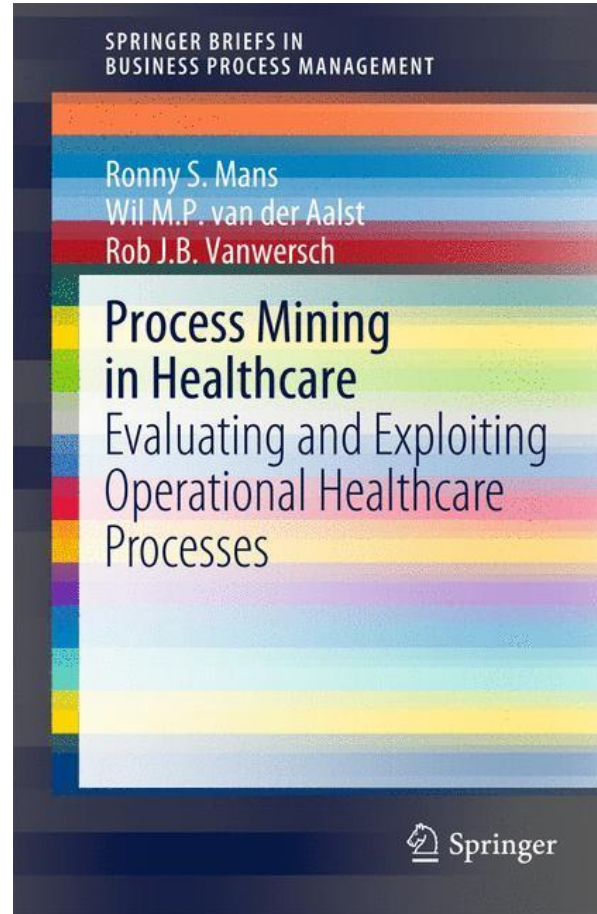
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Process Mining for Healthcare

Process mining: not only business processes!

Many success stories in the field of healthcare

On hospital data, clinical data, logistic data



<https://pods4h.com/alliance/>

Mans, Ronny S., Wil MP Van der Aalst, and Rob JB Vanwersch. *Process mining in healthcare: evaluating and exploiting operational healthcare processes*. Springer, 2015.



526

526

285,640

564,225



COVAS data

COrona**V**irus **A**achen **S**tudy (**COVAS**):
data from a cohort of COVID-19 patients
of the Aachen Uniklinik hospital

Spanning between **February 2020** and **December 2020**

216 cases, of which 196 are complete and 20 are ongoing

https://www.cbmb.ukaachen.de/register_studien/covas-studie/

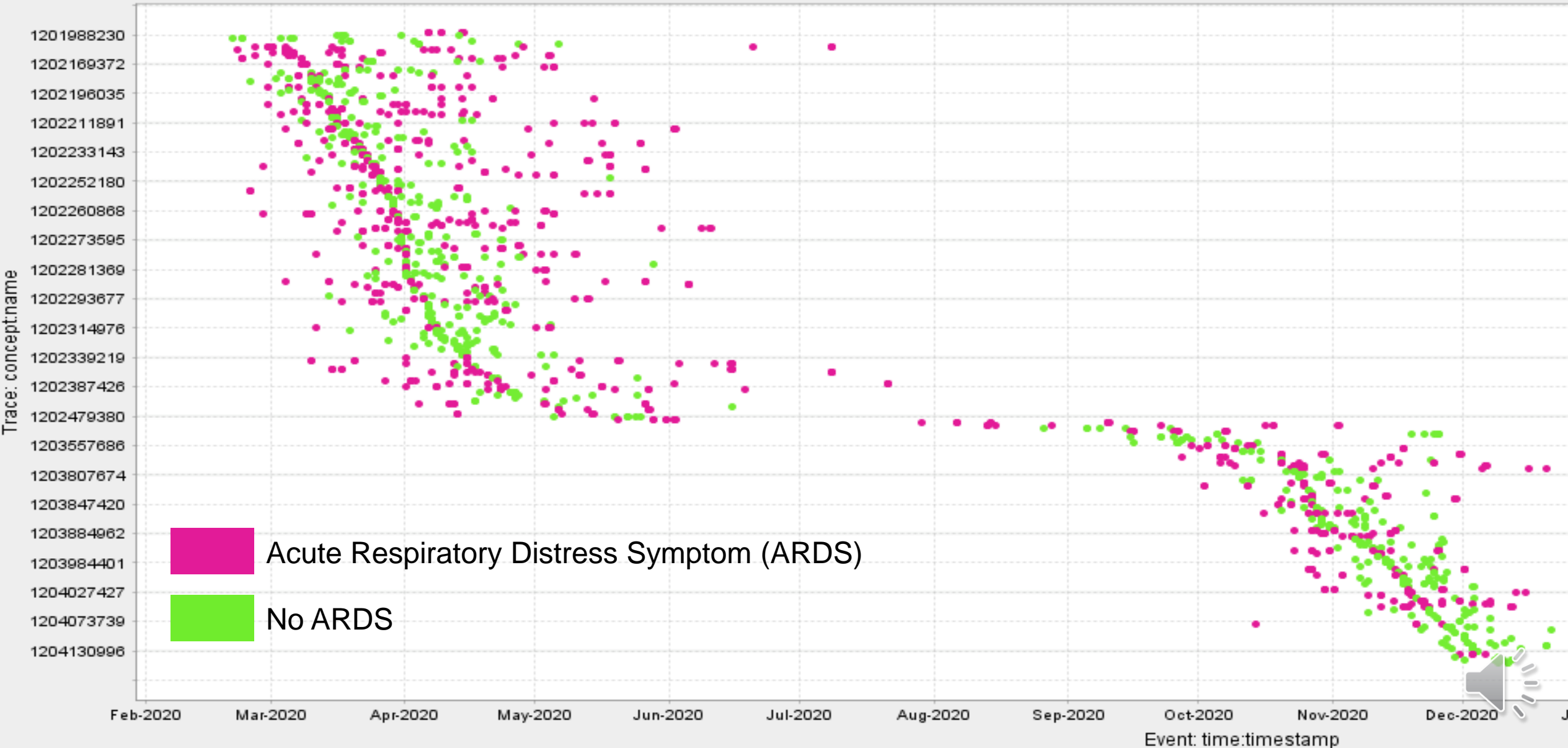
COVAS data

14 activities, including information on:

- COVID-19 symptoms
- Hospitalization/discharge
- ICU admission/discharge
- Oxygen
- Mechanical ventilation
- ExtraCorporeal Membrane Oxygenation (ECMO)

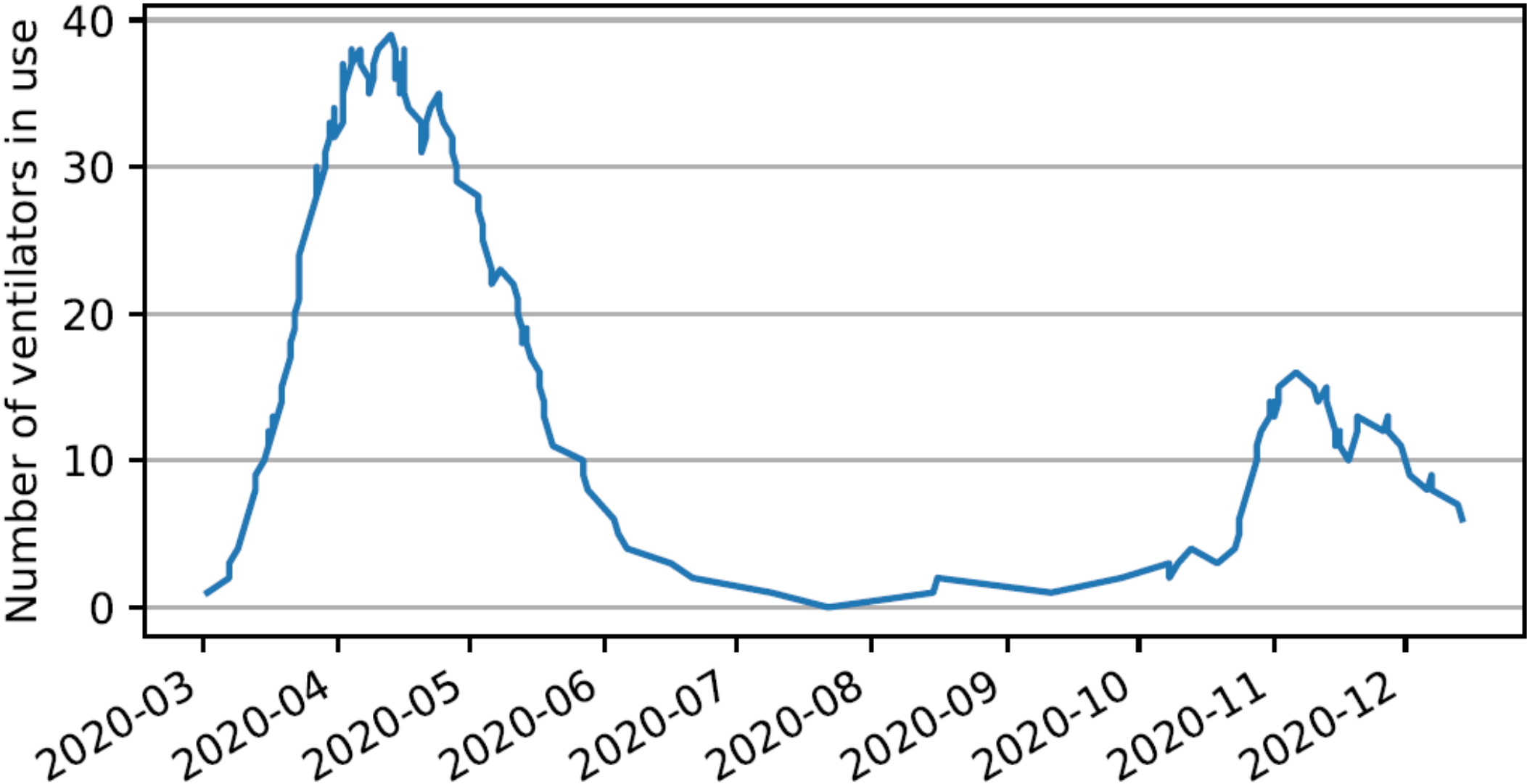
https://www.cbmb.ukaachen.de/register_studien/covas-studie/

COVAS data – Dotted chart



COVAS data – Mechanical ventilation

Usage of mechanical ventilators



First wave (133 cases) against
second wave (63 cases)

The average case resolution time is

- 33 days and 6 hours (first wave)
- 23 days and 1 hour (second wave)

This indicates a significant improvement in efficiency

Possible causes:

- lower ICU occupation
- better prepared medical personnel
- better medical equipment and resources

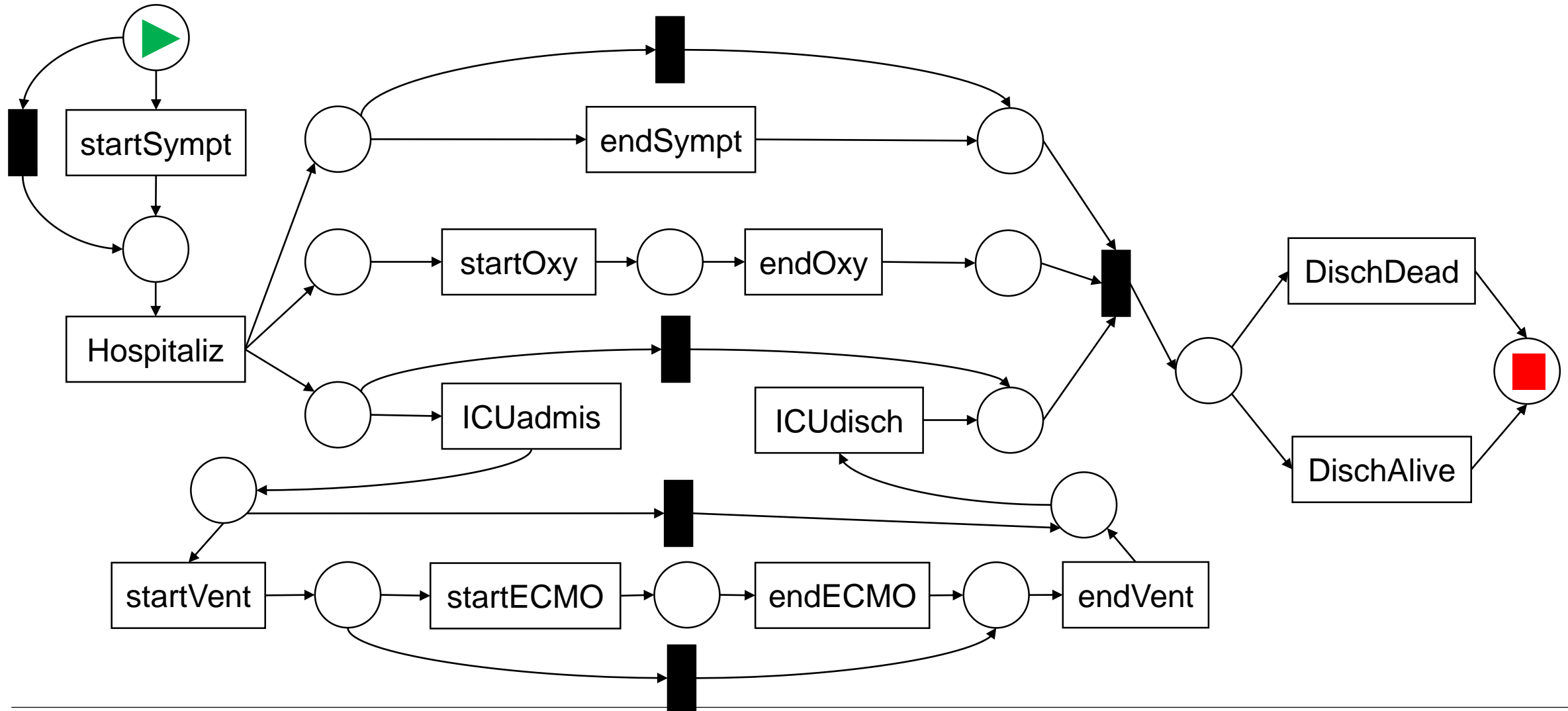
COVAS data – Process model

Process mining allows to automatically learn a process model from event data (**process discovery**)

This model provides a **description of the process**

The model can be adjusted by **process experts**

COVAS data – Petri net model (Interactive Discovery)



COVAS data – Process model

The data available follows the model **very well**

98% of the patient's data fit the model perfectly

This is an indication of a very compliant process, and of data with very little noise

Conclusion

Process mining techniques are **effective** in **gaining insights from data** in healthcare settings

Data and process sciences can help fight phenomena like the COVID-19 pandemics

To address: ever-growing need for **clean, reliable data!**



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Thank you!



References

1. Mans, Ronny S., Wil M.P. Van der Aalst, and Rob J.B. Vanwersch. *Process mining in healthcare: evaluating and exploiting operational healthcare processes*. Springer, 2015.
2. Wil M.P. van der Aalst. "Process Mining: Data science in action." *Process mining*. Springer.
3. Dixit, P.M., Verbeek, H.M.W., Buijs, J.C.A.M., van der Aalst, W.M.P.: Interactive data-driven process model construction. In: Trujillo, J.C., Davis, K.C., Du, X., Li, Z., Ling, T.W., Li, G., Lee, M.L. (eds.) ER 2018. LNCS, vol. 11157, pp. 251–265. Springer, Cham (2018)., Heidelberg, 2016. 3-23.