

## **Electronical Supplementary Material 2**

### **Manuscript Title**

Deficits in knowledge, attitude, and practice towards blood culture sampling: results of a nationwide mixed-methods study among inpatient care physicians in Germany

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## Supplementary Table 1

Descriptive analysis of all questions

	N	(x%)
<b>In which federal state is the institution located you mainly work at?</b>		
Baden-Württemberg	114	16.2
Bavaria	93	13.2
Berlin	53	7.5
Brandenburg	33	4.7
Hamburg	20	2.8
Hessen	56	7.9
Mecklenburg-West Pomerania	36	5.1
Lower Saxony	217	30.7
North Rhine-Westphalia	43	6.1
Rhineland-Palatinate	36	5.1
Saarland	5	0.7%
<b>Q2: A bedridden 86-year old woman attracted attention in her nursery home because of hypothermia; she has an auscultatory finding compatible with pneumonia. Would you take blood culture samples? N=706</b>		
yes	467	66.1
no	239	33.9
<b>Q2: Where would you take the blood culture samples in this case? N=467 ( if Q2=yes)</b>		
arterial	38	8.1
Peripheral-venous	459	98.3
Central-venous	35	7.5
<b>Q4: A Patient with a central-venous catheter has an elevated level of CRP. Would you take blood cultures? N=706</b>		
yes	478	67.7
no	228	32.3
<b>Where would you take the blood cultures in this case? N=478 ( if Q4=yes)</b>		
arterial	33	6.9
Peripheral-venous	382	79.9
Central-venous	369	77.2
<b>A 32-year old female patient presents in the outpatients clinic and reports dysuria and shivering. Would you take blood culture samples? N=706</b>		
yes	326	46.2
no	380	53.8
<b>Where would you take the blood culture samples in this case? N=326</b>		
arterial	12	3.7
Peripheral-venous	322	98.8

Central-venous	18	5.5
<b>Please state how much importance you attach to blood cultures as diagnostic procedure for sepsis patients. N=706</b>		
Not important	4	0.6
Less important	13	1.8
important	143	20.3
Very important	546	77.3
<b>Please state to which extent you feel responsible for blood culture sampling according to the guidelines. N=706</b>		
Not responsible	5	0.7
Less responsible	21	2.9
A bit responsible	153	21.7
Very responsible	527	74.7
<b>Please estimate the costs for the analysis of a blood culture set (standard analysis including material and working time). N=706</b>		
<5 euro	13	1.8
5 – 10 euro	77	10.9
10 – 20 euro	192	27.2
20 – 50 euro	249	35.3
50 – 100 euro	143	20.3
>100 euro	32	4.5
<b>Are there defined standards for blood culture sampling in your hospital? (Covering criteria for the ordering of blood cultures as well as for the sampling procedure)? N=706</b>		
Yes	347	49.2
no	126	17.8
I don't know	233	33.0
<b>Do these exist in writing? N=347</b>		
Yes	68	19.6
no	6	1.7
I don't know	24	6.9
<b>Are there defined standards for blood culture sampling at your ward? (Covering criteria for the ordering of blood cultures as well as for the sampling procedure)? N=706</b>		
Yes	410	58.1
no	176	24.9
I don't know	120	17.0
<b>Do these exist in writing? N=410</b>		
Yes	63	15.4
no	22	5.4
I don't know	20	4.9
<b>On the ward you are currently working, who is in general deciding about the ordering of blood cultures?</b>		

Please select all that apply from the following list. N=706		
Head of department	208	29.5
consultant	519	73.5
resident	610	86.4
nurse	22	3.1
Medical student	14	2.0
<b>On the ward you are currently working, who is carrying out the blood culture sampling?</b> Please select all that apply from the following list. N=706		
Head of department	30	4.3
consultant	121	17.1
resident	652	92.4
nurse	146	20.7
Medical student	157	22.2
<b>Please estimate the number of blood cultures you ordered in the last 30 working days. N=706</b>		
0	119	16.9
1 - 5	275	38.9
6 - 10	149	21.1
11 - 20	105	14.9
>20	58	8.2
<b>Please estimate the number of blood cultures you sampled yourself in the last 30 working days. N=706</b>		
0	233	33.0
1 - 5	296	41.9
6 - 10	108	15.3
11 - 20	45	6.4
>20	24	3.4
<b>In comparison to your colleagues, do you believe, that you took more or less blood culture samples? N=706</b>		
Considerably less	63	8.9
less	86	12.2
same	404	57.2
more	137	19.4
Considerably more	16	2.3
<b>Please, imagine your everyday clinical work, and indicate which criteria are the most common causes for you to take blood cultures.</b> Please choose 1-3 answers. N=706		
Rise in temperature	190	26.9
chills	322	45.6
hypothermia	55	7.8
leucocytosis	120	17.0
Left shift in the blood count	9	1.3

CRP increase	150	21.3
Procalcitonin increase	164	23.2
Neutropenia	75	10.6
Local infect	33	4.7
Fever (>38,5°C)	573	81.2
Clinical suspicion of infection	292	41.4
Neurological symptoms	35	5.0
<b>You decided to sample blood cultures from an adult patient. How many milliliter of blood do you usually fill into one flask? N=706</b>		
Less than 5 ml	19	2.7
5 – 8 ml	121	17.1
8 – 10 ml	421	59.6
10 – 20 ml	127	18.0
More than 20 ml	5	0.7
Don't know	13	1.8
<b>In accordance to the guidelines 8-10 ml blood should be put in every flask for adult patients. How often can you follow this recommendation in your daily working life? N=706</b>		
Never	10	1.4
In about 25% of the cases	25	3.5
In about 50% of the cases	87	12.3
In about 75% of the cases	323	45.8
always	261	37.0
<b>How many blood culture sets do you take if you have the clinical suspicion of a sepsis (apart from endocarditis)? One blood culture set comprises two flasks. N=706</b>		
One set	155	22.0
Two sets	368	52.1
Three sets	164	23.2
Four sets	15	2.1
More than four sets	4	0.6
<b>In which time frame do you take two blood cultures Just answer the questions, if the following conditions are met: response was two sets in the questions above N=368</b>		
At the same time	268	72.8
Individually in a timeframe of ___ hours	100	27.2
<b>In which time frame do you take three blood culture sets? Just answer the questions, if the following conditions are met: response was three sets in the questions above N=164</b>		
At the same time	52	31.7
Two at the same time, the third one in a timeframe of ___ hours	37	22.6

All Individually in a timeframe of ___ hours	75	45.7
<b>In which time frame do you take four blood culture sets? N=15</b>		
At the same time	2	13.3
Two at the same time, the third and fourth set within a timeframe of ___ hours	9	60
All Individually in a timeframe of ___ hours	4	26.7
<b>Please indicate how often you initially take blood culture samples from two different peripheral veins? N=706</b>		
Never	286	40.5
In about 25% of the cases	156	22.1
In about 50% of the cases	81	11.5
In about 75% of the cases	88	12.5
always	95	13.5
<b>In general, what do you do if your blood culture samples are negative, but the patient shows no clinical improvement and you continue to suspect sepsis? N=706</b>		
No further blood culture sample	1	0.1
No further blood culture sample but change of the antibiotic regimen and screening for infectious foci (sonography, ct scan)	123	17.4
Repeat blood culture sampling after the receipt of a negative result	208	29.5
Repeated blood culture sampling after the occurrence of new symptoms / lab results or if I have the suspicion, that the applied antibiotics are ineffective	332	47.0
else	42	6.0
<b>Which measures are you regularly applying in order to avoid false positive results by contamination? Please state the frequencies.</b>		
<b>Hand disinfection N=706</b>		
never	6	0.8
In about 25% of the cases	11	1.6
In about 50% of the cases	17	2.4
In about 75% of the cases	41	5.8
always	631	89.4
<b>Disposable gloves N=706</b>		
Never	17	2.4
In about 25% of the cases	15	2.1
In about 50% of the cases	26	3.7
In about 75% of the cases	53	7.5
always	593	84.0
I don't want to answer this question	2	0.3
<b>Skin disinfection N=706</b>		
Never	1	0.1
In about 25% of the cases	2	0.3
In about 50% of the cases	2	0.3

In about 75% of the cases	9	1.3
always	692	98.0
<b>Disinfection of the diaphragms of the blood culture flasks N=706</b>		
Never	79	11.2
In about 25% of the cases	18	2.5
In about 50% of the cases	30	4.2
In about 75% of the cases	69	9.8
always	508	72.0
I don't want to answer this question	2	0.3
<b>How often do you respect the recommended exposure time of 60 seconds after skin disinfection? N=706</b>		
Never	43	6.1
In about 25% of the cases	67	9.5
In about 50% of the cases	167	23.7
In about 75% of the cases	205	29.0
always	224	31.7
<b>Does it happen that you do not sample blood cultures before the first antibiotic shot despite a present indication? N=706</b>		
yes	429	60.8
no	277	39.2
<b>Please indicate the importance of the following reasons for not sampling blood cultures before the first antibiotic shot in your opinion.</b>		
<b>Lack of time N=429</b>		
Not important	106	24.7
Less important	82	19.1
important	140	32.6
Very important	101	23.6
<b>Calculated antibiotic therapy in presence of a known focus makes blood cultures superfluous N=429</b>		
Not important	204	47.5
Less important	94	21.9
important	105	24.5
Very important	26	6.1
<b>There are little local resistances N=429</b>		
Not important	290	67.6
Less important	88	20.5
important	48	11.2
Very important	3	0.7
<b>Economic reasons N=429</b>		
Not important	326	76.0
Less important	77	18.0
important	23	5.4
Very important	3	0,7
<b>Blood cultures can be repeated in case of treatment failure N=429</b>		

Not important	269	62.7
Less important	112	26.1
important	40	9.3
Very important	8	1.9
A relevant result cannot be expected N=429		
Not important	244	56.9
Less important	99	23.1
important	72	16.8
Very important	14	3.2
<b>What do you do if there is an indication for blood culture sampling but the antibiotic therapy has already been started? N=706</b>		
Stop antibiotic therapy, blood culture sampling on the next day	23	3.3
Blood culture sampling despite the antibiotic therapy	71	10.0
Blood culture sampling despite the antibiotic therapy, indicate ab for the lab	396	56.1
Blood culture sampling at a low serum concentration e.g. directly before the next shot of antibiotics	12	1.7
Blood culture sampling at a low serum concentration e.g. directly before the next shot of antibiotics and indicate antibiotic for the lab	193	27.3
Else	11	1.6
<b>How does the transportation of the blood culture flasks to the microbiological lab take place during the normal working hours? N=706</b>		
Each blood culture is sent immediately to the lab	406	57.5
Several blood culture sets are collected and then sent to the lab together	221	31.3
I don't know	79	11.2
<b>How do you store collected blood culture sets before the transportation to the lab in your department during normal working hours? N=300</b>		
Blood cultures are stored at room temperature	223	74.3
Blood cultures are chilled	9	3.0
Blood cultures are preincubated	30	10.0
I do not know	38	12.7
<b>During closing time of the lab (e.g. at night or at the weekend): what is the procedure in general? N=706</b>		
The lab is never closed and the procedure is always the same	289	40.9
Blood cultures are stored at room temperature	200	28.3



Blood culture are chilled	13	1.9
Blood cultures are preincubated	72	10.2
I do not know	132	18.7
<b>Do you adhere to the existent guidelines when taking blood cultures? N=706</b>		
Never	5	0.7
In about 25% of the cases	80	11.3
In about 50% of the cases	170	24.1
In about 75% of the cases	277	39.2
Always	80	11.3
I don't know the guideline	94	13.3
<b>In your opinion, if blood culture samples are not taken guideline-based, how important are the following issues:</b>		
The guideline is not well-known N=626		
Not important	45	7.2
Less important	77	12.3
important	334	53.3
Very important	170	27.2
There is not enough time to put the guideline into practice N=626		
Not important	52	8.3
Less important	143	22.8
important	316	50.5
Very important	115	18.4
The therapeutic consequence of blood culture sampling is questionable N=626		
Not important	258	41.2
Less important	229	36.6
important	121	19.3
Very important	18	2.9
Due to economic reasons blood cultures are not taken according to the guideline N=626		
Not important	415	66.3
Less important	164	26.2
important	42	6.7
Very important	5	0.8
The scientific basis of the guideline is questioned N=626		
Not important	393	62.8
Less important	190	30.3
important	31	5.0
Very important	12	1.9
The realization of the guideline is not requested by the head of the clinic/department N=626		
Not important	218	34.8
Less important	164	26.2
important	196	31.3
Very important	48	7.7
The colleagues do not follow the guideline		

either N=626		
Not important	223	35.6
Less important	189	30.2
important	175	28.0
Very important	39	6.2
The organizational effort (transport, fill out the form) is too much N=626		
Not important	276	44.1
Less important	214	34.2
important	115	18.4
Very important	21	3.3
<b>Please state how much you agree with the following statements.</b>		
To me sampling blood cultures is annoying because of the time-consuming procedure N=706		
Strongly disagree	287	40.7
disagree	195	27.6
agree	186	26.3
Strongly agree	38	5.4
The clinical budget should be used for other resources. N=706		
Strongly disagree	586	83.0
disagree	108	15.3
agree	10	1.4
Strongly agree	2	0.3
Blood cultures are often contaminated and lead to wrong therapeutic approaches. N=706		
Strongly disagree	294	41.6
disagree	348	49.3
agree	58	8.2
Strongly agree	6	0.8
Blood cultures are often negative and are therefore not really helpful for therapeutic decisions. N=706		
Strongly disagree	229	32.4
disagree	326	46.2
agree	132	18.7
Strongly agree	19	2.7
The results of blood cultures do not have a big impact on the therapy because a calculated antibiotic therapy has already been started and is continued in that way. N=706		
Strongly disagree	388	55.0
disagree	239	33.9
agree	72	10.2
Strongly agree	7	1.0
To sample blood cultures is a time consuming effort. N=706		

Strongly disagree	177	25.1
disagree	235	33.3
agree	239	33.9
Strongly agree	55	7.8
<b>In your opinion, to what extent are blood cultures taken in Germany? N=706</b>		
Far too few	86	12.2
Too few	417	59.1
sufficient	167	23.7
Too many	34	4.8
Far too much	2	0.3
<b>In your opinion, is there a general need to improve blood culture ordering and sampling? N=706</b>		
yes	574	81.3
no	132	18.7
<b>Please state to what extent the following measures are helpful to support blood culture sampling according to the guidelines.</b>		
Structured integration into routine procedures (e.g. by SOPs or checklists) N=574		
Not helpful	16	2.8
Little helpful	93	16.2
helpful	274	47.7
Very helpful	191	33.3
More time in the daily routine work N=574		
Not helpful	11	1.9
Little helpful	44	7.7
helpful	273	47.6
Very helpful	246	42.9
Regular training/further education N=574		
Not helpful	7	1.2
Little helpful	57	9.9
helpful	314	54.7
Very helpful	196	34.1
Improved internal communication about the significance of blood cultures N=574		
Not helpful	9	1.6
Little helpful	57	9.9
helpful	312	54.4
Very helpful	196	34.1
More staff for blood culture sampling N=574		
Not helpful	39	6.8
Little helpful	118	20.6
helpful	241	42.0
Very helpful	176	30.7
Improved extraction systems N=574		
Not helpful	34	5.9
Little helpful	157	27.4

helpful	257	44.8
Very helpful	126	22.0
<b>Faster diagnostic procedures (e.g. PCR-analysis)N=574</b>		
Not helpful	23	4.0
Little helpful	99	17.2
helpful	278	48.4
Very helpful	174	30.3
<b>Please state your highest professional qualification. N=706</b>		
Final year medical student	70	9.9
Board-certified physician	442	62.6
Physician in further education	194	27.5
<b>Please state your current function. N=706</b>		
Head of department	130	18.4
consultant	226	32.0
resident	280	39.7
Final year student	70	9.9
<b>How long have you already been working in your job? N=636</b>		
Less than twelve months	22	3.4
One to five years	131	20.6
Five to ten years	127	20.0
Longer than ten years	356	56.0
<b>Are you female or male? N=706</b>		
female	260	36.8
male	446	63.2
<b>In which department are you currently working? N=706</b>		
Ophthalmology	4	0.6
Oto-Rhino-Laryngology	15	2.1
General surgery	56	7.9
Casualty surgery	27	3.8
Orthopaedics	8	1.1
Plastic, Hand and Reconstructive Surgery	2	0.3
Urology	13	1.8
Neurosurgery	11	1.6
General medicine	1	0.1
Internal medicine	137	19.4
Neurology	44	6.2
Cardiology	27	3.8
Gastroenterology	10	1.4
Nephrology	4	0.6
Haematology / Oncology	14	2.0
Pneumonology	6	0.9
Rheumatology	2	0.3
Anesthesia	177	25.1
Pediatrics	52	7.4
Gynecology / Obstetrics	21	3.0
Dermatology	3	0.4

Geriatrics	12	1.7
Psychiatry	10	1.4
Other	50	7.1
<b>Which ward do you regularly work on at the moment? N=706</b>		
Normal ward	380	53.8
Intensive care unit	194	27.5
Emergency room	21	3.0
Outpatients' clinic/Ambulance	28	4.0
Op	83	11.8
<b>What is the number of beds in your hospital? N=706</b>		
<200	114	16.1
201 - 400	175	24.8
401 - 600	135	19.1
>600	249	35.3
I don't know	33	4.7
<b>Which type of hospital is your institution? N=705</b>		
University clinic	171	24.3
Academic teaching hospital	384	54.5
Other	147	20.8
I don't know	3	0.4
<b>Is there a microbiological laboratory available in your institution? N=706</b>		
Yes (microbiological laboratory in the house)	338	47.9
No (microbiological laboratory outside the house)	354	50.1
I don't know	14	2.0