



Universität St.Gallen

School of Medicine

The association of hospital profitability and digital maturity – An explorative study using data from the German DigitalRadar project

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From insight to impact.

Is a hospital's digital maturity associated with its profitability?

What other hospital characteristics are associated with hospitals' digital maturity?

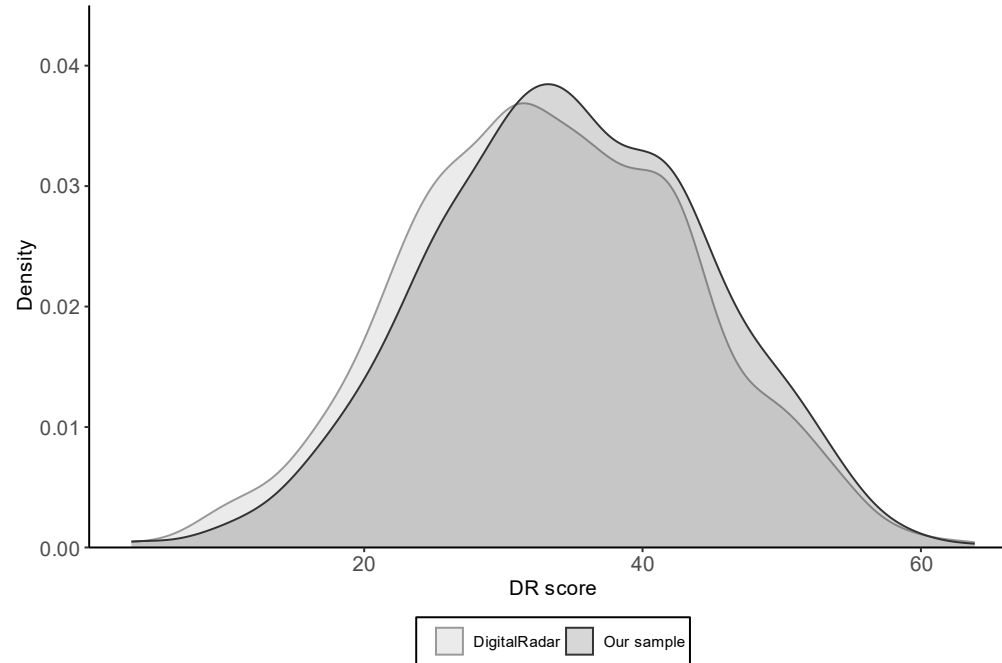
Methods | We follow a three-step explorative, empirical approach to answer the set research questions

- 1 We **identify potentially influential hospital characteristics** such as chain membership and chain size using descriptive statistics
- 2 We conduct **multivariate linear regressions** with hospitals' DR-score as dependent and hospitals' EBITDA margin as variable of interest
- 3 We **stratify by chain size** to uncover heterogeneities in the profitability-digitization relationship

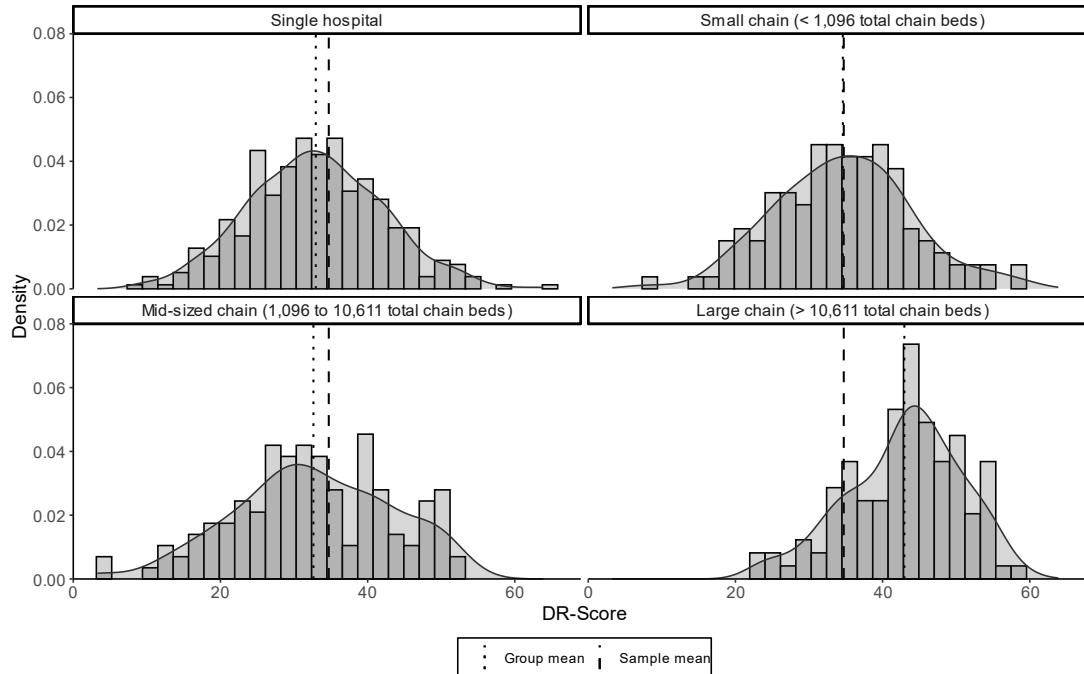
Data | We use data from four different sources and match all variables on hospital site level – final sample of 756 hospitals

Data category	Source(s)	Variable(s)	Data year	Data level	Matched to hospital sites via...
Digital maturity	DigitalRadar [2]	DR-score	2021	Hospital - site	
Profitability	Hospital Rating Report 2022 [10] Dafne database [42]	EBITDA margin	2020	Hospital site or hospital chain	If a hospital is part of a chain, the chain EBITDA margin was assigned to all sites of a chain
Hospital characteristics	German Hospital Directory [43]	Number of beds, ownership type	2021	Hospital site or hospital	If needed, hospital site addresses were used in addition to unique hospital identifiers
	Hospital Rating Report 2022 [10]	Chain membership	2020		
	INKAR database [44]	Federal state	2021		
County level controls	INKAR database [44]	Income tax revenue, population density	2021	County	Zip-code of hospital site was matched with zip-code's county ID

Data | Distribution of DR-scores similar for total DR-sample (~1,600 hospitals) and our sample (756 hospitals)



Descriptive results DR-score | Large chains exhibit higher DR-scores than single hospitals and smaller chains



375 hospitals are single hospitals, 127 hospitals are part of a small chain, 137 hospitals are part of a mid-sized chain, and 117 hospitals are part of a large chain

Small chains have less than 1,096 chain beds, mid-sized chains have between 1,096 and 10,611 chain beds, and large chains have more than 10,611 chain beds

Only two chains are part of the “large chain” group

More descriptives | Two values of EBITDA margins for large chains

Variable	N	Mean	Std. Dev.	Min	Median (IQR)	Max
<i>DR-score</i>	756	34.72	9.91	3.27	34.60 (14.08)	63.87
Single hospitals	375	32.95	9.12	8.98	32.75 (13.06)	63.87
Small chains	127	34.59	9.28	7.77	34.58 (12.13)	58.97
Mid-sized chains	137	32.63	10.69	3.27	32.22 (14.48)	51.52
Large chains	117	42.95	7.7	23.69	43.82 (10.68)	58.98
<i>EBITDA margin</i>	756	5.16	4.49	-16.33	4.88 (5.41)	18.45
Single hospitals	375	4.12	4.36	-16.33	3.96 (4.07)	18.45
Small chains	127	3.86	4.51	-9.81	3.52 (5.75)	14.28
Mid-sized chains	137	4.42	2.52	-0.14	4.88 (5.03)	7.35
Large chains	117	10.78	1.58	8.89	12.09 (3.21)	12.09
<i>Beds, in 100s</i>	756	3.152	2.30	0.20	2.55 (2.96)	11.81
Single hospitals	375	3.23	2.36	0.20	2.61 (2.94)	11.81
Small chains	127	2.88	2.00	0.31	2.41 (2.4)	10.42
Mid-sized chains	137	3.48	2.32	0.46	3.00 (3.31)	10.65
Large chains	117	2.82	2.34	0.34	2.09 (2.42)	11.50
<i>Chain beds, in 100s</i>	756	37.493	65.13	0.20	5.5 (25.73)	214.41
Single hospitals	375	3.23	2.36	0.20	2.61 (2.94)	11.81
Small chains	127	6.39	2.77	0.34	6.66 (4.43)	10.50
Mid-sized chains	137	43.57	36.09	10.96	31.15 (17.69)	106.11
Large chains	117	173.95	48.71	115.80	214.41 (98.61)	214.41

Both the DR-score and EBITDA margins for large chains are a lot higher than for the rest of the sample

Homogenous distribution of EBITDA margin limits interpretability of stratification results for large chains (see next slide)

OLS-Regression | Depending on controls, effects are different

	Dependent variable: DR-Score					
	(1)	(2)	(3)	(4)	(5)	(6)
EBITDA margin	0.357*** (0.108)	0.354*** (0.111)	0.329*** (0.113)	0.044 (0.107)	0.050 (0.107)	0.202* (0.109)
Base: Public ownership						
Private non-profit	-3.798*** (0.814)	-3.280*** (0.841)		-4.418*** (0.788)	-4.566*** (0.789)	-3.422*** (0.838)
Private for-profit	-1.295 (1.248)	-2.845** (1.275)		-10.845*** (1.395)	-10.180*** (1.306)	-8.265*** (1.621)
Chain		3.092*** (0.731)				
Base: Single hospital * private for-profit						
Single hospital * public			5.535*** (1.967)			
Chain * public			8.373*** (2.084)			
Single hospital * private nonprofit			2.653 (1.880)			
Chain * private non-profit			4.308** (1.890)			
Chain * private for-profit			6.441*** (1.892)			
Chain beds (in 100)				0.089*** (0.008)		
Base: single hospital						
Small chain					0.897 (0.922)	
Mid-sized chain					1.249 (0.919)	
Large chain					16.340*** (1.435)	
Base: Not part of "big 3" "Big 3" hospitals						
						10.763*** (1.634)
Hospital-level beds	Yes	Yes	Yes	No	No	Yes
County-level controls	No	Yes	Yes	Yes	Yes	Yes
Federal state dummies	No	Yes	Yes	Yes	Yes	Yes
Constant	29.288*** (1.226)	29.525*** (2.190)	24.980*** (2.721)	37.183*** (1.867)	36.898*** (1.852)	31.653*** (2.189)
N	756	756	756	756	756	756
R2 (adjusted)	0.125	0.159	0.163	0.223	0.240	0.207

Asterisks indicate the significance level

*** p < 0.01

** p < 0.05

* p < 0.10

Stratification | Profitability-digitization relationship found for large chains and “Big 3” hospitals

	Dependent variable: DR-Score					
	(1) Single hospitals	(2) Small chains	(3) Mid-sized chains	(4) Large chains	(5) Not part of big 3	(6) Big 3 hospitals
EBITDA margin	0.066 (0.128)	-0.343** (0.157)	0.958 (0.635)	1.904*** (0.407)	0.003 (0.107)	3.012*** (0.298)
Ownership controls	Yes	Yes	Yes	No	Yes	No
Hospital-level beds	Yes	Yes	Yes	Yes	Yes	Yes
County-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Federal state dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	375	127	137	117	606	150
R ² (adjusted)	0.088	0.303	0.573	0.477	0.168	0.564

Asterisks indicate the significance level

*** p < 0.01

** p < 0.05

* p < 0.10

More descriptives | 33 mid-sized chain hospitals are part of “big 3”

Variable	Single hospital			Small chain			Mid-sized chain			Large chain			p-value
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	
DR-score	375	32.95	9.12	127	34.59	9.28	137	32.63	10.69	117	42.95	7.70	< 0.001
EBITDA margin	375	4.12	4.36	127	3.86	4.51	137	4.42	2.52	117	10.78	1.58	< 0.001
Beds, in 100s	375	3.23	2.36	127	2.88	2.00	137	3.48	2.32	117	2.82	2.34	0.023
Chain beds, in 100s	375	3.23	2.36	127	6.39	2.77	137	43.57	36.09	117	173.96	48.71	< 0.001
<i>Ownership</i>	375			127			137			117			< 0.001
Public	130	34.7%		59	46.5%		34	24.8%		0	0%		
Nonprofit	202	53.9%		57	44.9%		54	39.4%		0	0%		
Private	43	11.5%		11	8.7%		49	35.8%		117	100%		
<i>Chain membership</i>	375			127			137			117			< 0.001
Not in a chain	375	100%		0	0%		0	0%		0	0%		
Part of a chain	0	0%		127	100%		137	100%		117	100%		
<i>Big 3 indicator</i>	375			127			137			117			< 0.001
Not part of Big 3	375	100%		127	100%		104	75.9%		0	0%		
Big 3 hospitals	0	0%		0	0%		33	24.1%		117	100%		
<i>Income tax level</i>	375			127			137			117			0.140
Lowest	110	29.3%		45	35.4%		48	35.0%		49	41.9%		
Middle	133	35.5%		40	31.5%		50	36.5%		29	24.8%		
Highest	132	35.2%		42	33.1%		39	28.5%		39	33.3%		
<i>Population density</i>	375			127			137			117			< 0.001
Lowest	116	30.9%		37	29.1%		39	28.5%		60	51.3%		
Middle	135	36.0%		47	37.0%		42	30.7%		28	23.9%		
Highest	124	33.1%		43	33.9%		56	40.9%		29	24.8%		

Discussion and conclusion | Chain membership and chain size are most strongly associated with digitization

- 1 Profitability seems to play some **(minor) role** for digitization
- 2 Central IT **strategy and standards**, centralized IT **infrastructure**, internal **policies** and **cross-financing** might play a more important role
- 3 All hospitals might benefit from **federal standards**
- 4 Single hospitals and smaller chains could **organize to develop IT strategy**



In any case: More research is needed to unveil the relationship between profitability and hospital digitization – for Germany and beyond!

Causal patterns to be evaluated after the next DR-data collection

Thanks!



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