Our Vision
The best care for every patient

NHS
Norfolk and Norwich University Hospitals
NHS Foundation Trust

A Clinical Guideline for the Screening and Treatment of Panton-Valentine Leukocidin (PVL) *Staphylococcus aureus*

For Use in:	All Clinical areas within Norfolk and Norwich University Hospital NHS Foundation Trust (NNUH)
By:	All personnel who work within the Trust
For:	For the screening and treatment of PVL-*Staphylococcus aureus*
Division responsible for document:	Clinical Support Services
Key words:	Staphylococcus aureus; PVL, Panton, Valentine, Leukocidin
Name of document author:	Dr Anastasia Kolyva
Job title of document author:	Microbiology STR
Name of document author's Line Manager:	Dr Reham Soliman
Job title of author's Line Manager:	Consultant Microbiologist
Supported by:	Dr Catherine Tremlett, Infection Control Doctor/ Consultant Microbiologist, Prof Nancy Fontaine – Director of Infection Prevention and Control (IP&C) IP&C Team (IP&CT)
Assessed and approved by the:	Hospital Infection Control Committee (HICC) chair If approved by committee or Governance Lead Chair's Action; tick here ✓
Date of approval:	April 2025
Ratified by or reported as approved to (if applicable)**:**	Clinical Safety and Effectiveness SubBoard
To be reviewed before: This document remains current after this date but will be under review	April 2025
To be reviewed by:	Microbiology
Reference and / or Trust Docs ID No:	10394
Version No:	1.5
Compliance links: *(is there any NICE related to guidance)*	*(e.g. NICE, CQC)*
If Yes - does the strategy/policy deviate from the recommendations of NICE? If so why?	

A Clinical Guideline for the Screening and Treatment of Panton-Valentine Leukocidin (PVL) *Staphylococcus aureus*

Version and Document Control:

Version No.	Date of Update	Change Description	Author
1.4	Feb 2018	Updated clinical management as per Health Protection Network Scottish Guidance 10 (2014)	IP&C
1.5	April 2022	Full review of guideline. Minor changes made and update to references.	IP&C & Micro

This is a Controlled Document
Printed copies of this document may not be up to date. Please check the hospital intranet for the latest version and destroy all previous versions.

1. Contents page

2. Definitions of Terms Used/Glossary

CA Community associated
CDC Centre for Disease Control and Prevention
GP General Practitioner
DIPC Director of Infection Prevention and Control
ICD Infection Control Doctor
IV Intra-venous
IVDU Intra-venous Drug User
IVIG Intra-venous Immunoglobulin
MRSA Meticillin Resistant Staphylococcus aureus
MSSA Meticillin Sensitive Staphylococcus aureus
PO Per-oral
PR Pulse rate
PVL Panton-Valentine leukocidin
PVL+SA Panton-Valentine leukocidin *Staphylococcus aureus*
PVL+MRSA Panton-Valentine leukocidin Meticillin Resistant *Staphylococcus aureus*
PVL+MSSA Panton-Valentine leukocidin Meticillin Sensitive *Staphylococcus aureus*
RR Respiratory rate
SA Staphylococcus aureus
TSS Toxic Shock Syndrome
UKHSA UK Health Security Agency (previously Public Health England)

3. Quick reference

Links to Quick Reference Flowcharts and Documents Some of these documents can be printed and displayed for information To open link hold the Ctrl button on your keyboard and click the link with your mouse.
Management of necrotising pneumonia
Isolation Procedures
Audit and Surveillance, Reporting for Infectious Disease, Healthcare Associated Infection and Post Infection Review

Quick Reference Guide

Management of Necrotising Pneumonia

NHS Norfolk and Norwich University Hospitals NHS Foundation Trust

Community acquired pneumonia (CAP) hospitalised; treat as per severe CAP regimen

Clinical suspicion of PVL + SA pneumonia +/- Skin and Soft Tissue, infection. For example:
- Young patient with multilobular infiltrates
- RR>40, PR>140
- Haemoptysis, leukopenia, high CRP

Pneumococcal and Legionella Ag in urine, Respiratory viral and atypical screen – exclude other causes of respiratory symptoms

ITU admission in side room with droplet/airborne precautions

Obtain respiratory cultures (Isolation & droplet/airborne precautions to be used if exposed to resp. secretions)
- Bronchoalveolar lavage
- Protected specimens brush
- Tracheal aspirate or sputum

Add empiric antibiotics covering MRSA – Linezolid 600mg bd + Clindamycin 1.2g qds – and if deteriorating or features of severe disease eg Toxic Shock Syndrome (TSS) add Intravenous Immunoglobulin (IVIG) 2g/kg + Rifampicin 600mg bd

Continue empiric antibiotics therapy for 48-72 hrs or until culture results finalized – if Clindamycin sensitive change to Clindamycin + Rifampicin; if resistant to Linezolid + Rifampicin

No improvement in symptoms
Increasing failure to ventilate

Re-evaluate for infection with antibiotic-resistant pathogen not covered by initial antimicrobial regimen

Exclude complicating issues (eg. Abscess, empyema) and non-infectious issues

Consider 2nd dose of IVIG

4. Objectives

The objectives of this guideline are to prevent cross infection within the Trust, to raise awareness about Panton Valentine Leucocidin *Staphylococcus aureus* (PVL+SA) infections, to offer advice on the clinical management and diagnosis of the disease and Infection Prevention and Control (IP&C) measures required in order to protect patients and members of the staff from acquiring PVL+ SA.

5. Rationale

Panton-Valentine Leukocidin (PVL) is a toxin that destroys white blood cells and is a virulence factor in some strains of *Staphylococcus aureus.* PVL+SA predominantly cause skin and soft tissue infections, but can also cause invasive infections, the most serious of which is a necrotising haemorrhagic pneumonia with a high mortality, and often follows a flu-like illness. It may affect otherwise healthy young people in the community.

Strains of PVL+SA producing a new pattern of disease have emerged in the UK and worldwide. In the UK the genes encoding for PVL are carried by less than 2% of clinical isolates of *Staphylococcus aureus* whether Meticillin-sensitive *staphylococcus aureus* (MSSA) or Meticillin-resistant *staphylococcus aureus* (MRSA). PVL-producing strains of community associated MRSA (CA+MRSA) appear to be associated with increased risk of transmission, complications and hospitalization.
The majority of PVL *Staphylococcus aureus* strains in the UK are PVL+MSSA.

The risk factors for PVL+SA seen in the UK are likely to correspond to those described for CA+MRSA.

This guideline is based on published literature as well as the Health Protection Agency (currently PHE guidelines of 2008 and Health Protection Network (Scotland) guideline 10 of 2014.

6. Processes to be followed

6.1 Clinical features of PVL+SA

Recurrent skin and soft tissue infections

- Boils (furunculosis), carbuncles, folliculitis, cellulitis, purulent eyelid infection
- Cutaneous lesions 5cm or larger in diameter (will require different treatment from smaller lesions)
- Pain and erythema out of proportion to severity of cutaneous findings
- Necrosis

Invasive infections

- Necrotising haemorrhagic pneumonia
- Necrotising fasciitis
- Osteomyelitis, septic arthritis and pyomyositis

- Purpura fulminans

Patients who develop necrotising pneumonia commonly have a preceding "flu-like" illness. Co-infection with respiratory viruses, including influenza, should be investigated.

Risk factors for PVL+SA
CDC guidance refers to the "5 C's" of risk factors for PVL-related infection and is a useful aide memoir:

1. Contaminated items
2. Close contact
3. Crowding
4. Cleanliness
5. Cuts and other compromised skin integrity

The following settings have been identified as higher risk for transmission:
- Households, nursing homes, long term facilities
- Close contact sports such as wrestling, American football, rugby, judo
- Military training camps, gyms, prisons
- Nurseries
- IVDUs

When to suspect PVL+SA infection?
- Recurrent boils/abscesses-especially if more than 1 case in a household, home or closed community
- Necrotising skin and soft tissue infections
- Invasive infection in immunocompetent people
- Community-acquired necrotising/haemorrhagic pneumonia
- Failed treatment of *Staphylococcus aureus* infections

Microbiological samples
This depends on each patient's clinical presentation and may include:

Clinical details regarding risk factors, occupation, signs and symptoms should be mentioned on the form. The various specimens for investigating PVL+SA include:
- Pus
- Swab of exudate from abscess or other lesion
- Screening swabs from anterior nares, axilla, throat, groin
- Tracheal aspirate or sputum
- Broncho-alveolar lavage
- Blood cultures
- Urine (Pneumococcal and Legionella antigen)
- Nose and throat swab for respiratory viral screen (viral transport medium)
- Atypical respiratory screening ("atypical PCR" options on ICE)
- HIV test

If TSS is suspected, seek Microbiology advice.

NNUH Microbiology laboratory will refer suspicious isolates based on clinical information to Reference Laboratory for PVL toxin testing and confirmation.

Surveillance
Microbiologist must inform UKHSA of PVL+ MSSA and PVL+ MRSA cases by either phone or electronic notification form. Refer to Audit and Surveillance, Reporting for Infectious Disease, Healthcare Associated Infection and Post Infection Review. If the patient has been discharged prior to the result being confirmed, the microbiologist must inform the GP.

Empiric Antibiotic Management of PVL+SA infections, for children please discuss with Microbiology

Infection	PVL+MSSA (MRSA not suspected)	PVL+MRSA (or MRSA suspected)
Minor skin and soft tissue infections without cellulitis (furunculosis/folliculitis/ small abscesses/boils)	Antibiotics not needed unless immunocompromised or deteriorating Incision and drainage is the optimal management for abscesses Lesions should be covered, advise good personal hygiene in particular hand-washing and avoid sharing towels, cloths and personal care items	
Moderate skin and soft tissue infections including cellulitis and larger abscesses (>5cm) **N.B. incision and drainage is optimal management for abscesses**	Flucloxacillin 500mg PO qds **If penicillin allergic:** Doxycycline 100mg PO bd (not in children <12 years) **OR** Co-trimoxazole 960mg PO bd **OR** Clindamycin 450mg PO qds (increased *C. difficile risk*)	Doxycycline 100 mg PO bd (not in children <12 years) **OR** Rifampicin 300mg PO bd **AND** Fusidic Acid PO 500mg tds **OR** Rifampicin 300mg PO bd **AND** Trimethoprim 200mg PO bd **OR** Clindamycin 450mg PO qds (increased *C. difficile risk*)
Severe skin and soft tissue infections +/- Toxic shock or Necrotising fasciitis or Purpura fulminans **N.B urgent surgical debridement of infected tissue is key**	Clindamycin 1.2 gm IV qds **AND** Linezolid IV 600 mg bd Consider use of IV immunoglobulin Treatment should be continued for 10-14 days ***IV flucloxacillin is not recommended in severe PVL related infections, even in combination with other agents***	

Deep seated infections (Bacteraemia/ Osteomyelitis/ Endocarditis) Long term treatment should be guided by antimicrobial susceptibility results	Clindamycin 1.2g IV QDS **AND either,** Rifampicin 600mg PO BD **OR** Linezolid 600mg PO (maximum duration 28 days)	Vancomycin 1 gm IV bd **AND either,** Sodium fusidate 500 mg PO tds **OR** Rifampicin 300 mg PO bd **OR** Gentamicin 5-7 mg/kg IV od
PVL related pneumonia	Quick reference guide, page 3 **Management of necrotising pneumonia**	

Empiric antibiotic choice above must be confirmed with sensitivity testing results. Advice should be sought from Clinical Microbiologist. **NB** Note that intravenous Flucloxacillin is not recommended for necrotising pneumonia regardless of the combination used, due to poor penetration into necrotic tissue and increase in PVL toxin production, according to in vitro studies.

6.2 Infection control management

Isolation
All patients with suspected or confirmed PVL+SA infection must be nursed in a single room with contact precautions (aprons, gloves). Respiratory precautions must be used in cases of PVL+SA pneumonia.

Staff who have not used respiratory precautions for patients with PVL pneumonia should contact workplace health and well-being for advice.

Should a PVL+SA result become known after the patient has been admitted to hospital and they have been in a multi-occupancy room with other patients the ICD/consultant microbiologist will determine the management of the other patients according to the level of risk.

If a case of PVL+SA infection is suspected or confirmed to be hospital acquired the IP&C team/ICD will undertake an investigation. Contacts will be managed as per UKHSA guidelines (see section 5.1.2 Hospital acquired infections).

For the management of close contacts of the patients with PVL pneumonia refer to the UKHSA guidelines "Assessment of risk to close contacts of patients with lower respiratory tract infection due to Panton-Valentine leukocidin-positive Staphylococcus aureus in England. Enhanced case and household contact protocol. Version 1.3".

Screening
Patients suspected to have PVL+SA should be screened for carriage of PVL+SA by sending charcoal swabs from nose, throat, axillae and groin. Request form must state: "Patient positive for PVL+MSSA/MRSA" in the global clinical details section.

Decolonisation

PVL+SA carriage should be treated with Octenisan washes and nasal ointments similar to the regime for MRSA decolonisation. Treatment of the acute infection should take priority over topical decolonisation, although this should be commenced as soon as possible. The patient should be screened 48 hours post decolonisation treatment.

Topical treatment procedure for PVL+SA

Site	Name of preparation	Duration
Nasal	Mupirocin nasal 2% ointment*	5 days (tds)
Nasal (when mupirocin resistance identified)	Naseptin** cream (Chlorhexidine hydrochloride and 0.1% Neomycin sulphate)	10 days (qds)
Body and hair* **	Triclosan 2% or Octenidine dihydrochloride 0.3% or Chlorhexidine gluconate 4%	Once daily for duration of admission

***Apply matchstick head-sized amount (less for small child) on the end of cotton bud to inner surface of each nostril and massage gently upwards**
****Contains arachis (peanut) oil, please ascertain whether the patient has a NUT ALLERGY OR SOYA ALLERGY and is also contraindicated in pregnancy.**
*****Do not dilute product in water as this reduces its efficacy.**
- Apply product directly to wet skin as soap on a disposable wipe or on hand.
- Do not use regular soap in addition during baths/showers.
- Do not apply to dry skin.
- Pay particular attention to armpits, groins, under breasts, hands and buttocks
- It should remain in contact with the skin for about a minute.
- Rinse off before drying thoroughly.

7. Clinical audit standards

A retrospective review of case notes and samples of patients who were known of having PVL+ SA can be conducted to audit compliance with the communication cascade, isolation guidelines and general measures. There are a number of specific audit standards that can be derived from this guideline including:

- It is documented that the patient with confirmed diagnosis of PVL+SA infection is isolated in a single room.
- It is documented that a microbiologist has notified the IP&CT and UKHSA.

8. Summary of development and consultation process undertaken before registration and dissemination

This Guideline was sent out for consultation to the following groups:

Matrons and Senior Nurses	HICC Members
Ward Sisters and Charge Nurses	Consultant Microbiologists

Health and Safety	IP&CT
Workplace Health and Wellbeing	

9. References

Health Protection Network. Interim Advice for the Diagnosis and Management of PVL-associated Staphylococcus aureus infections (PVL-S,aureus). Health Protection Network Scottish Guidance 10. Health Protection Scotland, Glasgow, G2 6QE.

Nathwani, D. et al., 2008. Guidelines for UK practice for the diagnosis and management of Meticillin-resistant Staphylococcus aureus (MRSA) infections presenting in the community. *The Journal of antimicrobial chemotherapy*, 61(5), pp.976–94. Available at: http://www.ncbi.nlm.nih.gov/pubmed/18339633 [Accessed Feb 24, 2021].

Otto M. Community-associated MRSA: what makes them special? Int J Med Microbiol. 2013 Aug;303(6-7):324-30. doi: 10.1016/j.ijmm.2013.02.007. Epub 2013 Mar 19. PMID: 23517691; PMCID: PMC3729626.

Gillet Y, Dumitrescu O, Tristan A, Dauwalder O, Javouhey E, Floret D, Vandenesch F, Etienne J, Lina G. Pragmatic management of Panton-Valentine leukocidin-associated staphylococcal diseases. Int J Antimicrob Agents. 2011 Dec;38(6):457-64. doi: 10.1016/j.ijantimicag.2011.05.003. Epub 2011 Jul 5. PMID: 21733661.

Niemann S, Ehrhardt C, Medina E, Warnking K, Tuchscherr L, Heitmann V, Ludwig S, Peters G, Löffler B. Combined action of influenza virus and Staphylococcus aureus panton-valentine leukocidin provokes severe lung epithelium damage. J Infect Dis. 2012 Oct 1;206(7):1138-48. doi: 10.1093/infdis/jis468. Epub 2012 Jul 26. PMID: 22837490; PMCID: PMC3433859.

Ellington MJ, Ganner M, Smith IM, Perry C, Cookson BD, Kearns AM. Panton-Valentine Leucocidin-related disease in England and Wales. Clin Microbiol Infect. 2010 Jan;16(1):86-8. doi: 10.1111/j.1469-0691.2009.02887.x. PMID: 19681948.

10. Associated Documentation

Health Protection Agency Guidance on the diagnosis and management of PVL-associated *Staphylococcus aureus* infections (PVL+SA) in England https://www.gov.uk/government/publications/pvl-staphylococcus-aureus-infections-diagnosis-and-management

PHE. Assessment of risk to close contacts of patients with lower respiratory tract infection due to Panton-Valentine leukocidin-positive Staphylococcus aureus in England. Enhanced case and household contact protocol. Version 1.3, 2013. PHE gateway number: 2013063.

11. Equality Impact Assessment (EIA)

This guideline has been screened to determine equality relevance for the following equality groups: race, gender, age, sexual orientation and religious groups. This guideline is considered to have little or no equality relevance.

Monitoring Compliance / Effectiveness Table **Appendix 1**

Element to be monitored	***Lead Responsible for monitoring*** *)*	***Monitoring Tool / Method of monitoring***	***Frequency of monitoring***	***Lead Responsible for developing action plan & acting on recommendations***	***Reporting arrangements***	***Sharing and disseminating lessons learned & recommended changes in practice as a result of monitoring compliance with this document***
Compliance with isolation for patients with confirmed PVL+SA Infection	IP&CT	Electronic audit tool Tpath list Business object	Every 2 years	IP&CT DIPC	IP&C Monthly Report, Clinical Governance and HICC	IP&CT Escalation to: HICC Clinical Safety Board
Compliance with notification of confirmed PVL+SA infection	Microbiology SpR	Tpath list Business object	Every 2 years	DIPC	IP&C Monthly Report, Clinical Governance and HICC	