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## **Management of necrotizing soft tissue infections in the intensive care unit: results of an international survey**

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### **Electronic supplementary material**

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Dear Editor,  
Necrotizing soft tissue infections (NSTIs) are rare and life-threatening bacterial infections characterized by subcutaneous tissue, fascia, or muscle necrosis. The mortality of NSTIs is high, ranging from 20 % in non-selected patients to up to 50 % in the most severe forms requiring intensive care unit (ICU) admission [1, 2]. Early recognition of NSTI is crucial; however, its management is challenging and requires a coordinated

and multidisciplinary approach. Treatment of NSTIs consists of early broad-spectrum antimicrobial therapy together with emergency and aggressive surgical debridement with excision of all necrotic and infected tissues [3]. We aimed to assess the burden of NSTIs and the organization of their early management in ICUs worldwide.

An online self-administered questionnaire was made available on the website of the European Society for Intensive Care Medicine (ESICM, <http://www.esicm.org/research/survey-of-the-month/completed>), after approval from members of the Research Committee and endorsement by the Infection Section of the ESICM. The questionnaire (see the online supplement) comprised 31 questions pertaining to the following domains related to the management of NSTIs: characteristics of institutions taking care of patients with NSTIs, organization of care, diagnosis, and therapeutic aspects. There were 135 respondents representing 100 ICUs in 23 countries, predominantly in Europe (15 countries, 85 ICUs). Forty-three percent of the respondents declared having managed two or less NSTIs in the previous year and 57 % three or more. Most of the institutions which participated in the survey were equipped with facilities allowing for the management of patients with NSTIs (i.e., imaging facilities, surgeon, and consultant dermatologist available) (Table 1). The ICUs where three or more patients were declared to be managed each year tended to be more frequently located in institutions hosting hyperbaric oxygen therapy units and were more likely to have an on-site expert consultant for the surgical management of NSTIs. In terms of

organization of care, more than one-third of respondents reported that the availability of the operating room was a limiting step for prompt surgical management. Yet, the factor which was deemed to have the highest impact on the time to first surgical debridement was a delay in NSTI diagnosis, with no significant difference between institutions reporting to manage at most two vs three or more patients with NSTIs per year. In all, respondents from 40 % of the ICUs declared that they had already referred patients to another center, mostly for hyperbaric oxygen therapy (34 %). Regarding therapeutic aspects, there were no striking differences between ICUs managing at most two vs three or more patients with NSTIs per year, with 90 % of respondents who reported using clindamycin and 25 % intravenous immunoglobulins (IVIGs) when a group A streptococcal (GAS) infection was suspected. Although strong evidence is still lacking on these aspects, observational studies suggest that clindamycin could reduce mortality in patients with invasive GAS infection, and that further reduction in mortality could be obtained when IVIGs are added [4]. Of note, although recommended by recent guidelines [3], less than half of the respondents declared performing a “second look” surgery after the first debridement. In contrast, two-thirds of the respondents considered hyperbaric oxygen therapy to be potentially useful while recent guidelines clearly position against its use [3]. A systematic review on interventions in NSTIs is on the way and will evaluate the evidence for medical and surgical aspects of NSTI management [5].

In conclusion, our survey depicts the management of patients having

**Table 1** Characteristics of 100 ICUs managing patients with necrotizing soft tissue infections

	All ICUs (n = 100)	ICUs managing $\leq 2$ NSTIs per year <sup>b</sup> (n = 43)	ICUs managing $\geq 3$ NSTIs per year <sup>b</sup> (n = 57)	p value
Characteristics of the institution				
Number of ICU beds				0.009
<500	29 (29)	17 (39)	12 (21)	
500–1000	36 (36)	18 (42)	18 (32)	
>1000	35 (35)	8 (19)	27 (47)	
Facilities				
Burn care unit	22 (22)	7 (16)	15 (26)	0.33
Hyperbaric oxygen therapy unit	21 (21)	5 (12)	16 (28)	0.051
CT scan	94 (94)	40 (93)	54 (95)	>0.99
Magnetic resonance imaging	94 (94)	40 (93)	54 (95)	>0.99
Surgeon 24/7	98 (98)	41 (95)	57 (100)	0.18
Dermatologist	89 (89)	37 (86)	52 (91)	0.52
Expert consultants for NSTI				
Surgical aspects	62 (62)	22 (51)	40 (70)	0.063
Medical aspects	59 (59)	22 (51)	37 (65)	0.17
Organization of care				
Priority access to the OR for NSTI patients (always or often)	91 (91)	39 (91)	52 (91)	>0.99
OR availability is sometimes or often a limiting step for prompt surgery	36 (36)	17 (39)	19 (33)	0.53
Factor with highest impact on time to surgery				0.71
Delayed diagnosis	62 (64)	27 (66)	35 (62)	
Delayed surgical decision	24 (25)	11 (27)	13 (23)	
Availability of the OR	5 (5)	1 (2)	4 (7)	
Other	6 (6)	2 (4)	4 (7)	
Patient referral for NSTI management <sup>a</sup>	40 (40)	20 (46)	20 (35)	0.27
Main reason for patient referral				0.12
Hyperbaric oxygen therapy	13 (34)	4 (20)	9 (50)	
Surgical management	11 (29)	8 (40)	3 (20)	
Burn care unit	8 (21)	6 (30)	2 (11)	
Medical expertise	5 (13)	2 (10)	3 (20)	
Post-operative management	1 (3)	0 (0)	1 (5)	
Diagnosis				
Imaging potentially useful	83 (85)	35 (85)	48 (86)	>0.99
Imaging modalities preferred				0.026
CT scan	67 (83)	24 (70)	43 (91)	
Magnetic resonance imaging	11 (13)	7 (20)	4 (8)	
Echography	3 (4)	3 (9)	0 (0)	
Therapeutic aspects				
“2nd look” surgery always performed	47 (47)	20 (46)	27 (47)	0.40
Vacuum-assisted closure therapy often or always used	73 (74)	30 (71)	43 (75)	0.20
Use of clindamycin when GAS suspected (often or always)	90 (90)	38 (88)	52 (91)	0.74
Use of IVIG when GAS suspected (often or always)	25 (25)	8 (19)	17 (30)	0.09
Usefulness of hyperbaric oxygen therapy				0.33
Not useful	32 (33)	10 (24)	22 (39)	
Useful in selected cases	54 (57)	25 (61)	29 (52)	
Beneficial for all NSTI patients	11 (11)	6 (15)	5 (9)	

All variables are reported as n (%). p values come from  $\chi^2$  or Fischer tests, performed as appropriate  
 NSTI necrotizing soft tissue infection, ICU Intensive care unit, OR operating room, GAS group A streptococcus, IVIG intravenous immunoglobulins

<sup>a</sup> Respondents were asked if they had previously referred one or more patients to other centers for NSTI management

<sup>b</sup> As reported by the respondents

NSTIs in 100 ICUs and highlights significant heterogeneity in terms of organization of care, treatment strategies, and adherence to the most recent guidelines. Importantly, two major and modifiable prognostic factors, i.e., delayed diagnosis of NSTI

and lack of priority access to the operating room, appear responsible for increasing the time to first surgical debridement. Continued medical education programs and optimized organization of care are warranted to improve the management pathways of

patients admitted to the ICU for NSTIs.

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#### Compliance with ethical standards

**Conflicts of interest** The authors have no conflict of interest.

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