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Federal Armed Forces Koblenz

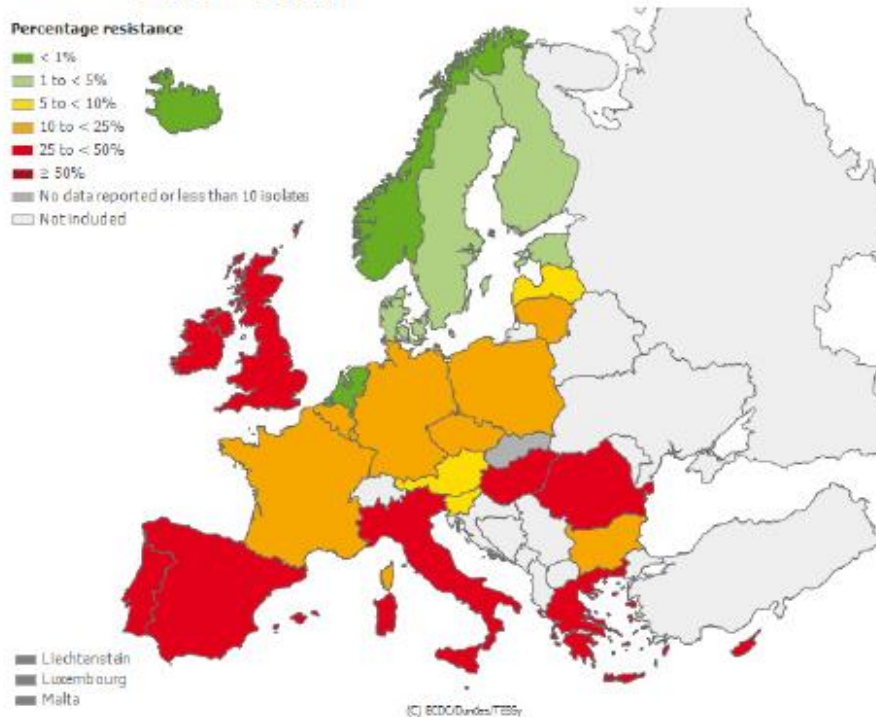
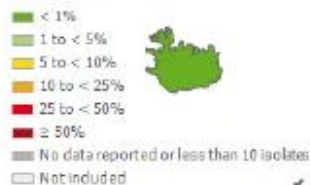
INFECTIONS AFTER ABROAD SITUATIONS

European Antimicrobial Resistance Surveillance Network (EARS-Net)



Proportion of Methicillin resistant *Staphylococcus aureus* (MRSA) isolates in participating countries in 2009 - 2010

Percentage resistance



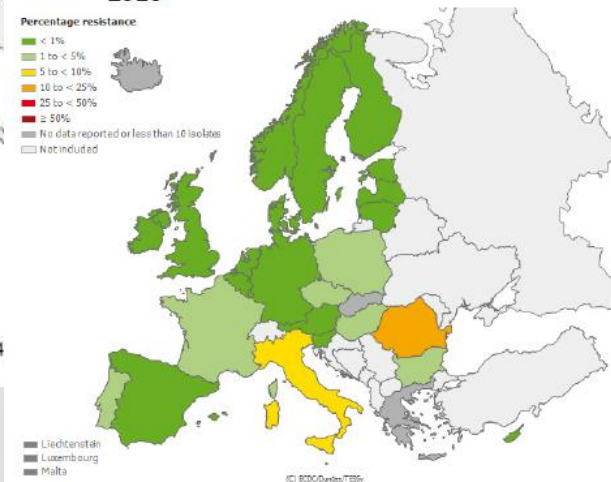
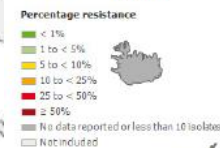
This report has been generated from data submitted to TESSy, The European Surveillance System on 2012-04-14 at 20:00. The report reflects the state of submissions in TESSy as of 2012-04-14 at 20:00.

EARS-Net is a European network of national surveillance systems that maintains a comprehensive surveillance and information system on antimicrobial resistance.

Data from 900 public-health laboratories serving over 1400 hospitals in Europe and providing services to an estimated population of 100 million European citizens.



Proportion of Rifampin (R) resistant *Staphylococcus aureus* isolates in participating countries in 2009 - 2010



This report has been generated from data submitted to TESSy, The European Surveillance System on 2012-04-15. Page: 1 of 1. The report reflects the state of submissions in TESSy as of 2012-04-14 at 20:00.



Most suspected in GE: MRSA

TABELLE 1

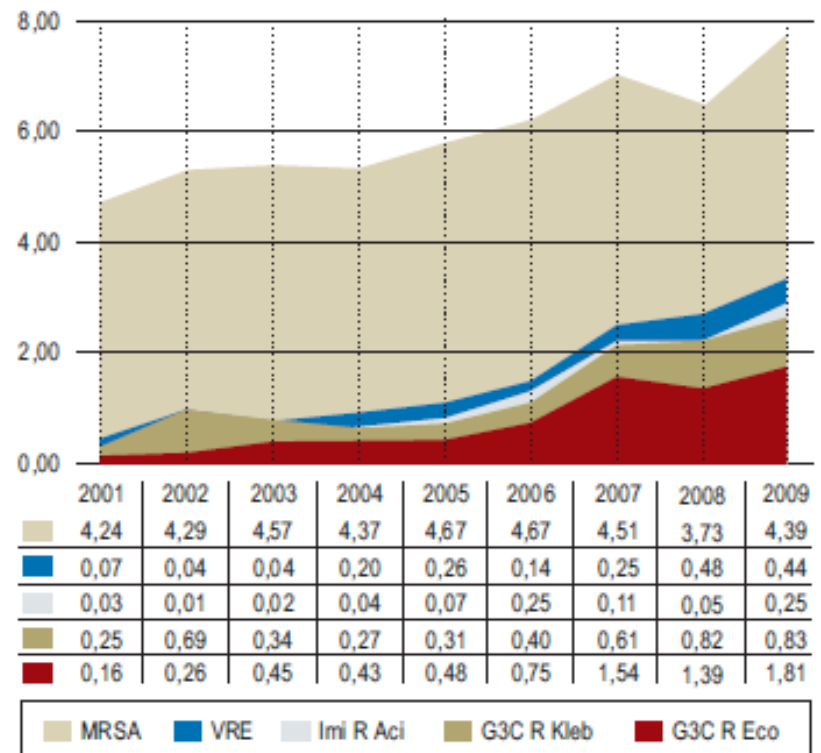
Definition der Multiresistenz von gramnegativen Erregern (MR-GNE)

Penicilline	Cephalosporine	Carbapeneme	Fluorchinolone
Enterobacteriaceae (z. B. E. coli, K. pneumoniae, E. cloacae)			
Leitsubstanz Piperacillin- Tazobactam ¹	Leitsubstanz Cefotaxim	Leitsubstanz Imipenem oder Meropenem oder Ertapenem ¹	Leitsubstanz Ciprofloxacin
R	R	S	R
R	R	R	S
R	S	R	R
R	R	R	R
Pseudomonas aeruginosa			
Leitsubstanz Piperacillin oder Piperacillin- Tazobactam	Leitsubstanz Ceftazidim	Leitsubstanz Meropenem	Leitsubstanz Ciprofloxacin
R	R	S	R
R	R	R	S
R	S	R	R
R	R	R	R
Acinetobacter baumannii ²			
-	-	Leitsubstanz Imipenem	Leitsubstanz Ciprofloxacin
-	-	S	R
-	-	R	S
-	-	R	R

R, resistent; S, sensibel; -, keine ausreichende Wirksamkeit

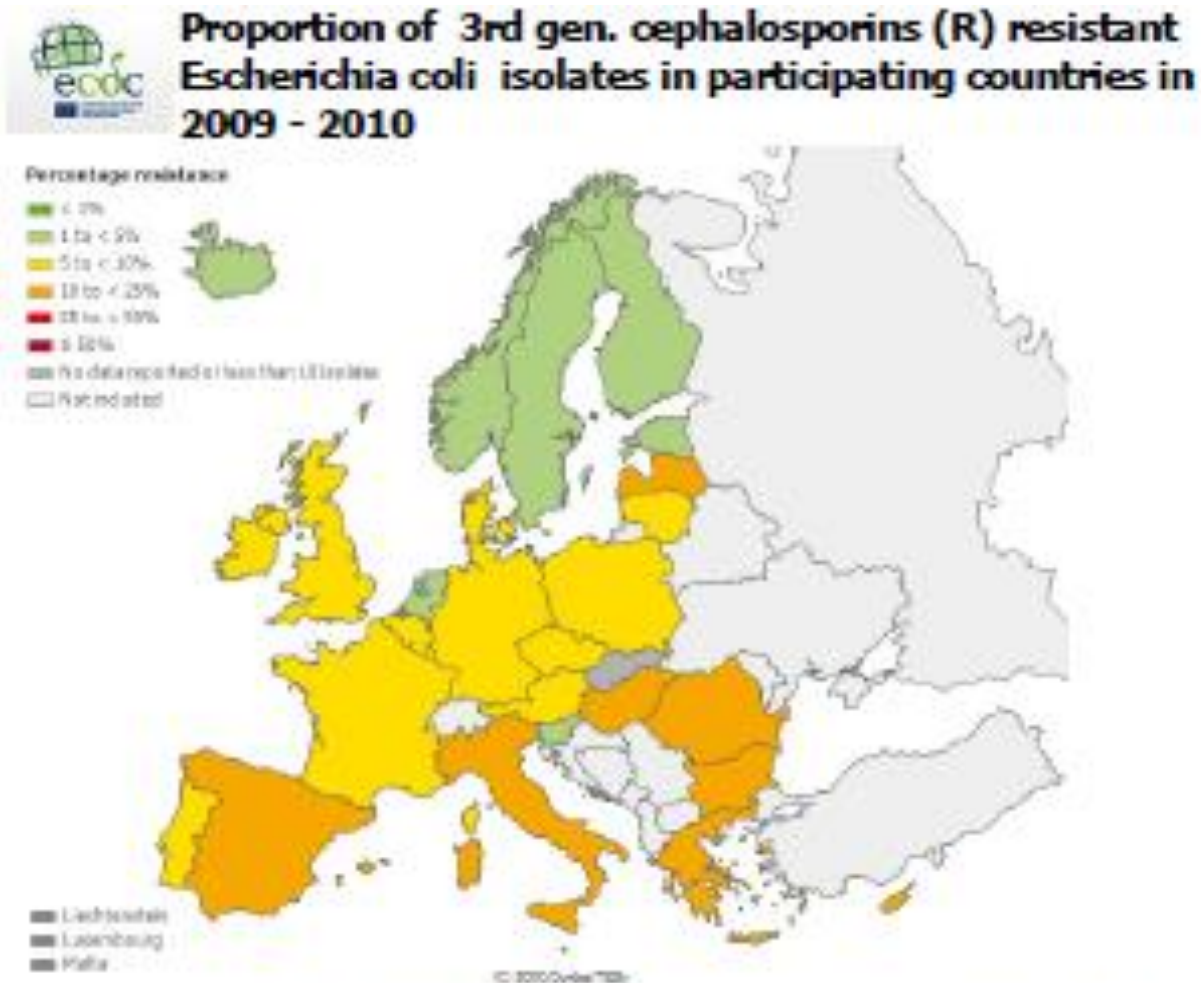
GRAFIK

Anzahl MRE pro 1 000 Patiententage



Darstellung von Inzidenzichten von 55 Intensivstationen, die am SARI-Projekt teilnehmen. Patienten mit multiresistenten Erregern (MRE) pro 1 000 Patiententage (2). SARI, Surveillance der Antibiotika-Anwendung und der bakteriellen Resistenzen auf Intensivstationen; MRSA, Methicillin-resistenter S. aureus; VRE, Vancomycin-resistenter Enterococcus faecium; Imi R Aci, Imipenem-resistenter Acinetobacter baumannii; G3C R Kleb, Gruppe-3-Cephalosporin-resistente Klebsiella pneumoniae; G3C R Eco, Gruppe-3-Cephalosporin-resistente Escherichia coli

Gram-negative bacteria: situation in Europe



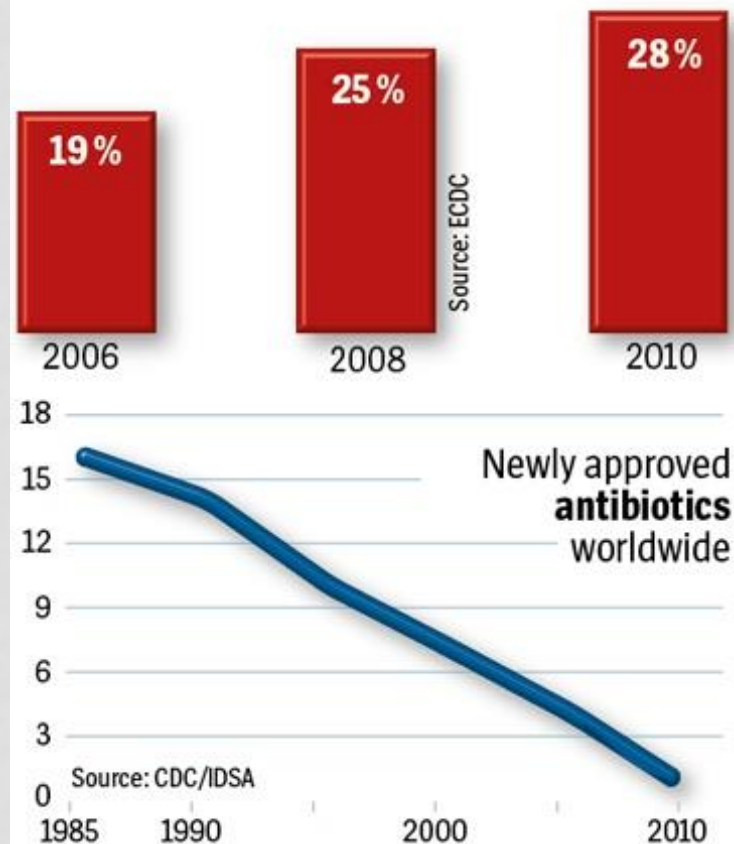
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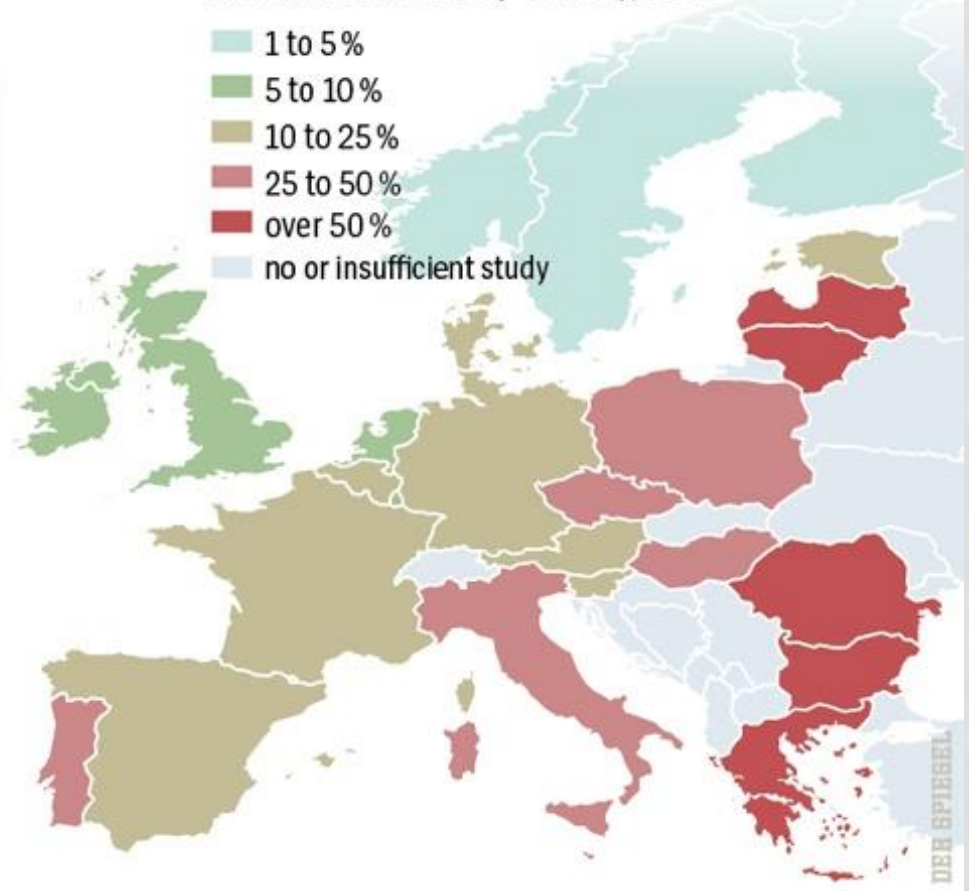
ESBL: situation in Europe

Victory of the Germs

Share of **ESBL-forming bacteria** in Europe
resistant to modern antibiotics



Proven resistance by country, 2010

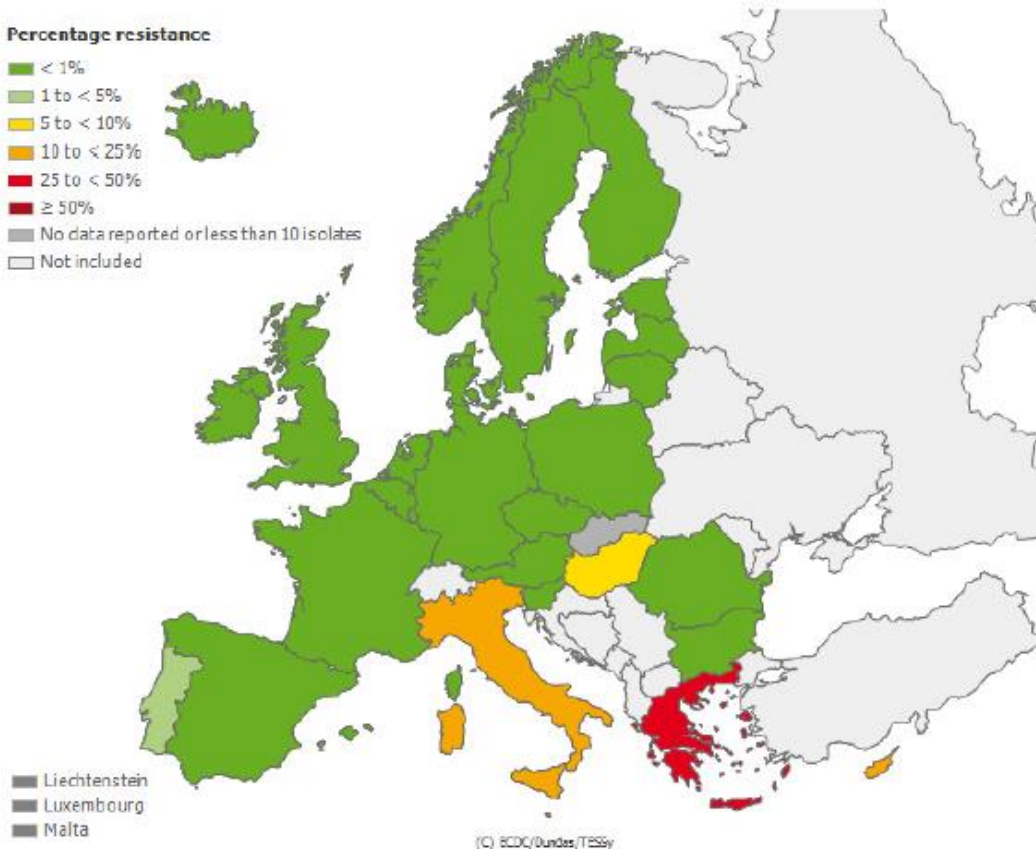
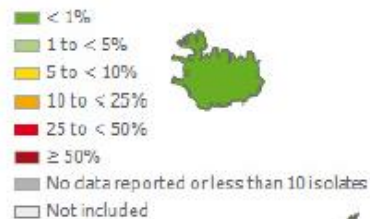


Carbapenem-resistance: the European issue



Proportion of Carbapenems (R) resistant *Klebsiella pneumoniae* isolates in participating countries in 2010

Percentage resistance



(C) ECDC/Dundas/TESSy

This report has been generated from data submitted to TESSy, The European Surveillance System on 2012-04-24. Page: 1 of 1.
The report reflects the state of submissions in TESSy as of 2012-04-24 at 20:00

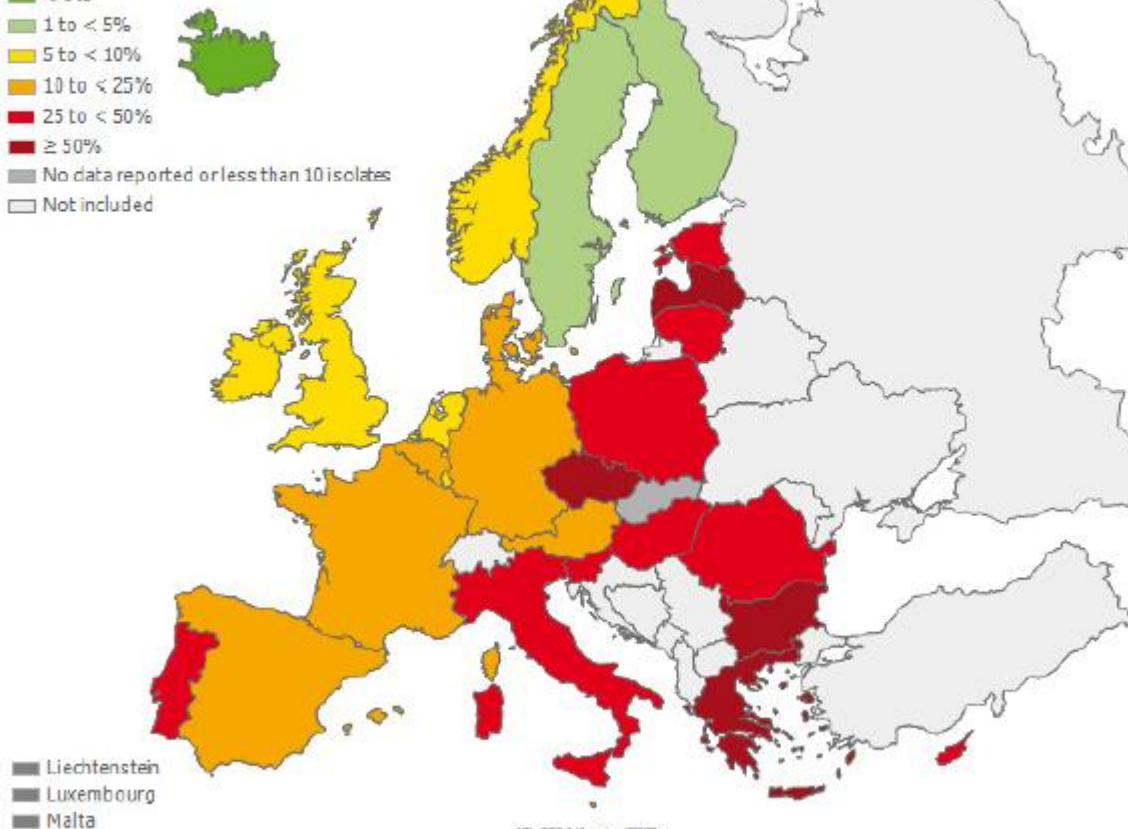
the metamorphosis of Klebsiella P.



Proportion of Fluoroquinolones (R) resistant *Klebsiella pneumoniae* isolates in participating countries in 2010

Percentage resistance

- < 1%
- 1 to < 5%
- 5 to < 10%
- 10 to < 25%
- 25 to < 50%
- ≥ 50%
- No data reported or less than 10 isolates
- Not included



(C) ECDC/Dundas/TESSy

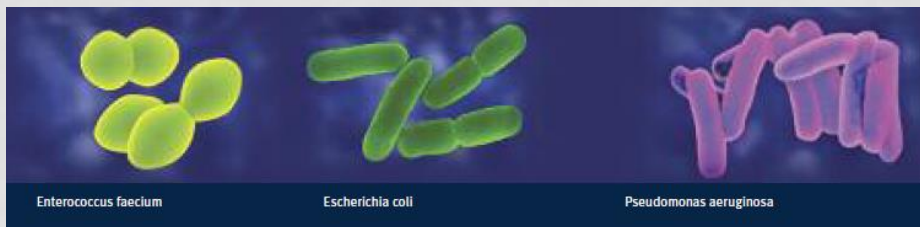


Different scenarios – different germs

One year ago not business as usual: Wound management, infection and psychoemotional control during tertiary medical care following the 2004 Tsunami disaster in southeast Asia

Marc Maegle^{1,2}, Sven Gregor³, Nedim Yucel¹, Christian Simanski¹, Thomas Pattrath¹, Dieter Rösen¹, Markus M Heiss³, Claudia Rudroff³, Stefan Saad³, Walter Perbix⁴, Frank Wappler⁵, Andreas Harzheim⁶, Rosemarie Schwarz⁷ and Bertil Bouillon¹

Critical Care 2006, **10**:R50 (doi:10.1186/cc4868)



Bacterial wound cultures:

- *Acinetobacter baumannii*
- *Enterococcus faecium*
- *Escherichia coli*
- *Proteus vulgaris*
- *Pseudomonas aeruginosa*
- MRSA
- *Stenotrophomonas maltophilia*
- *Candida*, *Aspergillus*, *Fusaria*

Trauma-related Infections in Battlefield Casualties From Iraq

Annals of Surgery • Volume 245, Number 5, May 2007

Kyle Petersen, DO,* Mark S. Riddle, MD, MPH, TM,† Janine R. Danko, MD, MPH,*
David L. Blazes, MD, MPH,† Richard Hayden, MS, M(ASCP)SBB,§ Sybil A. Tasker, MD,*
and James R. Dunne, MD||

TABLE 3. Distribution of the 7 Most Common Organisms by Culture Site

Specimen Site [no. (%)]	Bacteria Isolates (N = 120)							Total
	<i>Acinetobacter</i> spp.	<i>E. coli</i>	<i>Pseudomonas</i> spp.	<i>Coagulase-Negative</i> <i>Staphylococcus</i>	<i>Enterobacter</i> spp.	<i>Klebsiella</i> spp.	<i>Proteus</i> spp.	
Wound	33 (75)	18 (90)	17 (85)	3 (25)	9 (100)	4 (50)	7 (100)	91 (76)
Blood	11 (25)	1 (5)	3 (15)	9 (75)	0	3 (37.5)	0	27 (23)
CSF	0	1 (5)	0	0	0	1 (12.5)	0	2 (2)
Total	44	20	20	12	9	8	7	120

spp. indicates species; CSF, cerebrospinal fluid.

GE - Investigations from Maza e Sharif:

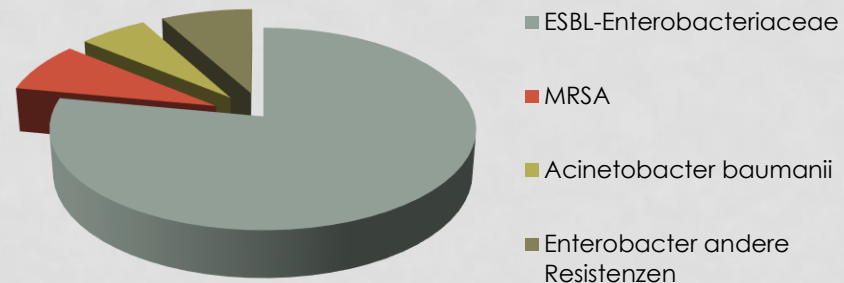


Vandersee, S. et al., HygMed 2011; 36-10, Sei. 384-392

Kolonisationsprävalenz der **afg. Patienten:**

- 29 % MRE+ (auf ICU 46%)

**Anteil MREs am Gesamtprobenaufkommen
05 / 2010 - 09 / 2010**



Sutter, DE. Et al., InfectControlHosp Epidemiolog 2011; 32(9): 854-60

Kolonisationsprävalenz bei 411 afg. Patienten 09/2007 – 08/2008:

- 51 % MRE+
- 76 % gram negative Keime (70% MRE's)
- Gram - MRE's:
 - 53% der E. coli, 90% der Acinetobacter, 60% der Klebsiellen

→ gram-negative MRE: dominating bacteria in crisis areas?



Gram-negative bacteria in combat related wounds: **- US experience -**

„After leaving the combat zone, patients are presenting to US military hospitals with a much higher rate of MDR gram-negative bacteria colonizing and infecting wounds“.

Murray C et al; JOT 2011; 71: 235-257



Causes of resistance?

- **low standards of development and hygienics**
- **free available, low-cost standard antibiotics**
- **overuse / misuse of antibiotics**
- **permanent reservoir in GIT and UGT**
- **travelling of germ vectors**
- **plasmid-hospitalism**
- **mutations and horizontal gen-transfer**

Bacterial traffic worldwide: partially migration related?

© Le Monde diplomatique, 2007



- Zielländer, die viele Armuts- und Wirtschaftsflüchtlinge aufgenommen haben
- wichtigste Herkunftsregionen
- hoch qualifizierte Wirtschaftsflüchtlinge
- gering und unqualifizierte Armutsflüchtlinge
- nennenswerte interne Wirtschaftsmigration



MDR identified as / to be differentiated

- **colonization (skin, GIT, respir. system)**
- **contamination (bacterial wound cultures pre- /post debridement)**
- **infection (proof of bacteria after onset)**



MDR – change throughout course

„after leaving the combat zone, patients are presenting to US military hospitals with a much higher rate of MDR gram-negative bacteria colonizing and infecting wounds.“

Murray C et al; JOT 2011; 71: 235-257

Established infection after ORIF



the sword of Damocles





Civilian benchmark: **Bone infection rates in Germany**

- **heterogenous data available**
- **no current data since last 5 years**
- **after closed fx: 0,5% - 3,0%**
- **after open fx: 2,6% - 10%**
- **after osteosynthesis: 0,6% - 3,4%**

**AH Tiemann, R Braunschweig, GO Hoffmann:
Knocheninfektionen, Unfallchirurg (2012), S. 480 – 488]**



MDR and combat related wounds: US experience

„Increasing colonization with MDR bacteria throughout the the evacuation chain from the combat zone, through Germany, to the US supports the concept, that most MDR bacteria colonization and infection is health care associated.“

Hospenthal DR et al; JOT 2011; 71: 210-234



Complications in combat related injuries: the large scale (USA)

- **7,4% primary amputation**
- **15% osteomyelitis**
- **17% relapse of infection**
- **primordial no typical risk factors**
acc. to young, healthy milit.
personnel



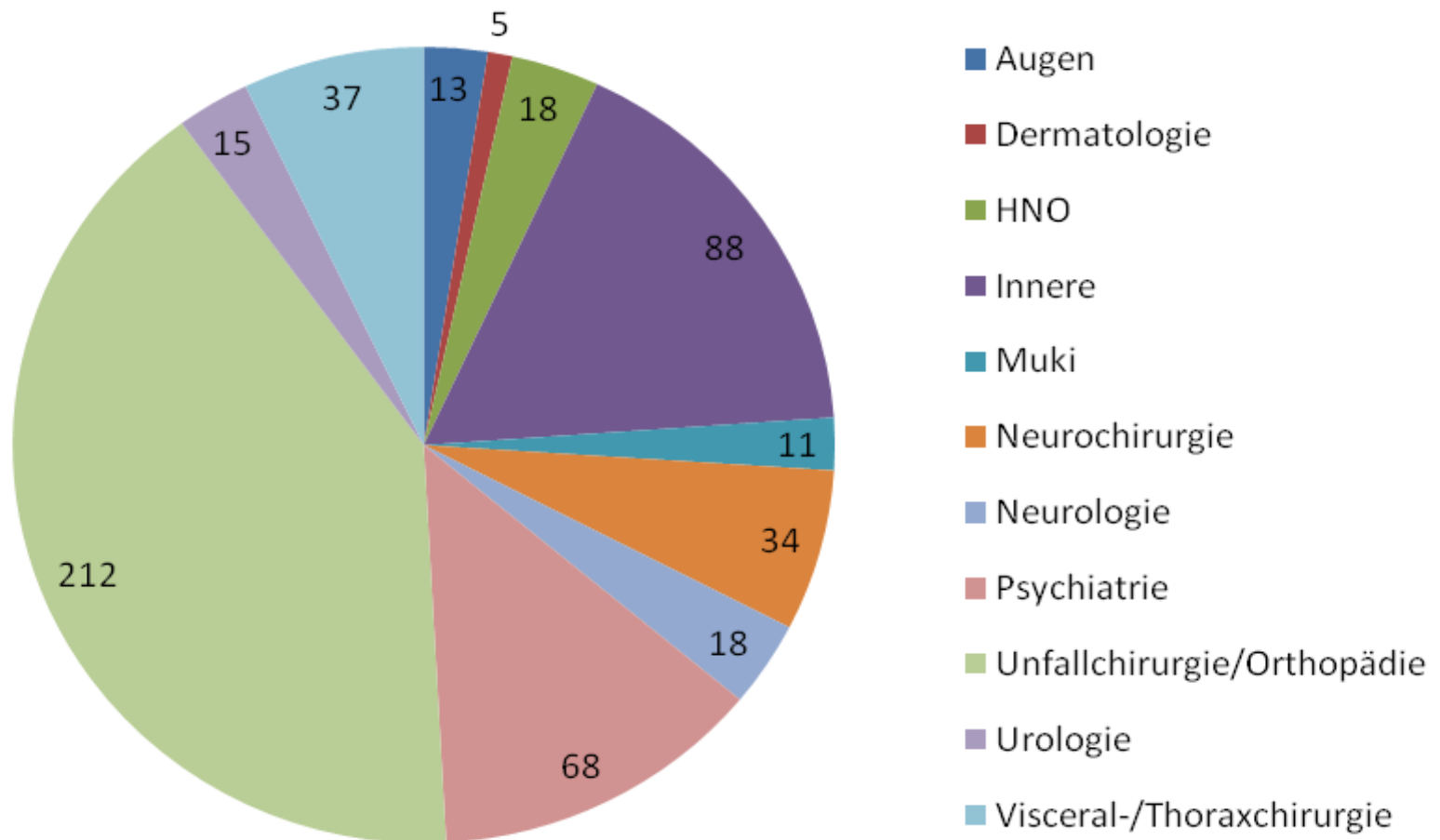
PRINCIPLES OF COMBAT RELATED INJURIES:

- 💣 in gunshot and blast-injuries gross contamination is obligatory**
- 💣 open wounds, damage in the deep easily underestimated**
- 💣 so called „developing wounds“**
- 💣 soft tissue determines preservation of bone and so called guiding structures, thereby the fate of a limb**
- 💣 sepsis is the killer No. 2 after hemorrhage**



Milit. repatriations from deployment to Germany

Repatriierungen 2005-2010

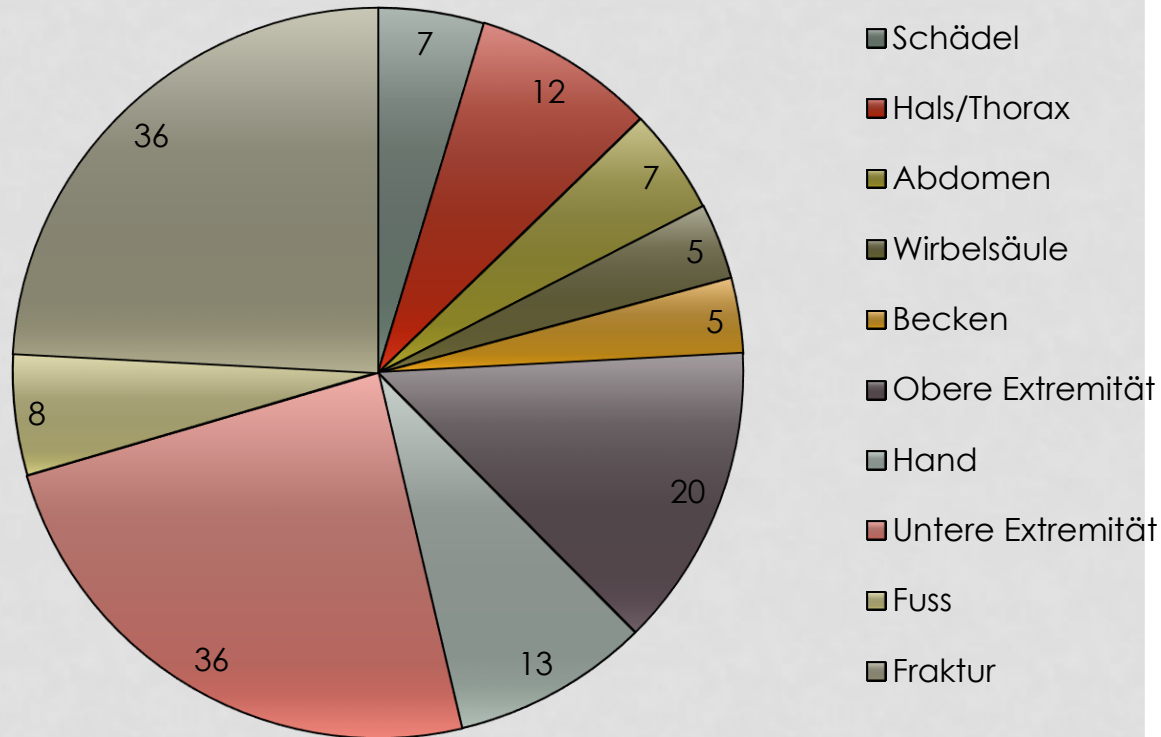




GSW Koblenz Centr Mil Hospital

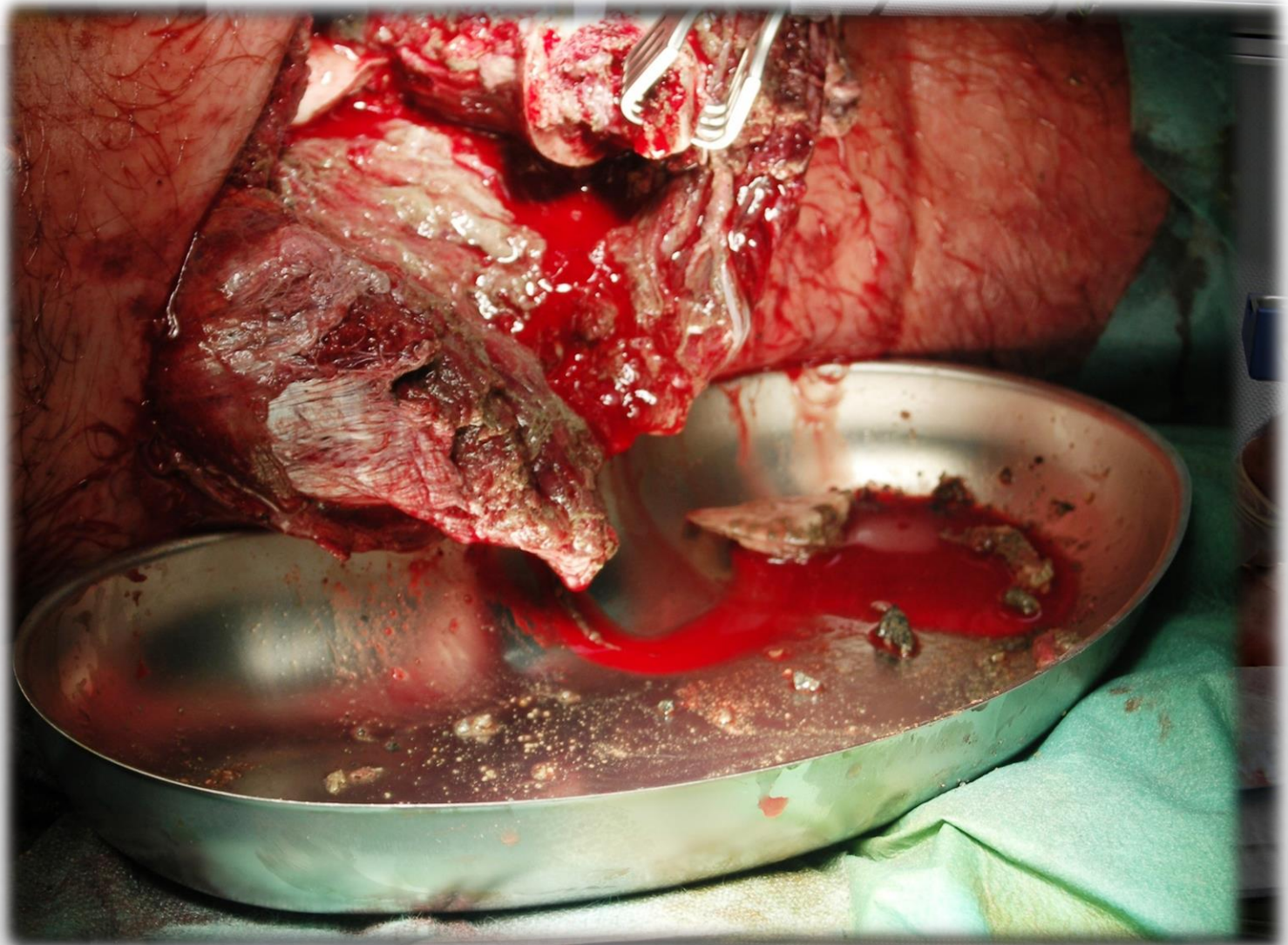
Lokalisation Schussverletzungen (113 Verletzungen bei 79 Patienten)

- 2004 – 2015
- combat: 40
- accident: 37



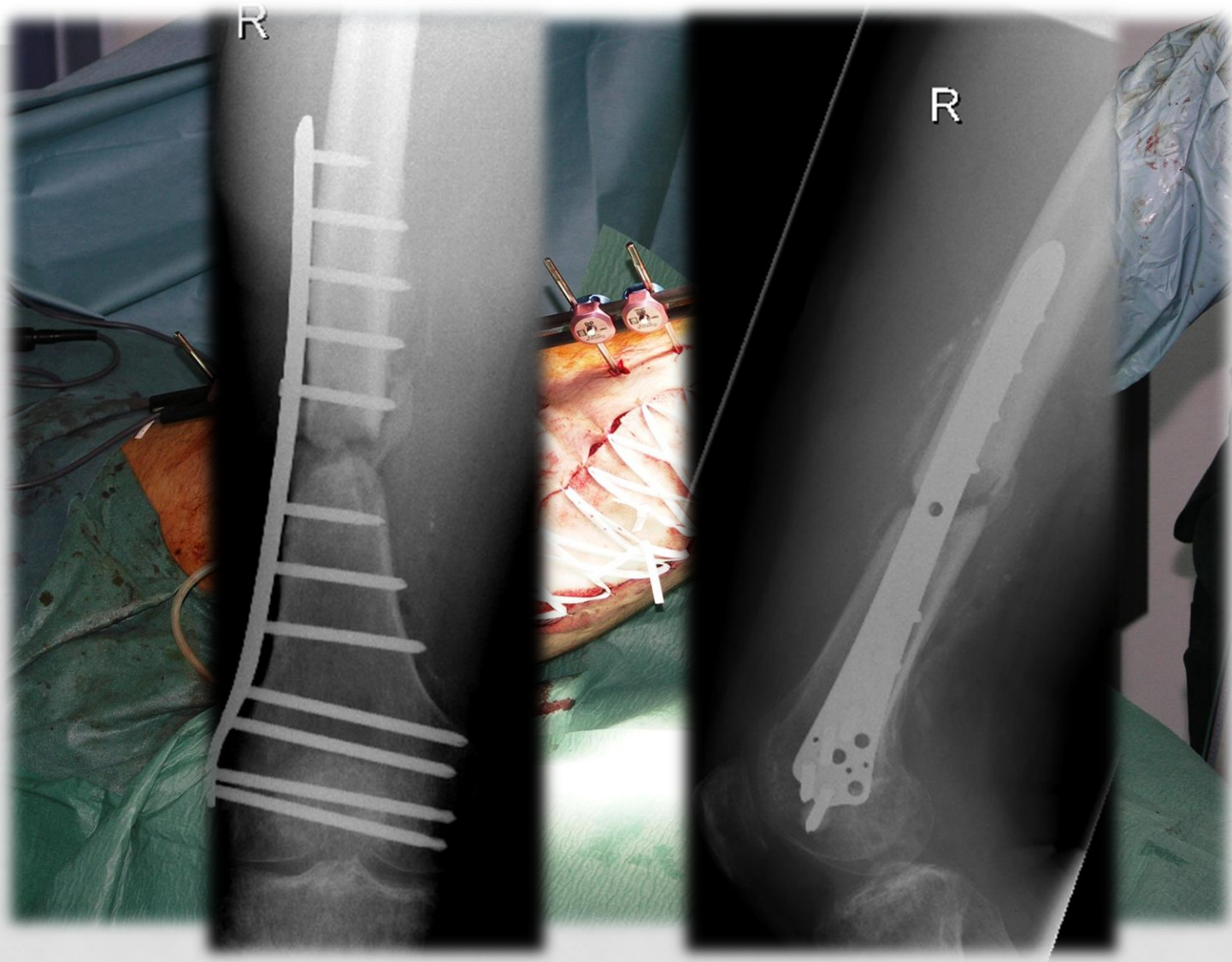


Blast injury caused by IED





Blast injury caused by IED

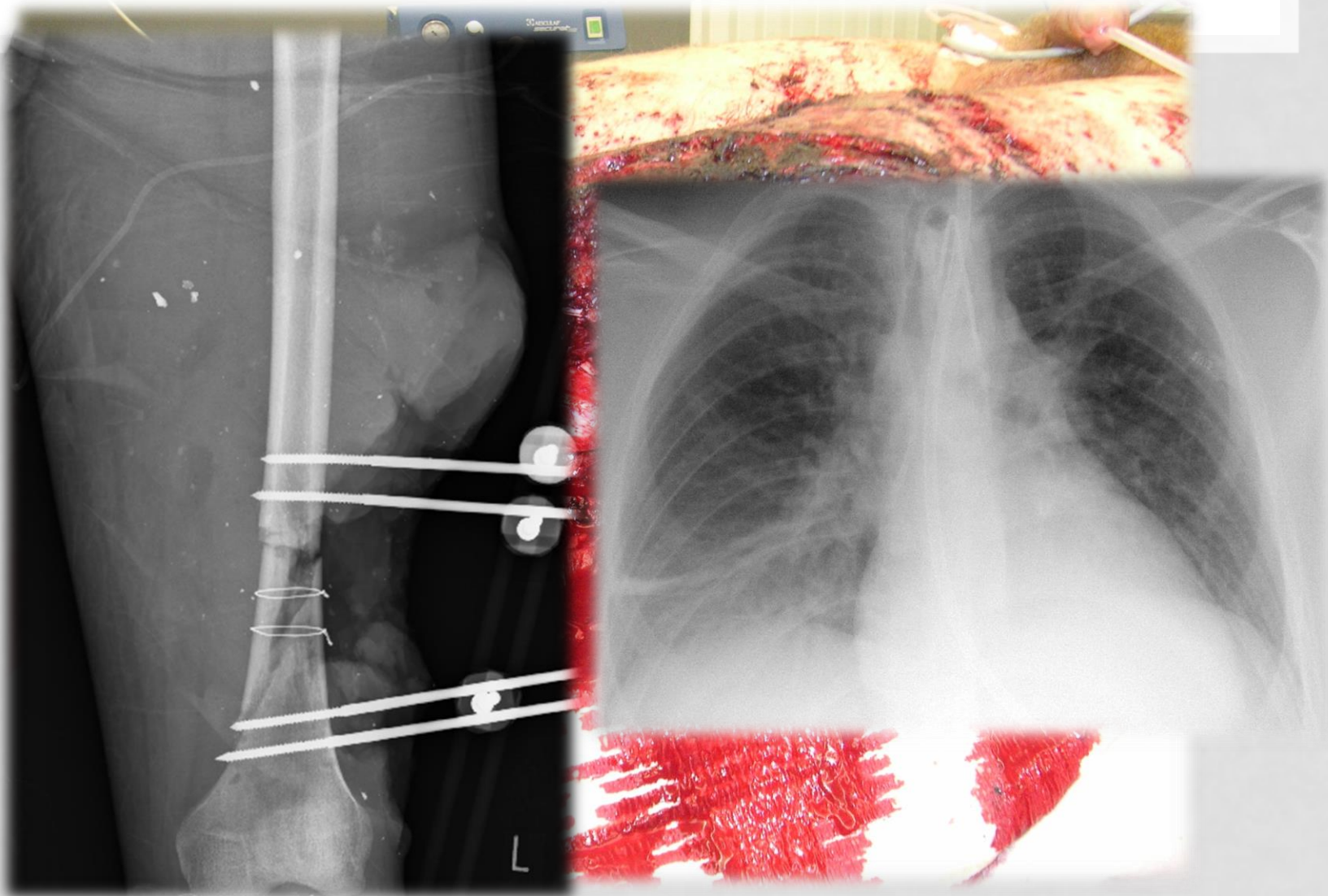




36 months

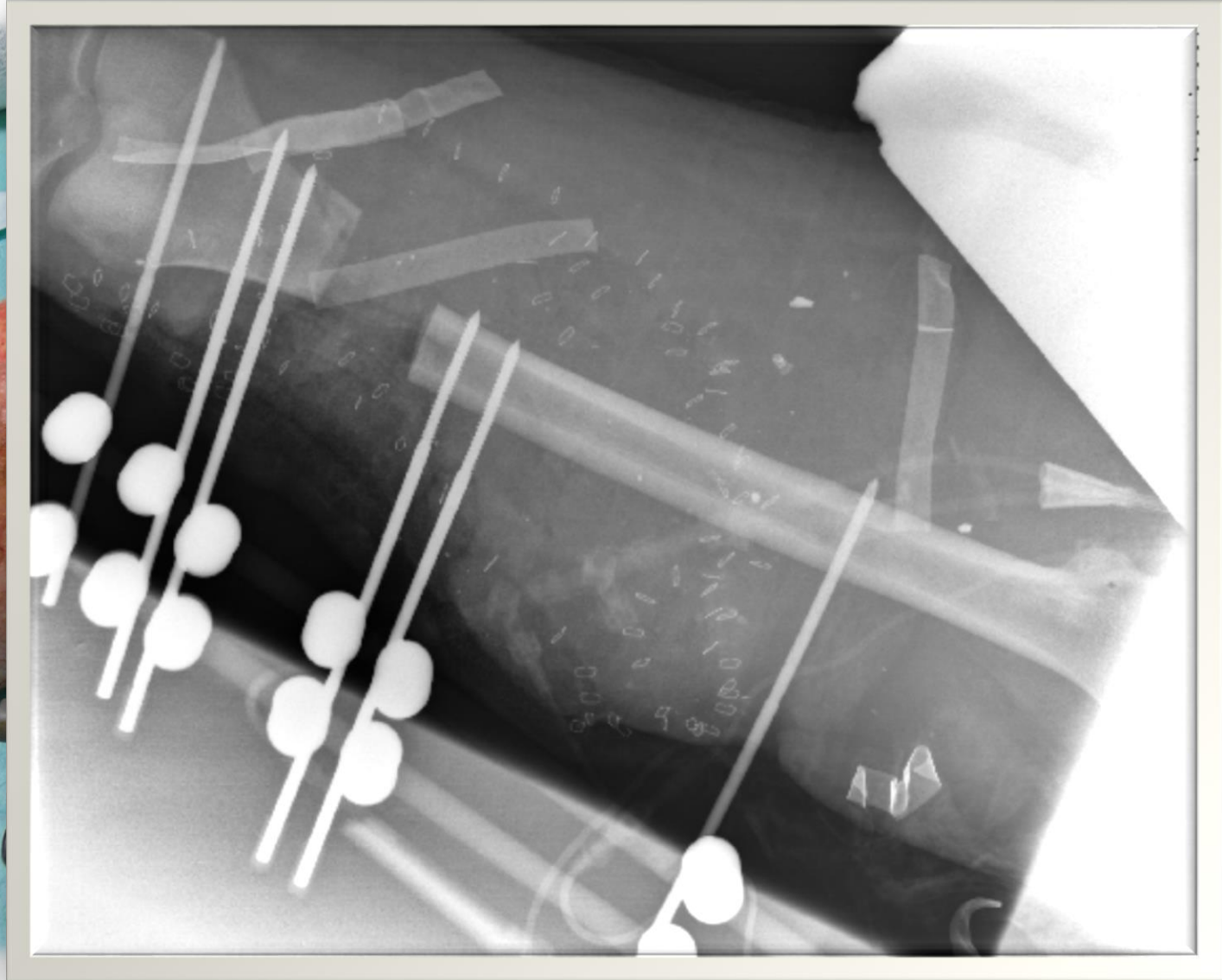


Blast injury caused by IED





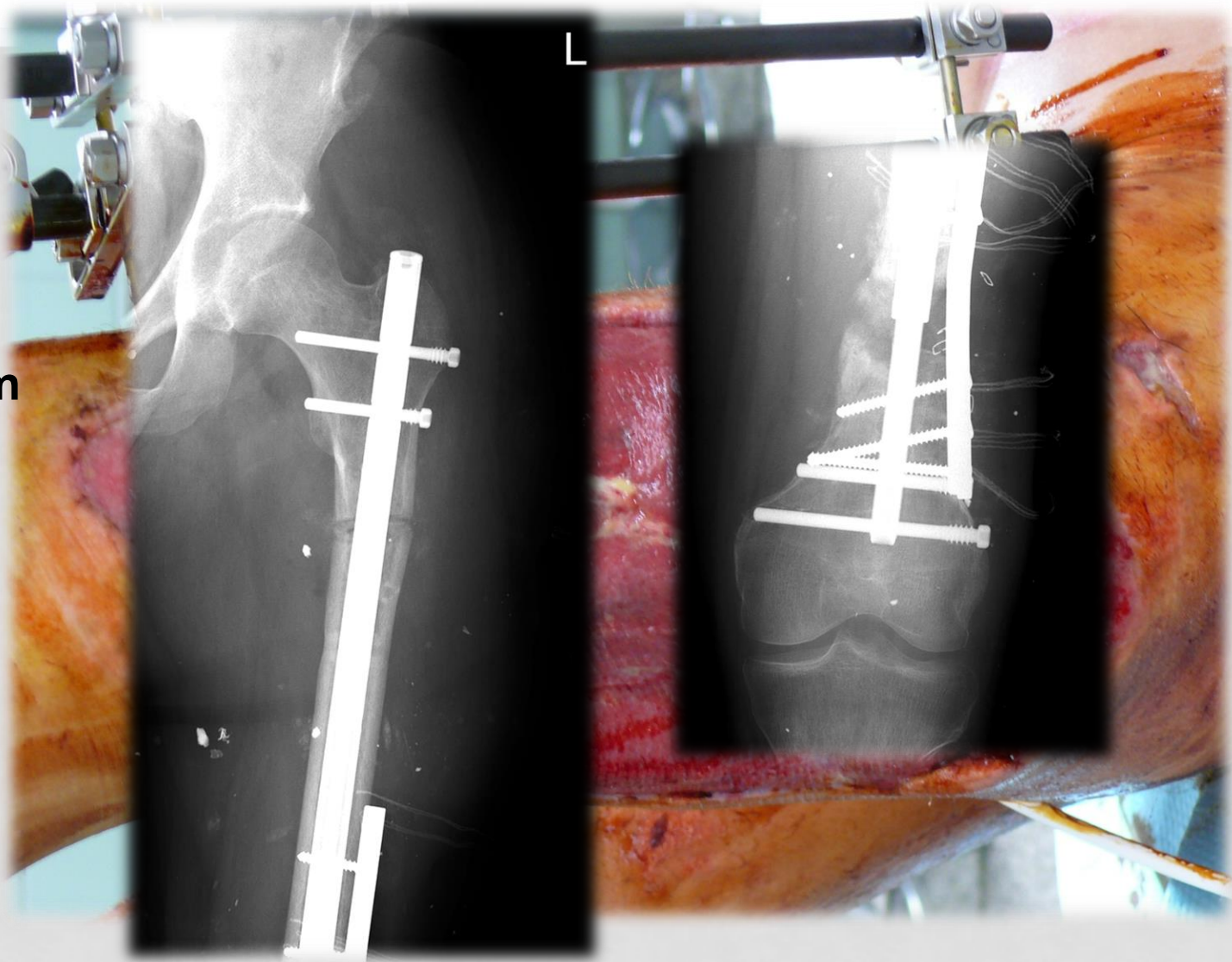
Blast injury caused by IED





Blast injury caused by IED

- NPWT
- Matriderm
- ISKD





Blast injury caused by IED: 12 months after





The Libyan experience 2011 - 12





The Lybian experience:

- **10 patients from Lybia, all wounded and pre-treated up to three months**
- **2/3 lower limb, 1/3 upper limb**
- **10/10 with established infection /wound drainage**
- **> 50% bone defect 50 to 80mm**



Cohort- and single - isolation





The Lybian experience – bacteriology:

- **bacterial cultures of wounds and surface**
- **9/10 positive for MRE**
- **3/10 positive for MRSA additionally**
- **4/10 Pseudom. Aeruginosa**
- **4/10 Acinetob. Baumannii**
- **1/10 positive blood-culture**



Spectrum of bacteria in combat related wounds

- **S. aureus**
- **MRSA (Methicillin-resistant, „multiresistant“)**
- **MRSE (Multiresistente S. epidermidis specimen)**
- **VRE**
- **Pseudomonas aeruginosa**
- **Klebsiella pneumoniae, Klebsiella pneumoniae (ESBL-pos.)**
- **Proteus species**
- **Enterobacter cloacae, Enterobacter cloacae (ESBL-pos.)**
- **Acinetobacter baumannii**
- **Enterococcus faecalis**
- **High-level-Gentamycin-resistenter Enterococcus**
- **Serratia marcescens, Serratia marcescens (ESBL-pos.)**
- **.....**



From the lab – a classic:

Auftrag 14.11.2011 309231	LabNr V09231	Material Material	Fragestellung In BK-Medium OS re
Entnahme am 14.11.2011		Probeneingang 14.11.2011 13:20: anget	
Befundbericht Bakteriologie / Myko			
E N D B E F U N D			
BAKTERIOLOGISCHE KULTUR			
Keim 1: Klebsiella pneumoniae ssp. pneumoniae			
Wichtiger Hinweis: Es handelt sich um einen ESBL-(Extended-Spektrum- β-Lactamase-)produzierenden Stamm. Auch bei an- scheinender in-vitro-Empfindlichkeit sollten β-Lactam-Antibiotika, einschließlich der Cephalo- sporine der 3. Generation (Cefotaxim, Ceftriaxon, Cefpodoxim, Cefprozid) und Monobactame (Aztreo- nam) nicht für die Therapie der durch diesen Keim hervorgerufenen Infektionen eingesetzt werden. Dies gilt auch für Tazobactam, das aber bei weitreichender Resistenz noch als Reserve- option genutzt werden kann. ESBL-produzierende Keime können ein ernsthaftes krankenhaushygienisches Problem darstellen. Ihre Weiterverbreitung sollte daher durch entsprechen- de krankenhaushygienische Maßnahmen unbedingt verhindert werden. Von Befunden, in denen ein ESBL-Nachweis mitge- teilt wird, erhält der hygienebeauftragte Arzt eine Kopie.			

ANTIBIOGRAMM		1
Ampicillin		R
Ampicillin-Sulbactam		R
Amoxicillin-Clavulans		R
Cefazolin		R
Cefuroxim		R
Cefotaxim		R
^t Gentamicin		R
Amikacin		I
Tobramycin		R
Cotrimoxazol		S
Levofloxacin		R
Ciprofloxacin syst.An		R
Ceftazidim		R
Piperacillin		R
Piperacillin-Tazobact		R
Aztreonam		R
Imipenem		I
Meropenem		R

(S = sensibel, R = resistent, I = intermediär)
Die Angaben über das Resistenzverhalten wurden
als Minimale Hemmstoff-Konzentrationen (MHK)
ermittelt.

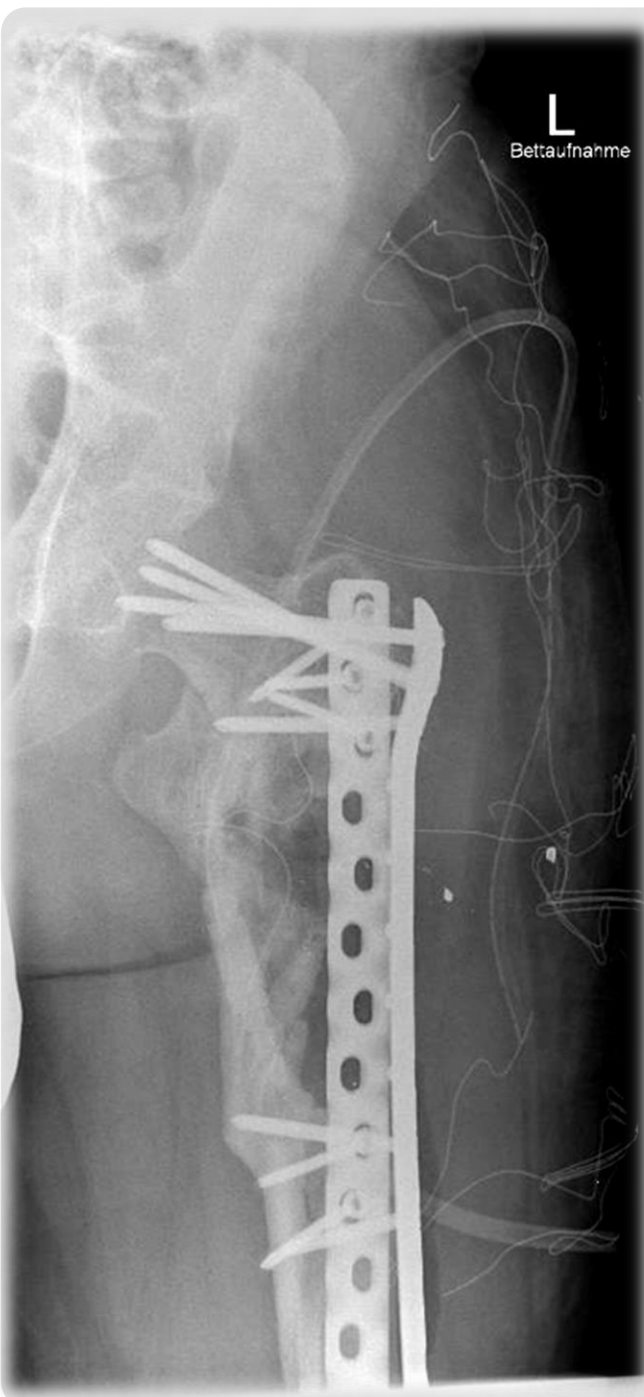


- MDR
- ESBL
- MRSA





reconstruction of bone defect
acc. to MASQUELET's method
with cancellous bone graft
augmented by platelet rich plasma



ORIF + Masquelet



one-step revision: relapsing infection thereafter





Infection, sepsis, ESBL:

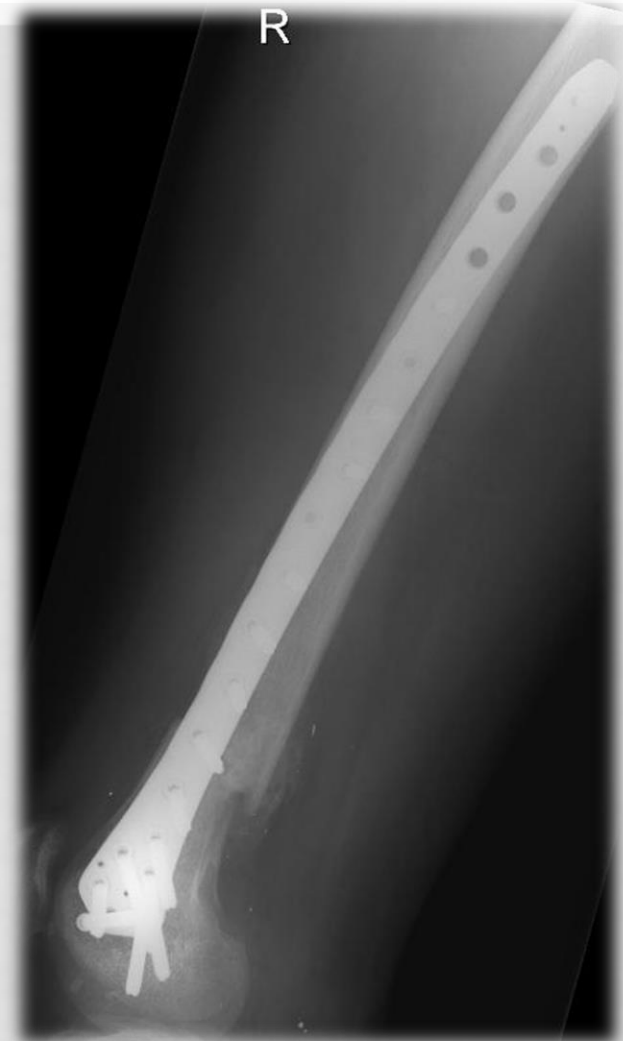




Patient's bacteria cultures

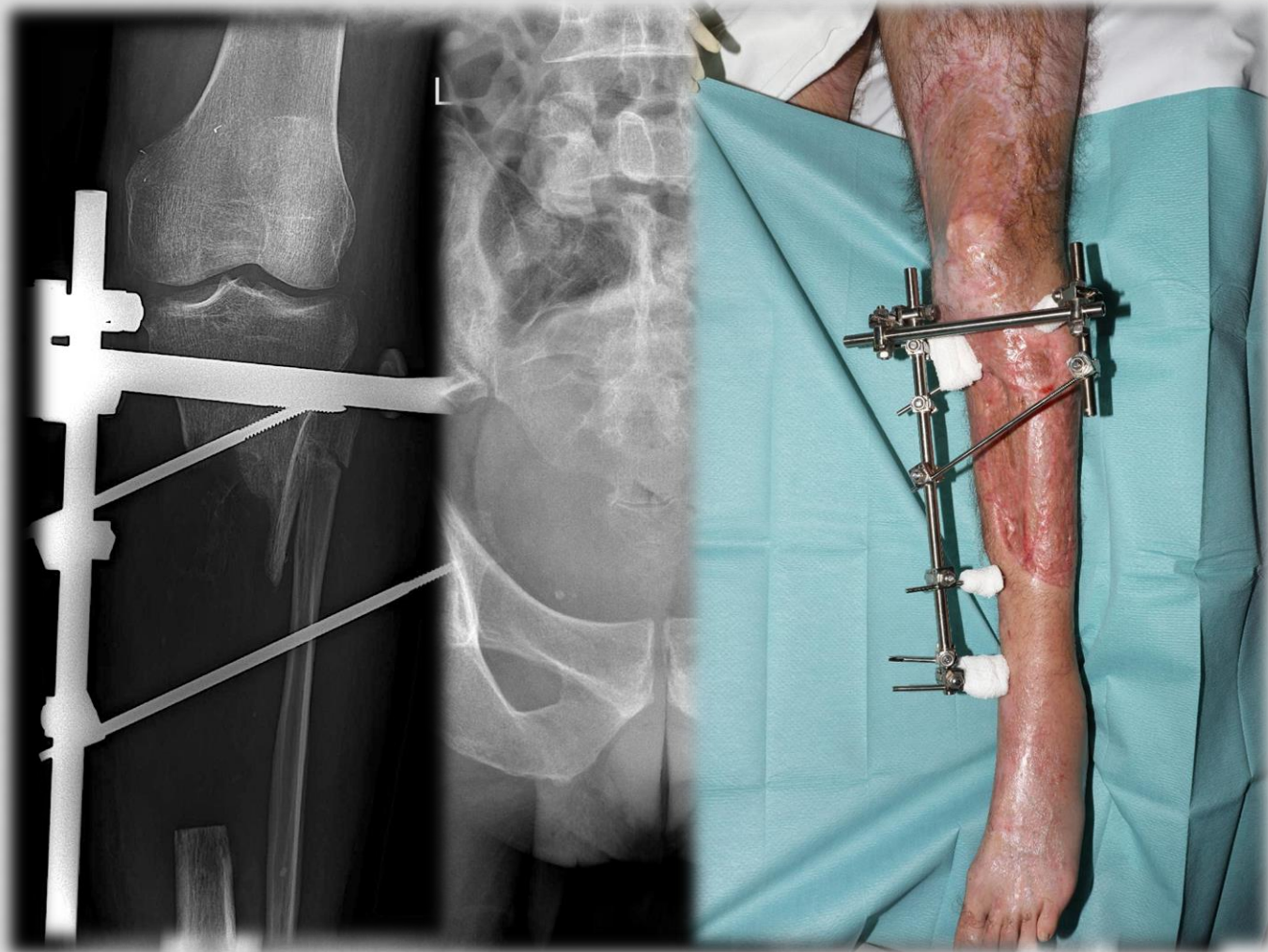
	wound	skin	blood culture
MRSA		+	
P. aeruginosa	+	+	
A. baumannii	+		
H-L-G-R Enterococcus		+	
ESBL-Klebsielle	++	+	+
P. mirabilis		+	
ESBL-Serratia	++	+	+
S. haemolyticus		+	
C. freundii		+	
E. coli		+	

...leaving the internal Titanium fixator in situ: 4 weeks post



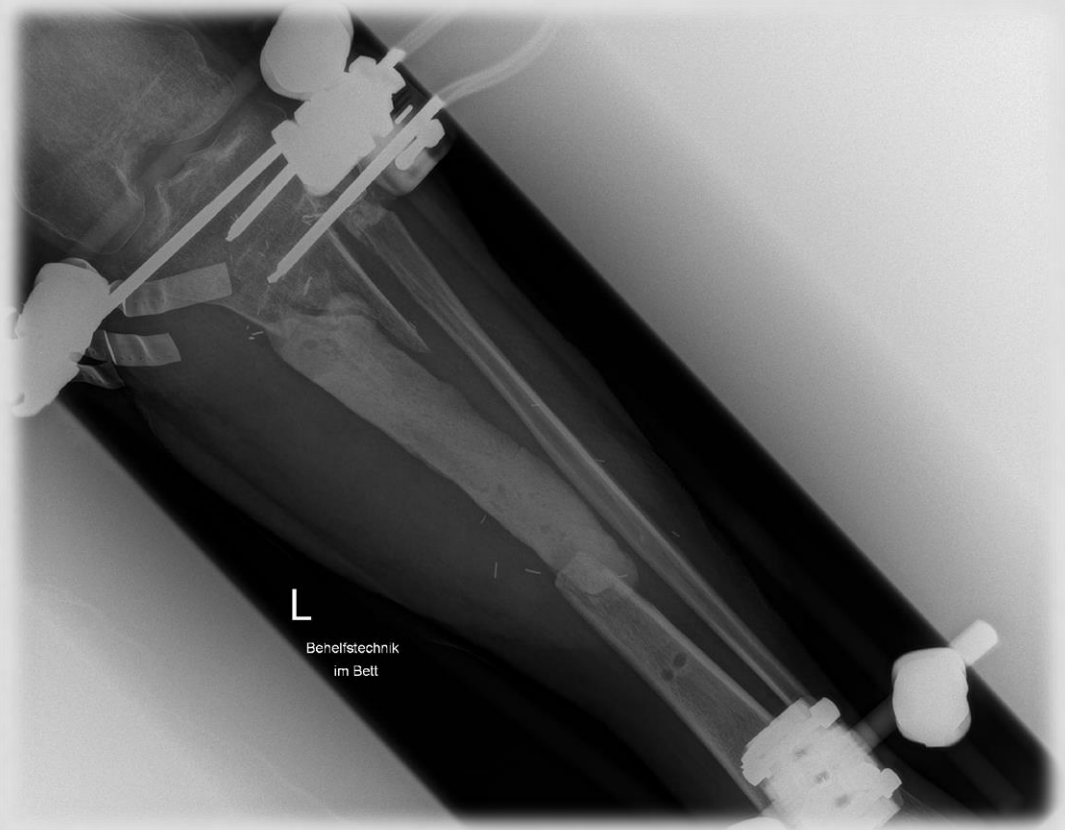
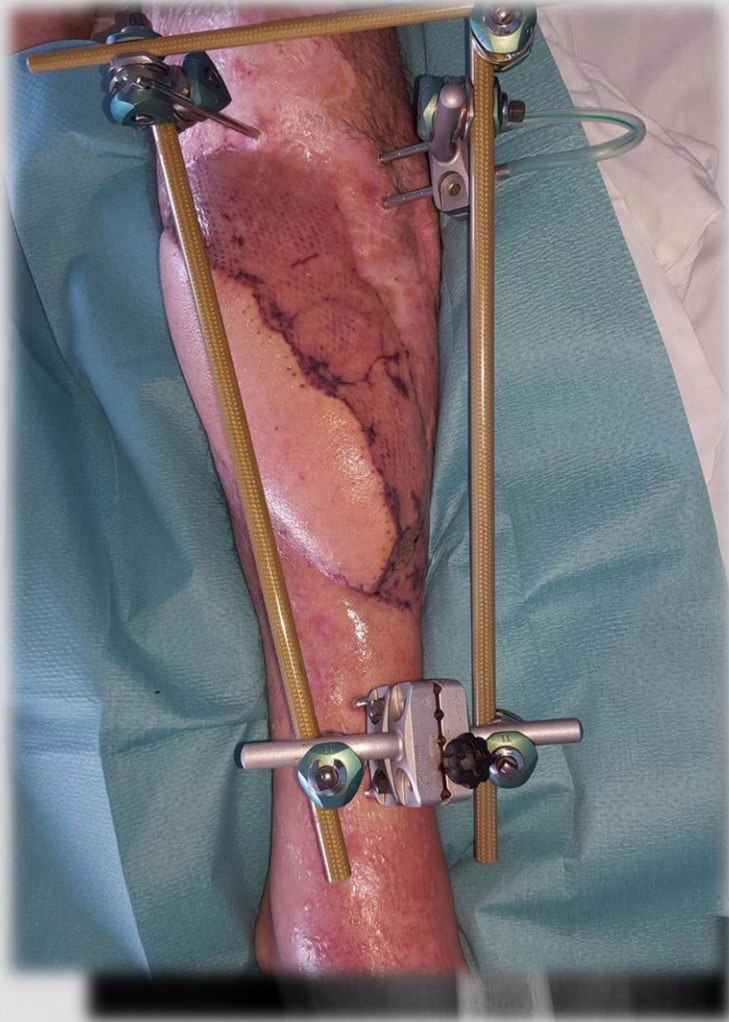


Ukrainian patient, multiple mortar wounds, 3- + 4-MRGN, MRSA





Ukrainian Patient, multiple mortar wounds, 3- + 4-MRGN, MRSA

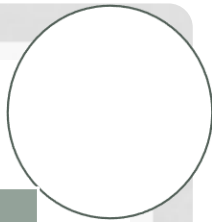




Ukrainian Patient, multiple mortar wounds, 3- + 4-MRGN, MRSA

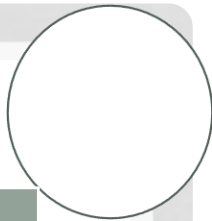


PATIENT A



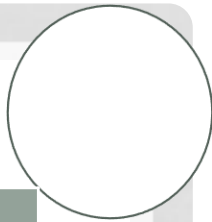
Lokalisation	Wundinfektion	Kontamination in Ganzkörperabstrichserien
28.06.2017 Wunde (Oberarm links außen und innen)	E.cloacae (ESBL)	E. cloacae (ESBL)
05.07.2017 Intraoperative Abstriche Markraum und Frakturregion (Humerus links)	E. cloacae (ESBL) A. baumannii	K. pneumoniae (ESBL) A. baumannii
10.07.2017 Intraoperative Abstriche Wunde (Oberarm links außen)	E.cloacae (ESBL)	K. pneumoniae (ESBL) (4MRGN) A. baumannii (4MRGN)
17.07.2017 Intraoperative Abstriche Wunde (Oberarm links außen Pinstelle)	A. baumannii (4MRGN)	
02.08.2017 Intraoperative Abstriche Wunde (Oberarm links außen Pinstelle)	A. baumannii (4MRGN)	
18.08.2017 Punktat	Kein Keimnachweis	

PATIENT B



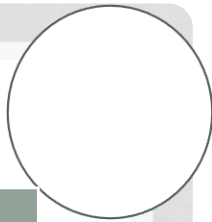
Lokalisation	Wundinfektion	Kontamination in Ganzkörperabstrichserien
28.06.2017 Wunde (Oberschenkel rechts, tief)	A. baumannii (3MRGN)	K. pneumoniae (ESBL)
30.06.2017 Wunde (Oberschenkel rechts, tief)	A. baumannii (3MRGN und Gentamicin resistent)	
03.07.2017 Wunde (Oberschenkel rechts, tief)	A. baumannii (3MRGN Carbapenem sensibel)	
17.07.2017 Wunde (Oberschenkel rechts, tief)	A. baumannii, S. lugdunensis, E. faecalis	
02.08.2017 Verschlossene Wundverhältnisse, reizfrei	Keimfrei	

PATIENT C



Lokalisation	Wundinfektion	Kontamination in Ganzkörperabstrichserien
28.06.2017 Wunde (Hüfte rechts)	Staphylokokkus hominis (Vancomycin sensibel)	A. baumannii, K. pneumoniae (ESBL) (3MRGN) K. pneumoniae (ESBL) (4MRGN) K. pneumoniae (ESBL) (3MRGN) (Tigecyclin resistent) E. coli (ESBL) (3MRGN) E. cloacae (ESBL) (VRE)
04.07.2017 Femur Markraum (rechts)	S. epidermidis (Linezolid sensibel)	
04.08.2017 Femur Markraum, Kapsel, Pfannengrund (rechts)	E. coli (ESBL) (3MRGN) (nur Tigecyclin und Carbapeneme sensibel)	
23.08.2017 PE Zugang Hüfte und Kapsel (rechts)	A. baumannii (4MRGN) (Gentamicin sensibel)	
06.09.2017 PE Zugang Hüfte (rechts)	E. coli (ESBL, 3MRGN)	
22.09.2017 PE Zugang Hüfte und Wunde Hüfte (rechts)	E. coli (ESBL, 3MRGN) S. Aureus)	
05.10.2017 Redondrainage	E. coli (ESBL, 3MRGN)	

PATIENT D



Lokalisation	Wundinfektion
28.06.2017 Wunde (Schulter links, tief)	S. hämolyticus, S. epidermidis
04.07.2017 Wunde (Schulter links, tief)	S. epidermidis (Clindamycin resistent, Gentamicin resistent)
28.07.2017 Primärer Wundverschluss	S. epidermidis (Clindamycin resistent, Gentamicin resistent) Ohne weitere Konsequenz und Wundheilungsstörung

Kontamination in Ganzkörperabstrichserien

K. pneumoniae (ESBL)



Surgical management I

- **consequent debridement**
- **appropriate stabilization / immobilization**
- **no additional damage by searching for foreign bodies, as long as not responsible for complications**
- **irrigation – no jet-lavage**



Surgical management II

- **programmated re-do's acc. to development**
- **NPWT recommended esp. after gross contamination and extended soft tissue damage**
- **topical use of antiseptic agents (e. g. polyhexanide)**
- **only viable tissue will heal**
- **no change to internal fixation methods unless proof of absence of infection is given**



management of antibiotics

- **flanking procedure**
- **acc. to resistance**
- **time is of an essence**
- **colonization is no target**
- **recurrent culture controls time scheduled**
- **„off label“ – use to be considered**



Orthop/Trauma: results since 2005

- **no additional amputation necessary**
- **all infections controlled, no relapse**
- **colonization can be eradicated – is it a must?**
- **no outbreak of specific bacteria**
- **combat related infections are highly demanding**



Take home messages (Orthop/Trauma) :

- **identify the gram-negative MRE as a global problem**
- **initial and repeated bacteriological screening**
- **strict isolation of patients, rigorous hygienics**
- **the surgical skills only ensure infection control and healing**
- **antibiotics only on demand and after proof**

