

Are survivors of cardiac arrest provided with standard cardiac rehabilitation? – Results from a national survey of hospitals and municipalities in Denmark

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1 **Title: Are survivors of cardiac arrest provided with standard cardiac**
2 **rehabilitation? – Results from a national survey of hospitals and municipalities**
3 **in Denmark.**

4

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19

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21

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23

24 **Abstract**

25 **Aim**

26 To quantify the provision of standard cardiac rehabilitation to Danish survivors of cardiac arrest at a
27 programme level, and to analyse whether organisational factors influenced the provision.

28 **Method**

29 We mapped the provision of cardiac rehabilitation core components to survivors of cardiac arrest
30 and compared this to a reference group of patients after acute myocardial infarct (AMI) using data
31 from a cross-sectional program-level survey among all hospitals (n=34) and municipalities (n= 98)
32 in Denmark. Organisational factors of potential importance to service provision were considered:
33 health care region, size of catchment area/population, type of department/municipality and socio-
34 economical index.

35 **Results**

36 Response rates for the provision of each core component of cardiac rehabilitation ranged from 64%
37 to 98%. All hospitals and municipalities provided some aspect of cardiac rehabilitation to survivors
38 of cardiac arrest. Across hospitals, provision of four core components of cardiac rehabilitation to
39 survivors of cardiac arrest was lower compared to post AMI patients: patient education (RR=0.45
40 (95% CI 0.27 to 0.75)), exercise training (RR=0.69 (95% CI 0.49 to 0.98)), screening for anxiety
41 and depression (RR=0.64 (95% CI 0.46 to 0.90), and nutritional counselling RR=0.76 (95% CI 0.62
42 to 0.93)). No difference was found in the provision of core components across municipalities.

43 Overall, the provision of cardiac rehabilitation to survivors of cardiac arrest was not affected by
44 organizational factors

45 **Conclusion**

46 This study indicates a need for future research to inform the development, adoption and
47 implementation of equal access to all components of cardiac rehabilitation for survivors of cardiac
48 in Denmark

49

50 **Introduction**

51 Survival after an out-of-hospital cardiac arrest is increasing due to improvements in bystander
52 resuscitation and improved acute hospital care^{1,2}. In Denmark, one year survival after out-of-hospital
53 cardiac arrest improved from 3.9% to 16% between 2001 and 2018 meaning there are at least 800
54 new survivors of out-of-hospital cardiac arrest every year³. Cardiac arrest may cause brain injury in
55 up to 50% of survivors of cardiac arrest. This, combined with underlying cardiac conditions, causes
56 survivors to suffer from a wide range of cognitive, psychological or physical problems impacting
57 negatively on their quality of life^{2,4,5}. Hence, rehabilitation to meet survivors needs has been
58 recommended in international guidelines including those produced by the European Resuscitation
59 Council⁶.

60 Cardiac rehabilitation is a comprehensive intervention that commonly includes the following core
61 elements: physical training, patient education, psychosocial management and secondary prevention⁷.
62 In Denmark, guidelines state patients should be systematically referred to cardiac rehabilitation after
63 ischemic heart disease^{8,9}. An attendance rate of 48% aligns with the standard rate for Europe¹⁰ and
64 the United Kingdom¹¹. It has been recommended for survivors of cardiac arrest of cardiac cause for
65 secondary prevention of cardiac disease¹²⁻¹⁴ and recent studies have found it to be tolerable and to
66 optimize survivors' physical condition^{15,16}.

67 Post cardiac arrest care has previously been mapped in Sweden and the Netherlands but these studies
68 focused on the post-hospital discharge phase, i.e. the provision of out-patient clinic follow-up to
69 survivors and families¹⁷ and screening for cognitive impairments and referral to cognitive
70 rehabilitation¹⁸. Mapping the provision of cardiac rehabilitation to survivors of cardiac arrest can
71 inform future development, adoption and implementation of rehabilitation services to the survivors
72 but, to our knowledge, have not previously been undertaken.

73 In Denmark, cardiac rehabilitation is provided either in hospital or local community settings (referred
74 to as municipalities). The provision has been mapped nationally at a program level every third year
75 since 2013¹⁹. The 2018 mapping survey collected data on provision to survivors of cardiac arrest for
76 the first time.

77 **Aim**

78 Based on data from the 2018 mapping survey we aimed to quantify the provision of standard cardiac
79 rehabilitation at a programme level to Danish survivors of cardiac arrest and further, to analyse
80 whether organisational factors influenced the provision. Our hypothesis was that cardiac
81 rehabilitation is not systematically provided to Danish survivors of cardiac arrest. Based on earlier
82 findings^{9,20,21}, we further hypothesised that organisational factors would influence the provision of
83 cardiac rehabilitation to this population..

84 **Method**

85 Study reporting follows the STROBE Statement for cross-sectional studies ([www.strobe-](http://www.strobe-statement.org)
86 [statement.org](http://www.strobe-statement.org)). This cross sectional study used data collected in 2018 as part of a routine nationwide
87 electronic survey among all hospitals (n=34) and municipalities (n= 98) in Denmark. The nationwide
88 survey was designed to map current services and quality of cardiac rehabilitation at a program-level¹⁹.
89 The survey is administrated by the Danish cardiac rehabilitation Database (DHRD) which has been
90 described in depth elsewhere^{9,19}. Hence, only the details of the method relevant to the data in this
91 paper will be described here.

92 *National survey*

93 There were two versions of the survey – one for the hospitals and one for the municipalities –
94 providing similar but context-adapted questions allowing for comparison between the two settings.
95 In Denmark, hospitals provide specialized rehabilitation services, while the main responsibility for

96 cardiac rehabilitation rests with the municipalities, but with the possibility of outsourcing the services
97 to the hospitals²².

98 The hospital survey was constructed from a previously tested and utilized questionnaire²³. The
99 municipality survey was similar to the hospital version, with minor modifications, for example, the
100 wording was changed from ‘hospital’ to ‘municipality’. Content validity was tested both in the
101 previous and current versions⁹.

102 The hospital and municipality surveys were sent as web-based questionnaires to respondents
103 employed in a leading or coordinating role relevant to local cardiac rehabilitation services. The
104 majority of hospital respondents (n=28) were qualified nurses with clinical responsibility for
105 delivering cardiac rehabilitation. Two were nurses responsible for coordinating provision of cardiac
106 rehabilitation while the remaining four were leaders of cardiology departments. The majority of
107 municipality respondents were leaders with either full responsibility (n=26) or some responsibility
108 (n=18) for the provision of cardiac rehabilitation. Twenty nine were employees working within
109 cardiac rehabilitation and 22 had other positions (e.g. rehabilitation coordinator or rehabilitation
110 consultant). The respondents were encouraged to consult colleagues in case they did not know the
111 answer to a question.

112 Each respondent received an e-mail invitation to fill out the web-based questionnaire. Two e-mail
113 reminders were sent and finally, remaining non-respondents were contacted by telephone. Surveys
114 were administered using SurveyXact software (Copyright ©Rambøll).

115 *Core components of cardiac rehabilitation*

116 To map the current provision of cardiac rehabilitation services at a program-level, the survey asks
117 about all the core components recommended by the Danish national clinical guidelines for cardiac
118 rehabilitation⁸, both overall, and divided into several specific cardiac diagnoses. In previous surveys⁹,

119 only rehabilitation services for ischemic heart disease, heart failure and heart valve disease were
120 mapped. However, in 2018, survivors of cardiac arrest were added to the list of target groups for
121 cardiac rehabilitation in Denmark, with a possibility to mark provision to ‘all’, ‘some’ or ‘none’ of
122 the patients in this diagnostic group. Thus, using data from the 2018 nationwide cross-sectional
123 electronic survey dataset, we were able to map the provision of; exercise training, patient education,
124 psychosocial support, anxiety and depression screening, nutritional counselling and smoking
125 cessation as the core components of rehabilitation provided to survivors of cardiac arrest in both
126 hospitals and municipalities.

127 *Organisational factors*

128 To assess possible differences in the provision of cardiac rehabilitation to survivors of cardiac arrest
129 in relation to organisational factors we collected organisational information as follows:

130 Hospitals: we sought information regarding health care region (five in total), hospital catchment area,
131 population size, and degree of specialization (cardiology specialist department yes/no).

132 Municipalities: we extracted data on organizational aspects including health care region,
133 classification according to geography, (urban/suburban/rural), municipality population size, and
134 socioeconomic index; this is calculated by the Danish Ministry of Social Affairs and based on 15
135 different socioeconomic variables such as education level and number of people without an
136 attachment to the labour market. A socioeconomic index value above 1 means the municipality has
137 a greater expenditure requirement relative to the average of all municipalities while a value below 1
138 means a lower expenditure requirement. Variables were chosen in accordance with Egholm et al.⁹
139 and information was obtained from the Ministry of Social Affairs and the Interior
140 (www.noegletal.dk).

141 *Statistics*

142 All statistical analyses were performed using the software SAS Enterprise Guide 5.1 (SAS Institute
143 Inc., Cary, NC, USA). We only took responses to the cardiac rehabilitation core components into
144 consideration in the analysis. Descriptive statistics were used for all categorical variables with
145 proportion of hospitals and municipalities described as frequencies and percentages respectively.
146 First, the provision of each cardiac rehabilitation core component to survivors of cardiac arrest were
147 calculated for hospitals and municipalities respectively. Secondly, Chi-square test or Fisher's exact
148 test (when cell count went below five) was used to explore differences in the provision of core
149 components (provided to all vs provided to some or none of the patients) to survivors of cardiac arrest
150 and AMI. When significant difference were explored (p value below 0.05) the relative Risk (RR) was
151 calculated. We used the provision of each core component to patients after acute myocardial
152 infarction (AMI) as a reference since the Danish national rehabilitation guidelines emphasize cardiac
153 rehabilitation for this patient group ⁸. Finally, to describe possible differences in the provision of
154 cardiac rehabilitation to survivors of cardiac arrest based on organizational aspects, we grouped
155 hospitals and municipalities into locations that systematically provided a core component to all, and
156 locations that only provided a core component to some or none of the survivors. Except municipality
157 population size which was divided into quartiles, all additional organizational information for
158 hospitals and municipalities was categorized in accordance with Egholm et al ⁹. Differences in the
159 provision due to the additional organizational information were tested using Chi-square test or
160 Fisher's exact test when cell count went below five. Level of statistical significance was set at $p < 0.05$.

161 *Data approval and ethics*

162 As only program-level data were collected, according to Danish law, approval from The Scientific
163 Ethical Committee was not necessary for this study. Permission to use the survey data was granted
164 by the DHRD steering committee. Names of the survey respondents, hospitals and municipalities
165 were kept confidential.

166 **Results**

167 The survey was sent to all 34 hospitals offering cardiac rehabilitation and all 98 municipalities in
168 Denmark. Study flow is presented in fig. 1. [insert Figure 1.] The proportion of responses on the
169 provision of each of the core components of cardiac rehabilitation was 100% for the hospitals and
170 97% for the municipalities, irrespective of cardiac diagnosis. Response proportions for provision of
171 each core component in relation to survivors of cardiac arrest were slightly lower, ranging from 64%
172 to 94% for hospitals and 84% to 98% for municipalities. Due to current national organizational issues,
173 screening for anxiety and depression is offered only in hospitals and smoking cessation only in the
174 municipalities²⁴.

175 The provision of cardiac rehabilitation core components irrespective of cardiac diagnosis, in Danish
176 hospitals and municipalities is available in appendix 1.

177 All hospitals and municipalities provided a minimum of one core component to survivors of cardiac
178 arrest and almost all the specific core components were provided to at least some survivors of cardiac
179 arrest by the hospitals and municipalities. The provision of the core components in Danish hospitals
180 and municipalities is illustrated in table 1.

181

Table 1: The provision of core components in rehabilitation services to survivors of cardiac arrest in Danish hospitals and Municipalities

Core component	Hospitals			Municipalities		
	All patients n (%)	Some patients n (%)	No patients n (%)	All patients n (%)	Some patients n (%)	No patients n (%)
Patient education	10 (40%)	13 (52%)	2 (8%)	64 (78%)	16 (20%)	2 (2%)
Exercise training	18 (56%)	13 (41%)	1 (3%)	75 (81%)	14 (15%)	4 (4%)
Psychosocial support	24 (77%)	5 (16%)	2 (7%)	52 (62%)	13 (15%)	19 (23%)
Screening for Anxiety and depression*	18 (56%)	13 (41%)	1 (3%)	N/A	N/A	N/A
Nutritional counselling	22 (76%)	6 (21%)	1 (3%)	58 (69%)	18 (21%)	8 (10%)
Smoking cessation*	N/A	N/A	N/A	69 (84%)	9 (11%)	4 (5%)

*Due to current national organizational issues, screening for anxiety and depression is offered only in hospitals and smoking cessation only in the municipalities ²⁴.

187

188 Fig. 2 illustrates the provision of each core component by hospitals and municipalities to survivors
 189 of cardiac arrest compared to post AMI patients [insert Figure 1.]. Significant differences were found
 190 for patient education ($p < 0.001$), exercise training ($p = 0.03$), screening for anxiety and depression
 191 ($p = 0.01$) and nutritional counselling ($p = 0.01$) in hospitals. RR for patient education was $RR = 0.45$
 192 ($95\% \text{ CI } 0.27 \text{ to } 0.75$), $RR = 0.69$ ($95\% \text{ CI } 0.49 \text{ to } 0.98$) for exercise training, $RR = 0.64$ ($95\% \text{ CI } 0.46$
 193 $\text{ to } 0.90$) for screening for anxiety and depression and $RR = 0.76$ ($95\% \text{ CI } 0.62 \text{ to } 0.93$) for nutritional
 194 counselling when hospital provision of these components was compared between survivors of cardiac
 195 arrest and AMI. In the municipalities, no significant differences were found between survivors of
 196 cardiac arrest and AMI.

197 *Organisational factors influencing the provision of cardiac rehabilitation*

198 Differences in the provision of cardiac rehabilitation to survivors of cardiac arrest according to
 199 selected organizational factors are displayed in tables 2 and 3 respectively. At a hospital level, only
 200 the provision of nutritional counselling varied significantly between regions ($p = 0.04$). For
 201 municipalities, patient education varied between regions ($p = 0.02$) and the provision of exercise
 202 training varied with population size ($p < 0.001$). No other differences were found based on
 203 organizational factors.

Table 2: Proportion of hospitals that provide core components to all (systematic provision) or only some/none survivors of cardiac arrest (no systematic provision) in relation to organizational structure; a) National health care region, b) Population size in catchment area and c) Cardiology specialist department.

Variable	Patient education		Exercise training		Psychosocial support		Screening for anxiety and depression		Nutritional counselling	
	Systematic provision n (%)	No systematic provision n (%)	Systematic provision n (%)	No systematic provision n (%)	Systematic provision n (%)	No systematic provision n (%)	Systematic provision n (%)	No systematic provision n (%)	Systematic provision n (%)	No systematic provision n (%)
Region										
Capital Region	3 (33%)	6 (67%)	5 (56%)	4 (44%)	7 (78%)	2 (22%)	4 (44%)	5 (56%)	9 (100%)	0 (0%)
Region Zealand	4 (80%)	1 (20%)	5 (83%)	1 (17%)	5 (100%)	0 (0%)	3 (60%)	2 (40%)	4 (80%)	1 (20%)
Region of Southern Denmark	6 (86%)	1 (14%)	4 (50%)	4 (50%)	5 (63%)	3 (37%)	4 (50%)	4 (50%)	3 (38%)	5 (62%)
Central Denmark Region	1 (50%)	50 1 (50%)	3 (43%)	4 (57%)	5 (83%)	1 (17%)	4 (67%)	2 (33%)	4 (80%)	1 (20%)
North Denmark Region	1 (50%)	1 (50%)	1 (50%)	1 (50%)	2 (67%)	1 (33%)	3 (75%)	1 (25%)	2 (100%)	0 (0%)
	p=0.17		p=0.71		p=0.63		p=0.87		p=0.04	
Population size in catchment area										
<=100.000	2 (40%)	3 (60%)	4 (80%)	1 (20%)	3 (60%)	2 (40%)	3 (60%)	2 (40%)	4 (80%)	1 (20%)
>100.000 - <=200.000	7 (47%)	8 (53%)	11 (58%)	8 (42%)	16 (84%)	3 (16%)	11 (55%)	9 (45%)	14 (78%)	4 (22%)
>200.000 - <=300.000	1 (33%)	2 (67%)	2 (40%)	3 (60%)	4 (100%)	0 (0%)	3 (75%)	1 (25%)	3 (100%)	0 (0%)
>300.000	0 (0%)	2 (100%)	1 (33%)	2 (67%)	1 (33%)	2 (67%)	1 (33%)	2 (67%)	1 (33%)	2 (67%)
	p=0.91		p=0.52		p=0.10		p=0.79		p=0.35	
Specialist cardiology department										
No	6 (46%)	7 (54%)	9 (47%)	10 (53%)	13 (72%)	5 (28%)	11 (58%)	8 (42%)	13 (81%)	3 (19%)
Yes	4 (33%)	8 (67%)	9 (69%)	4 (31%)	11 (85%)	2 (15%)	7 (54%)	6 (46%)	9 (69%)	4 (31%)
	p=0.69		p=0.30		p=0.67		p=0.82*		p=0.67	

*P-value calculated from a Chi-square test instead of a Fisher's exact test

Table 3: Proportions of municipalities that provide core components to all (systematic provision) or only some/none survivors of cardiac arrest (no systematic provision) in relation to organizational structure; a) National health care region, b) Population size in catchment area, c) Classification (geographical) and d) Socio-economic index

Variable	Patient education		Exercise training		Psychosocial support		Nutritional counselling		Smoking cessation	
	Systematic provision	No systematic provision	Systematic provision	No systematic provision	Systematic provision	No systematic provision	Systematic provision	No systematic provision	Systematic provision	No systematic provision
Region										
Capital Region	18 (72%)	7 (28%)	27 (93%)	2 (75%)	15 (58%)	11 (42%)	17 (63%)	10 (37%)	16 (76%)	5 (23%)
Region Zealand	10 (91)	(9%)	12 (80%)	3 (20%)	8 (73%)	3 (27%)	10 (91%)	1 (9%)	13 (93%)	1 (7%)
Region of Southern Denmark	8 (47%)	9 (53%)	14 (70%)	6 (30%)	7 (39%)	11 (61%)	10 (59%)	7 (41%)	14 (74%)	5 (26 %)
Central Denmark Region	16 (89%)	2 (11%)	14 (82%)	3 (18%)	13 (72%)	5 (28%)	13 (72%)	5 (28%)	15 (88%)	2 (12%)
North Denmark Region	10 (91%)	1 (9%)	7 (64%)	4 (36%)	9 (82%)	2 (18%)	13 (72%)	(28%)	11 (100%)	0 (0%)
	p=0.02		p=0.14		p=0.13		p=0.44		p=0.26	
Population size in catchment area										
<=29.669	17 (81%)	4 (19%)	23 (96%)	1 (4%)	13 (62%)	8 (38%)	16 (73%)	6 (27%)	17 (89%)	2 (11%)
>29.669- <=42.884	16 (84%)	3 (16%)	20 (90%)	2 (9%)	13 (68%)	6 (32%)	15 (75%)	5 (25%)	17 (85%)	3 (15%)
>42.884 - <=60.356	16 (80%)	4 (20%)	19 (83%)	4 (17%)	15 (68%)	7 (32%)	15 (75%)	5 (25%)	18 (82%)	4 (18%)
>60.356	13 (59%)	9 (41%)	12 (52%)	11 (47%)	11 (50%)	11 (50%)	12 (55%)	10 (45%)	17 (81%)	4 (19%)
	p=0.26		p<0.001		p=0.59		p=0.43		p=0.90	
Geographical Classification										
Urban	21 (72%)	8 (28%)	31 (89%)	4 (11%)	20 (67%)	10 (33%)	20 (65%)	11 (35%)	22 (85%)	4 (15%)
Suburban	9 (75%)	3 (25%)	12 (80%)	3 (20%)	7 (58%)	5 (42%)	10 (77%)	3 (23%)	11 (79%)	3 (21%)
Rural	32 (78%)	9 (22%)	31 (74%)	11 (26%)	25 (60%)	17 (40%)	28 (70%)	12 (30%)	36 (86%)	6 (14%)
	p=0.93		p=0.25		p=0.82		P=0.78		p=0.85	
Socioeconomic index										
Low (below index 1)	27 (69%)	23 (31%)	38 (84%)	7 (16%)	26 (65%)	14 (35%)	27 (66%)	14 (34%)	35 (81%)	8 (19%)
High (over index 1)	35 (81%)	8 (19%)	36 (77%)	11 (23%)	26 (59%)	18 (41%)	31 (72%)	12 (28%)	34 (87%)	5 (13%)
	p=0.30		p=0.43		p=0.66		p=0.64		p=0.55	

3 Discussion

4 This study is, to our knowledge, the first to report on the provision of standard cardiac rehabilitation
5 following cardiac arrest. We found that survivors of cardiac arrest to some extent are provided with
6 standard cardiac rehabilitation by hospitals and municipalities in Denmark, but at hospital level
7 rehabilitation is provided less consistently to survivors of cardiac arrest than to AMI patients. For
8 municipalities, the provision of psychosocial support was broadly low for both survivors and AMI
9 patients. Overall, the provision of standard cardiac rehabilitation aimed at survivors of cardiac arrest
10 was similar across the health care regions and was not affected by organizational factors.

11 Post-cardiac arrest care has previously been mapped in Sweden and the Netherlands but these studies
12 focused on the post-hospital discharge phase, i.e. the provision of out-patient clinic follow-up to
13 survivors and families¹⁷ and screening for cognitive impairments and referral to cognitive
14 rehabilitation¹⁸. Results showed that these post-hospital care elements were far from successfully
15 implemented despite existing international recommendations for rehabilitation after cardiac arrest⁶.
16 We show a similar situation for rehabilitation after hospital discharge in our study.

17 Similar to other countries, Denmark currently has no clinical guidelines on post-cardiac arrest care,
18 including rehabilitation. Danish national cardiac rehabilitation guidelines state that patients diagnosed
19 with ischemic heart disease, heart failure or after heart valve replacement should be systematically
20 referred to cardiac rehabilitation^{8,9}. Despite the lack of national guidelines addressing rehabilitation
21 services for survivors of cardiac arrest, our results show that all hospitals and municipalities in
22 Denmark deliver some components of standard cardiac rehabilitation to survivors of cardiac arrest.
23 Still the hospital results show that a lower proportion of survivors of cardiac arrest were provided
24 with four core components of cardiac rehabilitation (patient education, exercise training, screening
25 for anxiety and depression and nutritional counselling) compared to AMI patients. This lower hospital
26 level provision was found to be independent of the organizational factors analyzed in this study. In

27 contrast, there was no difference in the proportion of municipalities providing cardiac rehabilitation
28 to survivors of cardiac arrest and AMI. A possible explanation could be that a patient with a sudden
29 cardiac arrest caused by coronary heart disease is routinely referred by the hospital to the municipality
30 for cardiac rehabilitation in line with current guidelines for coronary heart disease or heart failure⁸.
31 In the municipalities, the provision of cardiac rehabilitation services to survivors of cardiac arrest is
32 likely to be generic and based on one of the underlying diseases that is mentioned in the national
33 guidelines for cardiac rehabilitation⁸ – hence similar to AMI. Conversely, the survivors of cardiac
34 arrest population at the hospital level do not follow the coronary heart disease referral pathway into
35 cardiac rehabilitation and are therefore not seen in standard cardiac rehabilitation services. However,
36 further research in referral pathways for survivors of cardiac arrest is required to determine whether
37 this explanation is accurate.

38 Previous studies found that organisational factors (e.g. health care region, population size of the
39 catchment area, and classification according to geography) influenced the provision of cardiac
40 rehabilitation^{9,20,21}. We only found a few statistically significant differences in the organisational
41 factors. This is likely explained by the small sample size, in particular for hospitals. While not
42 statistically significant, there are variations in provisions between sites, (e.g. variation in the
43 systematic provision of exercise training in hospitals and municipalities in relation to the population
44 size), which may be relevant for practice. Also it is plausible that other organisational factors than
45 those included in this study may affect provision, as contextual factors are known to influence the
46 implementation of interventions in healthcare²⁵.

47 Provision of standard cardiac rehabilitation is recommended in international literature, and has been
48 demonstrated to be tolerated by patients with a cardiac cause of cardiac arrest as secondary prevention
49 and to optimize their physical condition^{12–16}. Cardiac rehabilitation has been extensively tested,
50 improved and implemented^{10,26}. Hence, the aim of further research should not be to reinvent cardiac

51 rehabilitation for cardiac arrest survivors. Rather, it should be to develop and adopt components that
52 can be added to cardiac rehabilitation to meet the needs of survivors beyond their cardiac disease. For
53 example, cognitive screening and interventions for cognitive deficits are not a part of standardised
54 cardiac rehabilitation but are internationally recommended as essential components of rehabilitation
55 after cardiac arrest^{6-8,13}. Furthermore, current cardiac rehabilitation services do not meet the needs of
56 caregivers. These are also recommended as recipients of rehabilitation after cardiac arrest as they are
57 likely to suffer from emotional problems, including symptoms of post-traumatic stress after
58 witnessing a cardiac arrest²⁷⁻³¹. In addition, studies could focus on which implementation strategies
59 that would be most successful in hospitals and municipality settings respectively. Hereby, research
60 will support the implementation of standardized clinical pathways that allow tailored access to
61 interventions that meet the individual needs of survivors. Our results demonstrate that in Denmark
62 only to some extent and for some survivors are cardiac rehabilitation needs met. National
63 rehabilitation guidelines that promote the provision of cardiac and cognitive rehabilitation to cardiac
64 arrest survivors may be a solution to enhance rehabilitation services to this highly burdened patient
65 group and their caregivers.

66 *Limitations*

67 This study is the first to map current provision of standard cardiac rehabilitation to survivors of
68 cardiac arrest in Denmark and thus provides a benchmark to which the success of initiatives to
69 improve the provision of rehabilitation can be assessed. Still, our study also has limitations, which
70 must be considered when interpreting the findings. The 2018 nationwide cross-sectional survey was
71 originally designed to map the provision of cardiac rehabilitation to ischemic heart patients and was
72 not designed to map rehabilitation services for survivors of cardiac arrest. Data were self-reported
73 and there was no requirement for specific evidence to be uploaded with the survey responses.
74 Response options addressing cardiac arrest survivors were limited to the provision of cardiac

75 rehabilitation core components without the possibility to add additional information or services (e.g.
76 the provision of cognitive rehabilitation or rehabilitation to family). Although the response rate for
77 questions related to cardiac arrest survivors was lower than that of the overall response rate (response
78 rate ranged from 64% to 94%), it was still above the 60% often regarded as acceptable³². Nonetheless,
79 due to relative small population sizes (34 hospitals and 98 municipalities) the rate of missing
80 responses likely reduce the strength in some of our analyses. Furthermore, the national survey was
81 developed to quantify the provision of standard cardiac rehabilitation in an organizational context
82 with the response categories “All” “Some” or “None” for each cardiac rehabilitation core component.
83 Nevertheless, this induces uncertainty in quantifying the proportion of patients in each response
84 category. We cannot tell if the response “none” reflects whether the service is not provided or that
85 the service not is needed since patients are simply not referred.

86 To ensure an overview of the local cardiac rehabilitation provision, responders were all in leading or
87 coordinating roles. Previous research within the field of cardiac rehabilitation indicates that staff in
88 leading and coordinating roles may have differing perceptions of quality improvement issues³³.
89 Hence, leaders and coordinators could have varying views, knowledge and/or interest in the same
90 question, which may induce potential bias in our results. Another issue is social-desirability bias
91 where responders base their answers on social expectations rather than current practice. If present in
92 our study, this would have caused an overestimation of the current provision and hence, not affect
93 our overall conclusion - only strengthen it. Still, data were self-reported factors of evidence of were
94 uploaded in the survey.

95 While this study may be useful to inform the implementation of rehabilitation to survivors of cardiac
96 arrest in Denmark, it also highlights the general importance of studying the provision of rehabilitation
97 services to this specific group of patients, and provides simple solution to do so. In addition, our
98 study, creates national knowledge in the provision of rehabilitation services recommended to this

99 group of patients⁶, which is important for visualizing the expansion and implementation of post-
100 cardiac arrest care around the world.

101 In conclusion, our study indicates that, positively, all hospitals and municipalities in Denmark offer
102 some components of cardiac rehabilitation to all or some survivors of cardiac arrest. This is despite
103 the lack of national guidelines in Denmark for rehabilitation after cardiac arrest. However, there it
104 still room for improvement. Hospital based cardiac rehabilitation provision to survivors of cardiac
105 arrest remains lower than to patients suffering from an AMI. In addition, municipality provision of
106 psychosocial support was low for both cardiac arrest survivors and AMI patients. Further research
107 should support the implementation of standardized clinical pathways and help inform the
108 development of national guidelines to promote the provision of rehabilitation after a cardiac arrest.

109

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118 **Declaration of Conflicting Interests**

119 The Authors declare that there is no conflicts of interest

120

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