2023 ESC Guidelines for the management of endocarditis

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Prophylaxis

Population at Risk

ESC European Society of Cardiology
European Heart Journal (2018) 39, 586–595
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CLINICAL RESEARCH
Prevention and epidemiology

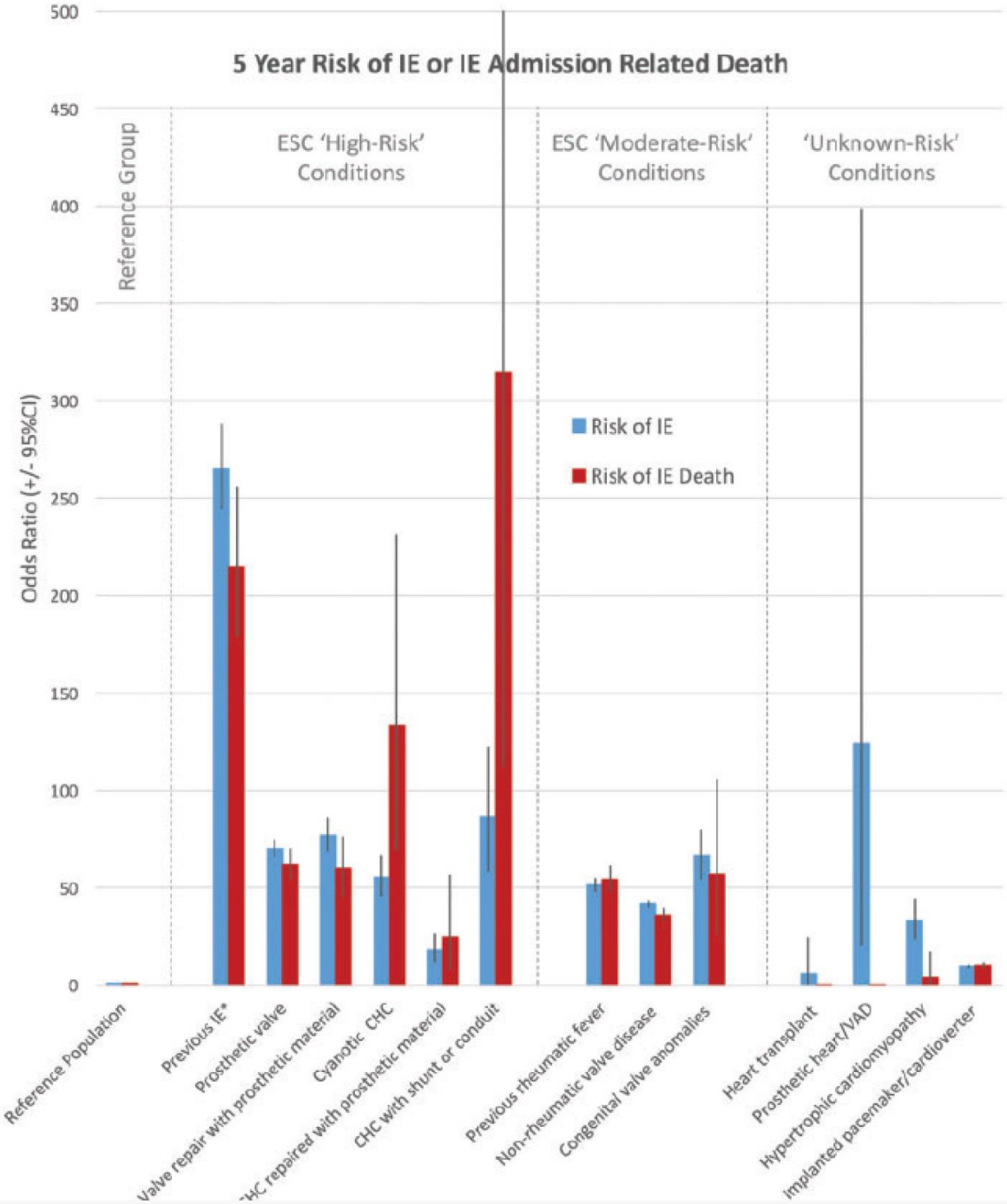
Quantifying infective endocarditis risk in patients with predisposing cardiac conditions

Martin H. Thornhill[1,2]*, Simon Jones[3,4], Bernard Prendergast[5], Larry M. Baddour[6], John B. Chambers[5], Peter B. Lockhart[2], and Mark J. Dayer[7]

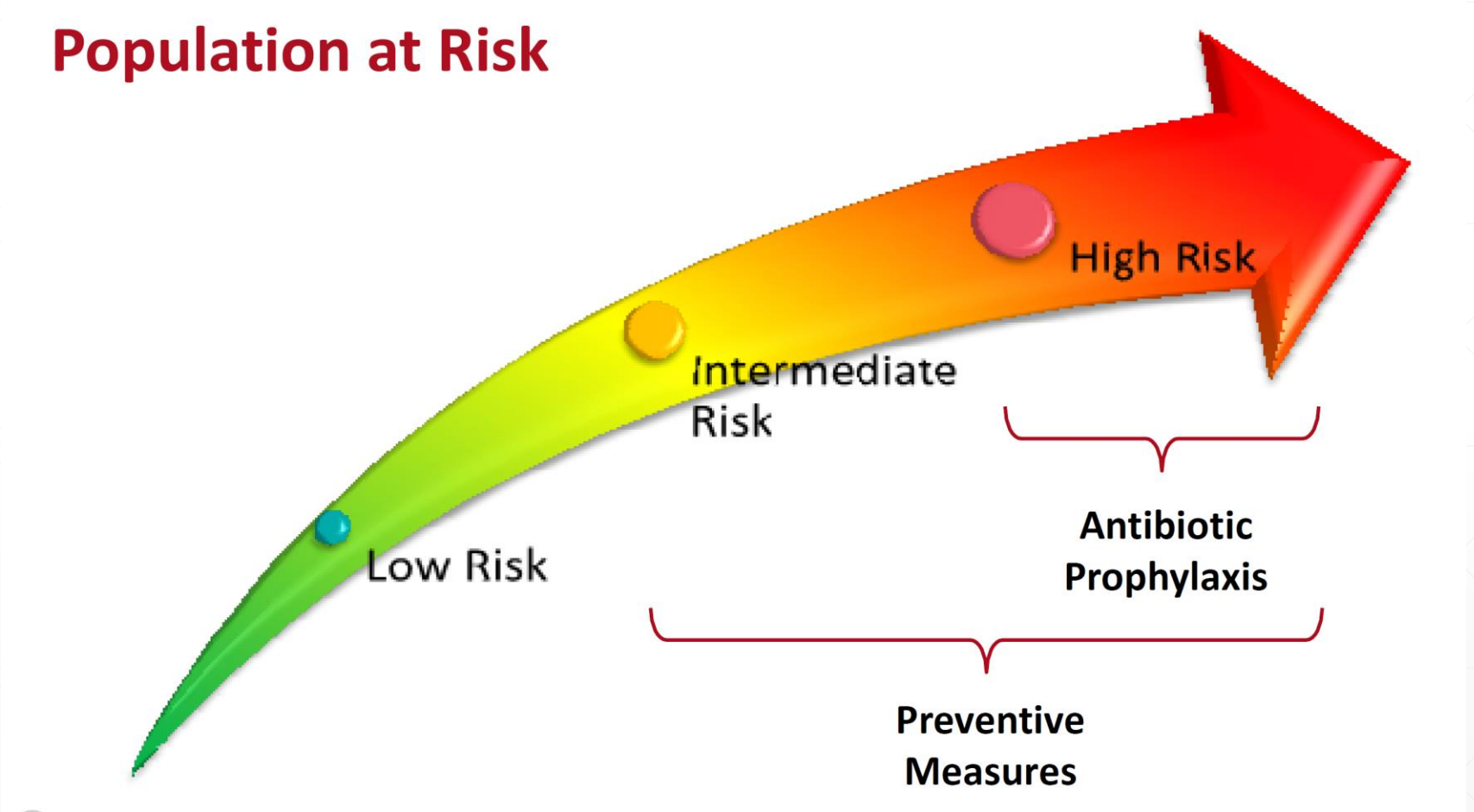
Reference incidence of IE in UK 3.6/100,000/year

Intermediate Risk: 280/100,000/year

High Risk: 497/100,000/year



Prophylaxis



Recommendations for antibiotic prophylaxis in patients with cardiovascular diseases undergoing oro-dental procedures at increased risk for IE (1)

Recommendations	Class	Level	
General prevention measures are recommended in individuals at high and intermediate risk for IE.	I	C	New
Antibiotic prophylaxis is recommended in patients with **previous IE**.	I	B	Revised
Antibiotic prophylaxis is recommended in patients with surgically implanted **prosthetic valves and with any material used for surgical cardiac valve repair**.	I	C	Revised
Antibiotic prophylaxis is recommended in patients with **transcatheter implanted** aortic and pulmonary valvular prostheses.	I	C	Revised
Antibiotic prophylaxis is recommended in patients with **untreated cyanotic CHD**, and **patients treated with surgery or transcatheter procedures with post-operative palliative shunts, conduits, or other prostheses**. After surgical repair, in the absence of residual defects or valve prostheses, antibiotic prophylaxis is recommended only for the first 6 months after the procedure.	I	C	Revised

Recommendations for antibiotic prophylaxis in patients with cardiovascular diseases undergoing oro-dental procedures at increased risk for IE (2)

Recommendations	Class	Level	
Antibiotic prophylaxis is recommended in patients with **ventricular assist devices**.	I	C	New
Antibiotic prophylaxis should be considered in patients with **transcatheter mitral and tricuspid valve repair**.	IIa	C	Revised
Antibiotic prophylaxis may be considered in recipients of **heart transplant.**	IIb	C	New
Antibiotic prophylaxis is not recommended in other patients at low risk for IE.	III	C	

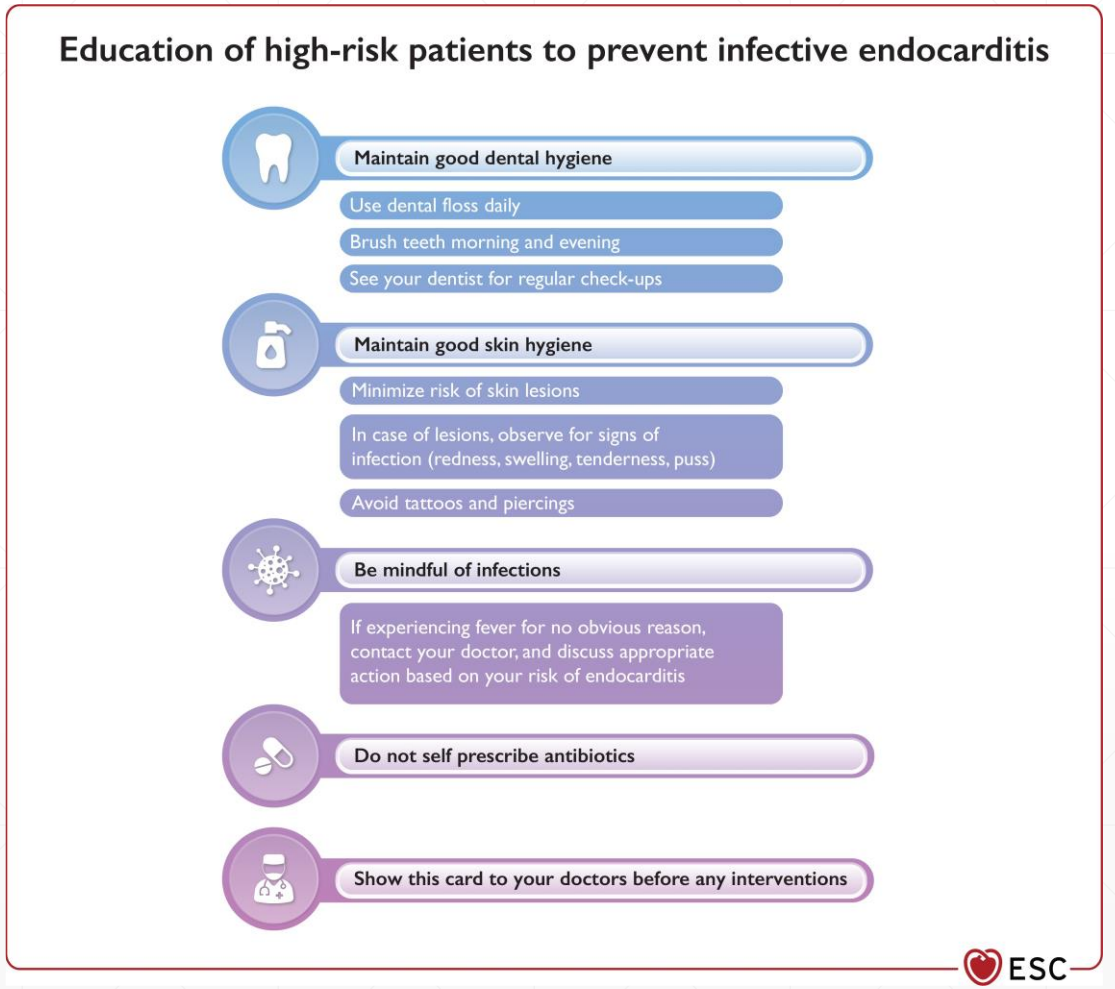
Intermediate risk patients

Patients at intermediate risk of IE include those with: (i) rheumatic heart disease (RHD); (ii) non-rheumatic degenerative valve disease; (iii) congenital valve abnormalities including bicuspid aortic valve disease; (iv) cardiovascular implanted electronic devices (CIEDs); and (v) hypertrophic cardiomyopathy.[47,103,104] Some epidemiological data suggest that certain conditions stratified as intermediate risk are associated with a higher risk of IE compared with the background population,[47,90,103] but further studies are required. In patients at intermediate risk of IE, antibiotic prophylaxis is not routinely recommended and may be considered on an individual basis. However, prevention measures (*Table 5*) are strongly encouraged in these patients.[7]

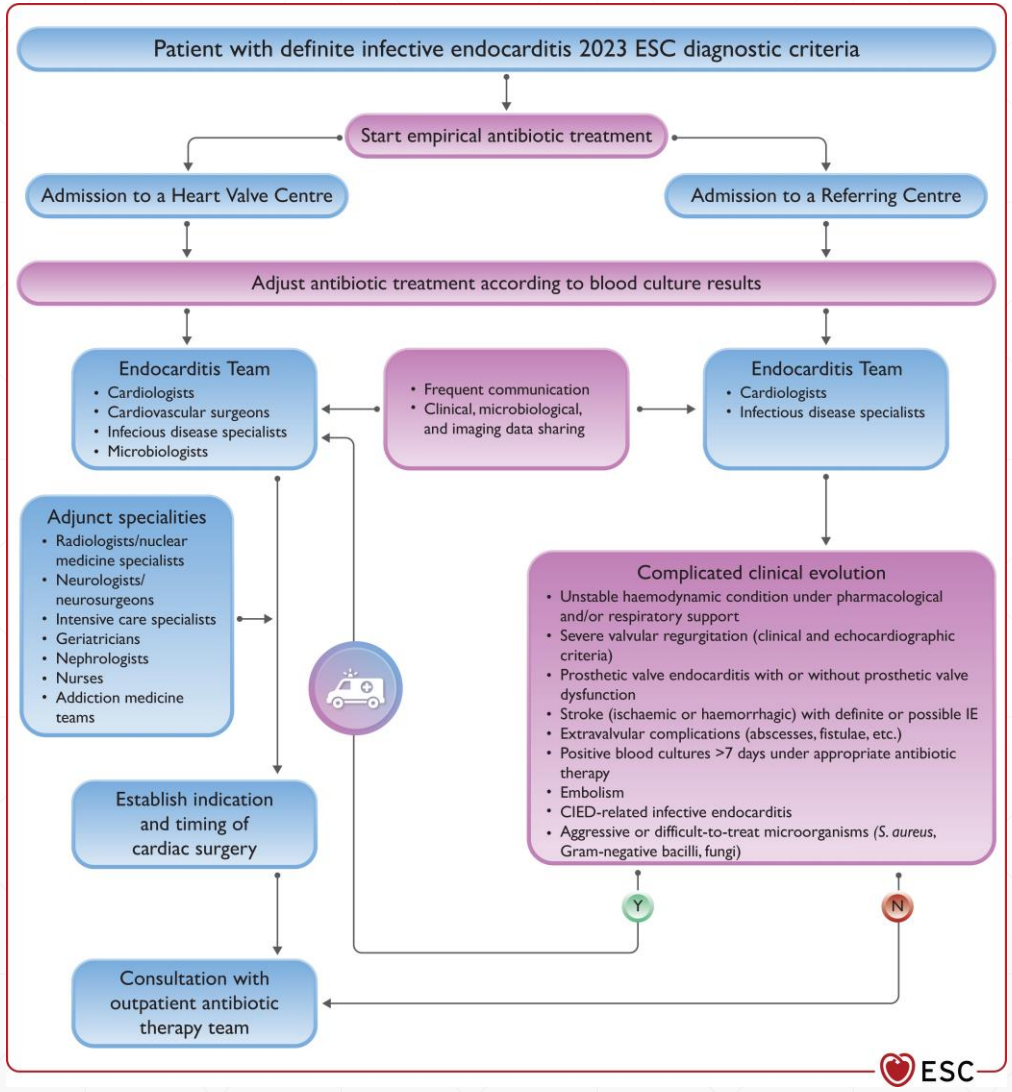
Recommendations	Class[a]	Level[b]
Pre-operative screening for nasal carriage of *S. aureus* is recommended before elective cardiac surgery or transcatheter valve implantation to treat carriers.[113,114]	I	A
Peri-operative antibiotic prophylaxis is recommended before placement of a CIED.[116–118]	I	A
Optimal pre-procedural aseptic measures of the site of implantation is recommended to prevent CIED infections.[119]	I	B
Periprocedural antibiotic prophylaxis is recommended in patients undergoing surgical or transcatheter implantation of a prosthetic valve, intravascular prosthetic, or other foreign material.[120]	I	B
Surgical standard aseptic measures are recommended during the insertion and manipulation of catheters in the catheterization laboratory environment.	I	C
Elimination of potential sources of sepsis (including of dental origin) should be considered ≥2 weeks before implantation of a prosthetic valve or other intracardiac or intravascular foreign material, except in urgent procedures.	IIa	C
Antibiotic prophylaxis covering for common skin flora including *Enterococcus* spp. and *S. aureus* should be considered before TAVI and other transcatheter valvular procedures.[121]	IIa	C
Systematic skin or nasal decolonization without screening for *S. aureus* is not recommended.	III	C

CIED, cardiac implantable electronic device; TAVI, transcatheter aortic valve implantation.
[a]Class of recommendation.
[b]Level of evidence.

Preventive Measures



Endocarditis Team



Recommendations	Class[a]	Level[b]
Diagnosis and management of patients with complicated IE are recommended to be performed at an early stage in a Heart Valve Centre, with immediate surgical facilities and an 'Endocarditis Team' to improve the outcomes.[36–41,122,123,125,126]	I	B
For patients with uncomplicated IE managed in a Referring Centre, early and regular communication between the local and the Heart Valve Centre endocarditis teams is recommended to improve the outcomes of the patients.[36–41,122,123,125,126]	I	B

IE, infective endocarditis.
[a]Class of recommendation.
[b]Level of evidence.

Diagnosis and Imaging

Revised recommendations (6)

2015	Class	Level	2023	Class	Level
Recommendations for the role of echocardiography in infective endocarditis					
TOE should be considered in patients with suspected IE, even in cases with positive TTE, except in isolated right-sided native valve IE with good quality TTE examination and unequivocal echocardiographic finding.	**IIa**	**C**	TOE is recommended in patients with suspected IE, even in cases with positive TTE, except in isolated right-sided native valve IE with good quality TTE examination and unequivocal echocardiographic findings.	**I**	**C**

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New recommendations (3)

Recommendations	Class	Level
Recommendations for the role of computed tomography, nuclear imaging, and magnetic resonance in infective endocarditis (continued)		
Cardiac CTA is recommended in patients with possible NVE to detect valvular lesions and confirm the diagnosis of IE.	I	B
[18F]FDG-PET/CT(A) and cardiac CTA are recommended in possible PVE to detect valvular lesions and confirm the diagnosis of IE.	I	B
[18F]FDG-PET/CT(A) may be considered in possible CIED-related IE to confirm the diagnosis of IE.	IIa	B
Cardiac CTA is recommended in NVE and PVE to diagnose paravalvular or periprosthetic complications if echocardiography is inconclusive.	I	B
Brain and whole-body imaging (CT, [18F]FDG-PET/CT, and/or MRI) are recommended in symptomatic patients with NVE and PVE to detect peripheral lesions or add minor diagnostic criteria.	I	B

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Surgery

Recommendations for the main indications of surgery in infective endocarditis (native valve endocarditis and prosthetic valve endocarditis) (3)

Recommendations	Class	Level	
(iii) Prevention of embolism			
Urgent surgery is recommended in aortic or mitral NVE or PVE with persistent vegetations ≥10 mm after one or more embolic episodes despite appropriate antibiotic therapy.	I	B	=
Urgent surgery is recommended in IE with vegetation ≥10 mm and other indications for surgery.	I	C	upgraded
Urgent surgery may be considered in aortic or mitral IE with vegetation ≥10 mm and without severe valve dysfunction or without clinical evidence of embolism and low surgical risk.	IIb	B	NEW

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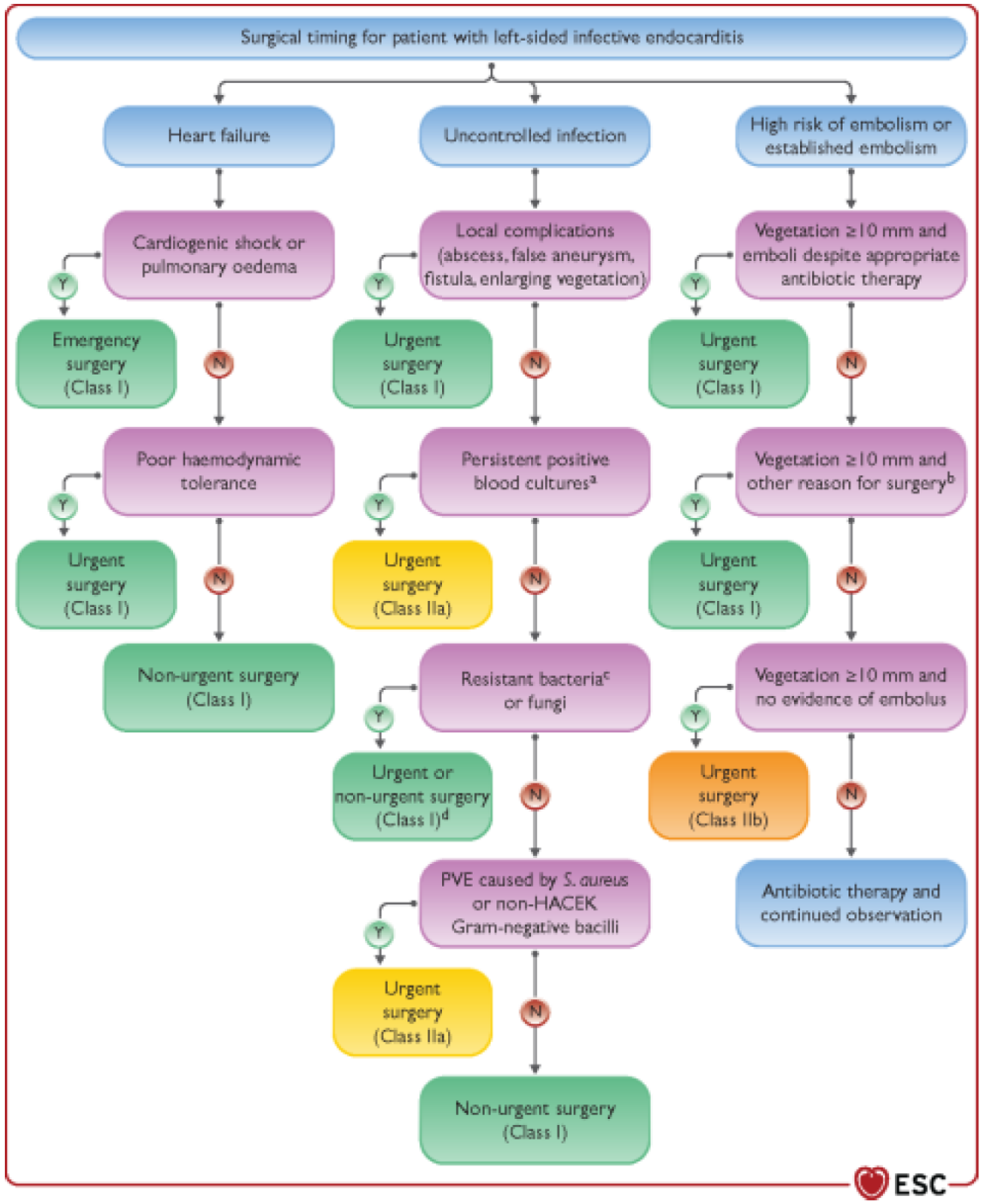
Proposed surgical timing for infective endocarditis

2023 NEW TIMING DEFINITIONS

EMERGENCY: within 24h

URGENT: within 3–5 days

NON-URGENT: within same admission



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Surgery after stroke

Recommendations	Class[a]	Level[b]
After a transient ischaemic attack, cardiac surgery, if indicated, is recommended without delay.[454,468]	I	B
After a stroke, surgery is recommended without any delay in the presence of HF, uncontrolled infection, abscess, or persistent high embolic risk, as long as coma is absent and the presence of cerebral haemorrhage has been excluded by cranial CT or MRI.[451,468,473,567,568,570–578]	I	B
Following intracranial haemorrhage, delaying cardiac surgery >1 month, if possible, with frequent re-assessment of the patient's clinical condition and imaging should be considered.[571]	IIa	C
In patients with intracranial haemorrhage and unstable clinical status due to HF, uncontrolled infection or persistent high embolic risk, urgent or emergency surgery should be considered weighing the likelihood of a meaningful neurological outcome.[199,581–584]	IIa	C

CT, computed tomography; HF, heart failure; MRI, magnetic resonance imaging.
[a]Class of recommendation.
[b]Level of evidence.

Cardiac Implanted Devices

New recommendations (10)

Recommendations	Class	Level
Recommendations for cardiovascular implanted electronic device-related infective endocarditis (continued)		
Use of an antibiotic envelope may be considered in select high-risk patients undergoing CIED reimplantation to reduce risk of infection.	IIb	B
In non-*S. aureus* CIED-related endocarditis without valve involvement or lead vegetations, and if follow-up blood cultures are negative without septic emboli, 2 weeks of antibiotic treatment may be considered following device extraction.	IIb	C
Removal of CIED after a single positive blood culture, with no other clinical evidence of infection, is not recommended.	III	C
Recommendations for the surgical treatment of right-sided infective endocarditis		
Tricuspid valve repair should be considered instead of valve replacement, when possible.	IIa	B

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Revised recommendations (9)

2015	Class	Level	2023	Class	Level
Recommendations for cardiovascular implanted electronic device-related infective endocarditis					
Routine antibiotic prophylaxis is recommended before device implantation.	I	B	Antibiotic prophylaxis covering *S. aureus* is recommended for CIED implantation.	I	A
TOE is recommended in patients with suspected cardiac device-related infective endocarditis with positive or negative blood cultures, independent of the results of TTE, to evaluate lead-related endocarditis and heart valve infection.	I	C	TTE and TOE are both recommended in case of suspected CIED-related IE to identify vegetations.	I	B

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Revised recommendations (10)

2015	Class	Level	2023	Class	Level
Recommendations for cardiovascular implanted electronic device-related infective endocarditis (continued)					
In patients with NVE or PVE and an intracardiac device with no evidence of associated device infection, complete hardware extraction may be considered.	**IIb**	**C**	Complete CIED extraction should be considered in case of valvular IE, even without definite lead involvement, taking into account the identified pathogen and requirement for valve surgery.	**IIa**	**C**

Revised recommendations (11)

2015	Class	Level	2023	Class	Level
Recommendations for cardiovascular implanted electronic device-related infective endocarditis (continued)					
Complete hardware removal should be considered on the basis of occult infection without another apparent source of infection.	IIa	C	In cases of possible CIED-related IE or occult Gram-positive bacteraemia or fungaemia, complete system removal should be considered in case bacteraemia/fungaemia persists after a course of antimicrobial therapy.	IIa	C
			In cases of possible CIED-related IE with occult Gram-negative bacteraemia, complete system removal may be considered in case of persistent/relapsing bacteraemia after a course of antimicrobial therapy.	IIb	C

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Revised recommendations (12)

2015	Class	Level	2023	Class	Level
Recommendations for cardiovascular implanted electronic device-related infective endocarditis (continued)					
When indicated, definite reimplantation should be postponed if possible, to allow a few days or weeks of antibiotic therapy.	**IIa**	**C**	If CIED reimplantation is indicated after extraction for CIED-related IE, it is recommended to be performed at a site distant from the previous generator, as late as possible, once signs and symptoms of infection have abated and until blood cultures are negative for at least 72 h in the absence of vegetations, and negative for at least 2 weeks if vegetations were visualized.	**I**	**C**

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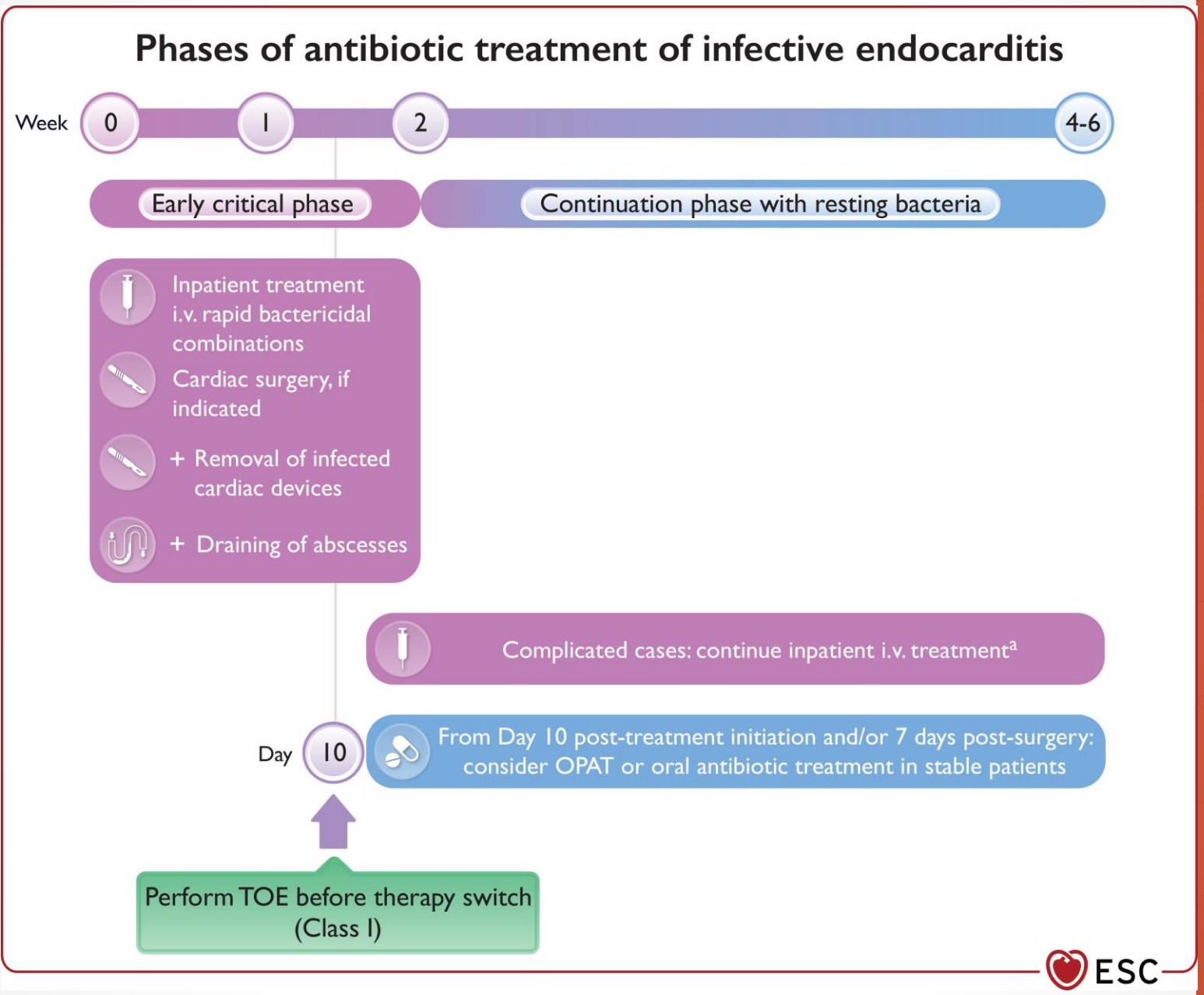
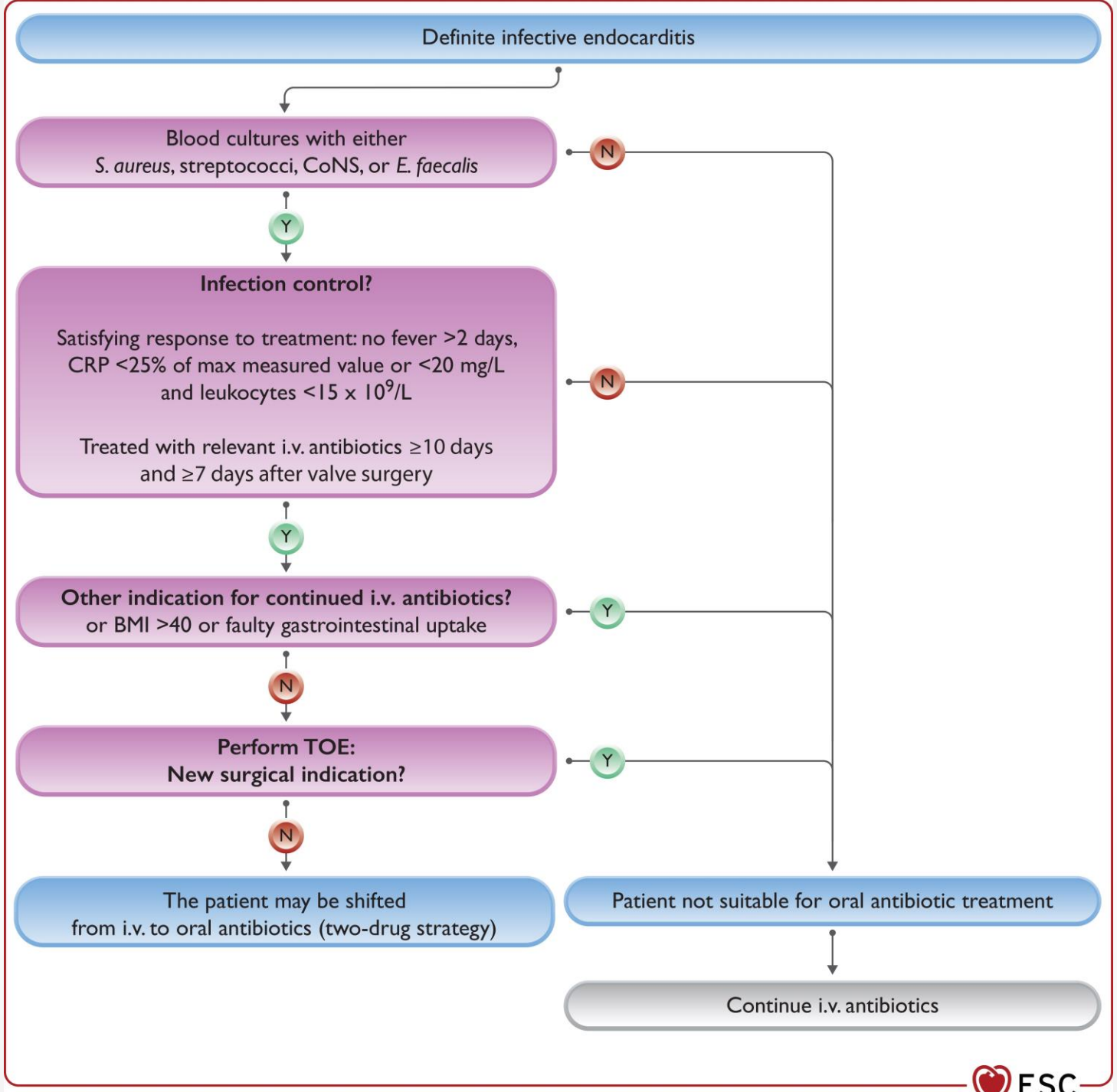
Treatment



Treatment phases



Outpatient oral treatment

Recommendations for outpatient antibiotic treatment of infective endocarditis

Recommendations	Class	Level
Outpatient parenteral or oral antibiotic treatment should be considered in patients with left-sided IE caused by *Streptococcus* spp., *E. faecalis*, *S. aureus*, or CoNS who were receiving appropriate i.v. antibiotic treatment for at least 10 days (or at least 7 days after cardiac surgery), are clinically stable, and who do not show signs of abscess formation or valve abnormalities requiring surgery on TOE.	IIa	A
Outpatient parenteral antibiotic treatment is not recommended in patients with IE caused by highly difficult-to-treat microorganisms, liver cirrhosis (Child-Pugh B or C), severe cerebral nervous system emboli, untreated large extracardiac abscesses, heart valve complications, or other severe conditions requiring surgery, severe post-surgical complications, and PWID-related IE.	III	C

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Table S9 Combinations of antibiotics for oral step-down treatment

Penicillin-and methicillin-susceptible *S. aureus* & CoNS	Methicillin-susceptible *S. aureus* & CoNS	Methicillin-resistant CoNS	*E. faecalis*	Penicillin-susceptible streptococci	Penicillin-resistant streptococci
Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Dicloxacillin 1 g × 4 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Fusidic acid 750 mg × 2	Amoxicillin 1 g × 4 Moxifloxacin 400 mg × 1	Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2
Amoxicillin 1 g × 4 Fusidic acid 750 mg × 2	Dicloxacillin 1 g × 4 Fusidic acid 750 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2	Amoxicillin 1 g × 4 Linezolid 600 mg × 2	Amoxicillin 1 g × 4 Moxifloxacin 400 mg × 1	Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2
Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2	Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2		Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Amoxicillin 1 g × 4 Linezolid 600 mg × 2	Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1
Linezolid 600 mg × 2 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2		Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1	Linezolid 600 mg × 2 Rifampin 600 mg × 2	
Linezolid 600 mg × 2 Fusidic acid 750 mg × 2	Linezolid 600 mg × 2 Fusidic acid 750 mg × 2		Linezolid 600 mg × 2 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1	

CoNS, coagulase-negative staphylococci.

FOCUS

Endocarditis

Infective endocarditis is a complex and potentially life-threatening condition. It often affects individuals with pre-existing heart conditions, artificial valves, cardiac devices or a history of intravenous drug use who can benefit from preventive strategies including antibiotic prophylaxis in selected procedures.

The initial diagnosis can often be challenging in view of its heterogeneous clinical presentation resulting in delayed initiation of appropriate treatment and a greater risk of complications. Therapeutic management mandates a personalised, multidisciplinary approach, with early intervention together with targeted antibiotic treatment remaining the pillar of effective management.

Advanced imaging techniques have gained an increasingly important role both for diagnosis and management. Surgical intervention in cases with refractory infection, embolic complications, or valvular insufficiency, requires surgical expertise and meticulous postoperative care.

The content below, selected by Ronen Beeri, Alessandro Sionis, Alexander Borg, Katerina Naka, Marta Pons, Maria Stratinaki with the support of Victoria Delgado and Michael Borger, will help you expand your knowledge of endocarditis.

ESC 2023 Clinical Practice Guidelines Webinars

What's the latest on infective endocarditis
15 September
Michael Borger, Suzanne de Waha and Emil Fosbol

Diagnostic challenges in infective endocarditis
27 September
Victoria Delgado, Margarita Brida and Maria Nazarena Pizzi

Essentials

ESC Guidelines resources

2023 ESC Guidelines for the Management of Endocarditis - Full text

2023 ESC Guidelines for the Management of Endocarditis - Guidelines overview

2023 ESC Guidelines on Endocarditis

- Prevention of infective endocarditis
- Diagnostic criteria of infective endocarditis
- New indications in antibiotic therapy
- Indications for surgery in infective endocarditis

2023 ESC Guidelines for the Management of Endocarditis - Ask the Guidelines Task Force

2021 ESC Guidelines on cardiac pacing and cardiac resynchronisation therapy - Implantation, complications, perioperative and long term management

Key supporting evidence

Infective endocarditis - Euro Endo registry launch

POET - Partial oral treatment of left-sided infectious endocarditis

POETry - Long-term outcome of nationwide clinical implementation of oral step-down antibiotic treatment for endocarditis

Current recommendations and uncertainties for surgical treatment of infective endocarditis: a comparison of American and European cardiovascular guidelines

Cardiac device-related infective endocarditis need for lead extraction whatever the device according to the ESC EORP EURO-ENDO registry

Outcomes of culture-negative vs. culture-positive infective endocarditis: the ESC EORP EURO-ENDO registry

Relevant Textbook Chapters

ESC CardioMed - Chapter 36. Infective endocarditis

Dig deeper

Exclusive content for Members

In Practice | Interface with the Specialists | Pioneers' Viewpoint

Guidelines in Practice: 2023 ESC Guidelines for the Management of Endocarditis

Role of multi-modality imaging in patients with suspected infective endocarditis

State-of-the-art lecture in cardiac device infections: risks and prevention

Thank you