



Sodium Nitrite Self-Poisoning: A Case Study

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INTRODUCTION

- Sodium Nitrite:** white, odorless powder primarily used as a preservative for meats, known as curing salt. It is also found in local anesthetics, nitroglycerin, chloroquine, dapsone, sulfonamides, foods preserved with nitrates/nitrites, root vegetables, leafy green vegetables, antifreeze, and nitrogen-based fertilizers.
- Accessibility:** widely available for purchase in large quantities and high concentrations without age verification through online vendors such as Amazon and Walmart, and is part of "suicide kits" on suicide-related forums.^{3,5,7,9}
- Prevalence:** 2018 -> 2021, 253% increase in the utilization of nitrates and nitrites as a suicide mechanism.^{1,2,4}
- Pathogenesis:** development of methemoglobinemia which impedes oxygen delivery and exchange to tissues resulting in hypoxia.^{6, 10}
- Symptoms:** methemoglobinemia presents with symptoms such as fatigue, weakness, hypoxia, cyanosis, hypotension, tachycardia, loss of consciousness, and even death.⁸



Figure 1. Sodium Nitrite available on Amazon.¹¹

PATHOPHYSIOLOGY OF SODIUM NITRITE OVERDOSE

- Methemoglobin is an altered state of hemoglobin in which the heme iron is oxidized from the ferrous (Fe^{2+}) to the ferric (Fe^{3+}) state.
- The ferric hemes of methemoglobin do not bind O_2 . The ferric heme in the hemoglobin tetramer causes the remaining normal ferrous hemes within the same tetrameric hemoglobin molecule to have increased O_2 affinity.
- This produces a left shift of the hemoglobin oxygen dissociation curve, which in turn further decreases O_2 delivery to the tissues.
- >10% methemoglobin causes symptoms. While 30-40% is considered severe and life-threatening.

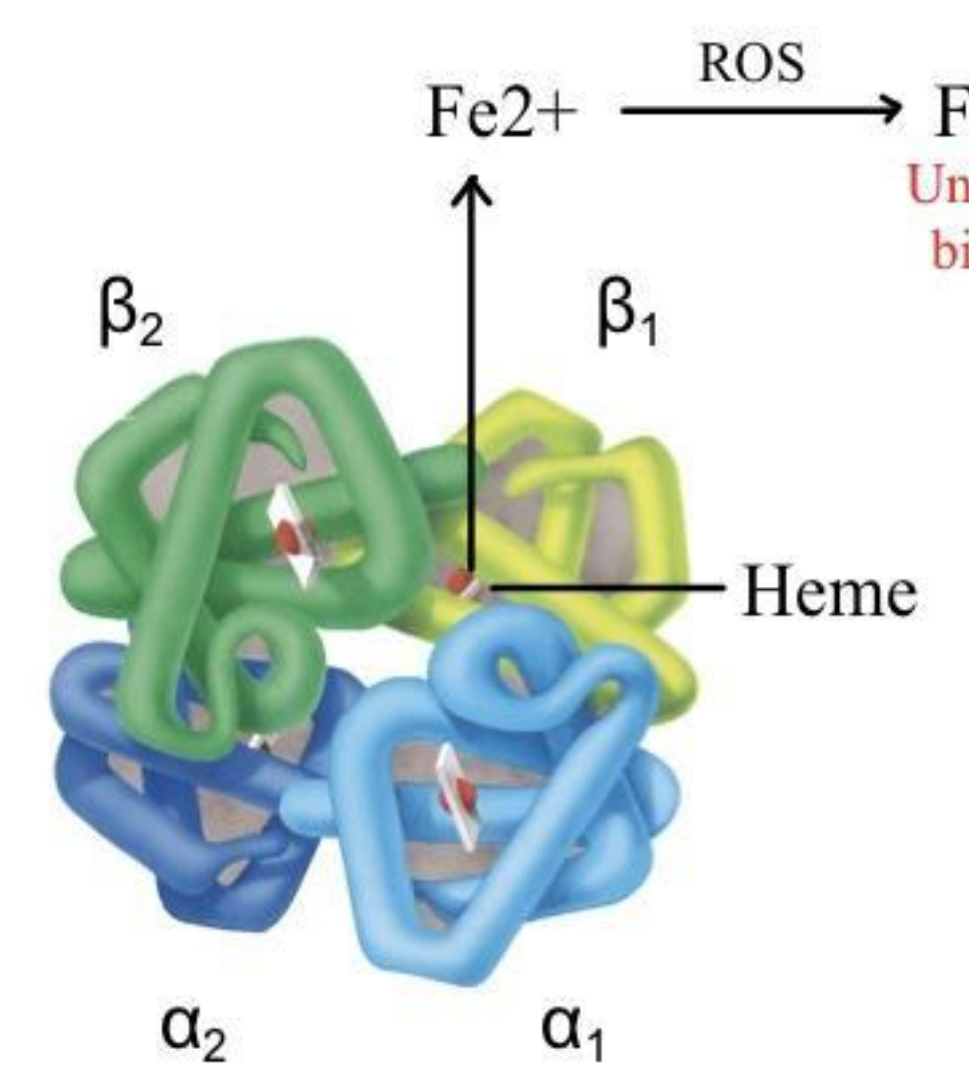


Figure 2. Tetrameric hemoglobin molecule¹²

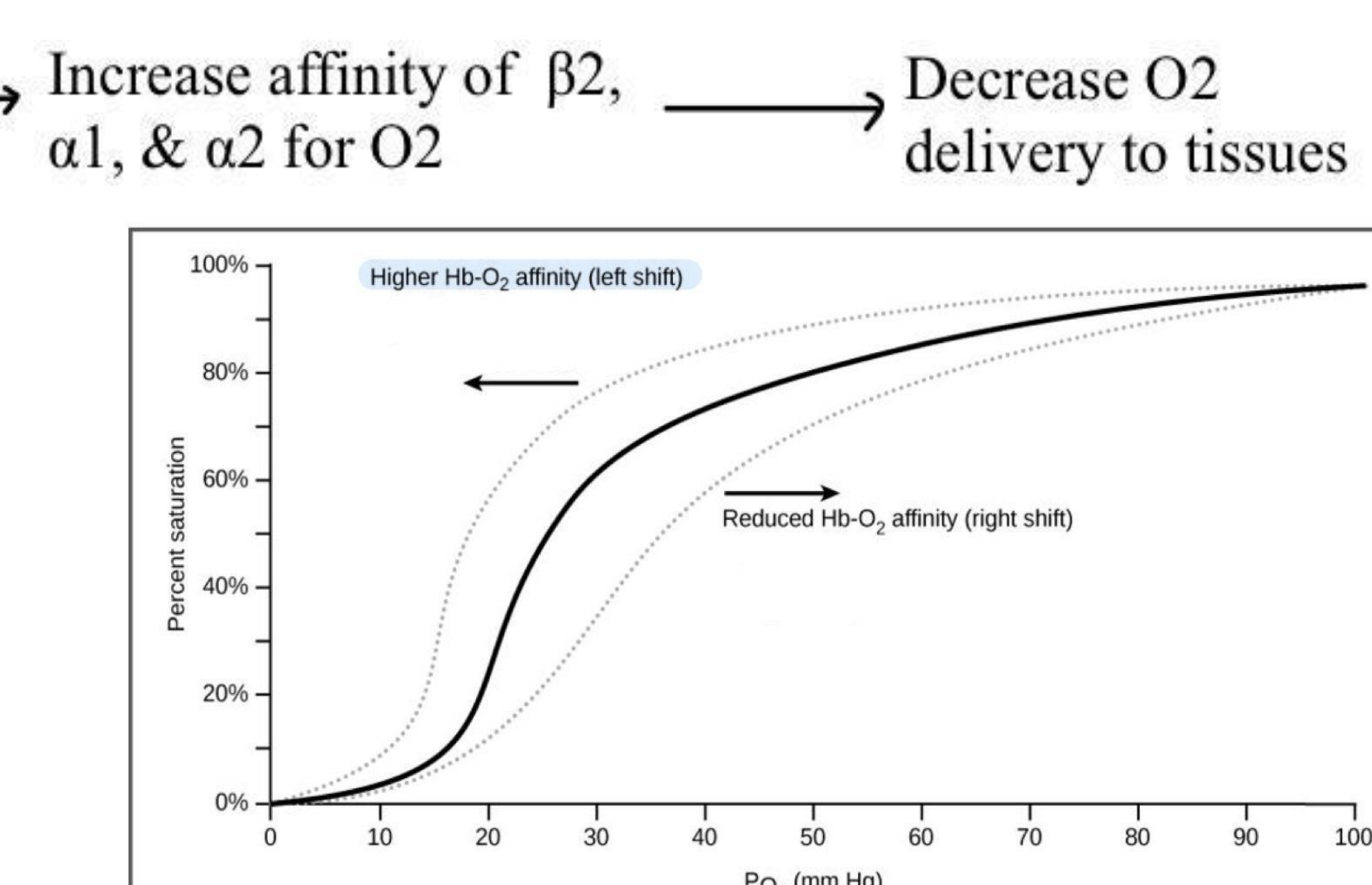


Figure 3. An oxygen-hemoglobin dissociation curve. Highlighted is a left shift in the curve indicating an increased affinity of hemoglobin for oxygen therefore decreasing oxygen delivery to the tissues. Ultimately, this can result in hypoxia.¹³

TIMELINE

Unknown Ingested 1.5 tbsp of sodium nitrite	<ul style="list-style-type: none"> GCS 3 SpO2 86% on 70% non-rebreather mask Vitals: HR 148, RR 24, BP 77/33, temp 33.9 °C Decerebrate posturing 										
0310 Arrival to the ED											
0321 Initial ABG	<table border="1"> <tr><td>pH Arterial POCT</td><td>7.20</td></tr> <tr><td>pO2 Arterial POCT</td><td>283.0</td></tr> <tr><td>Total Hemoglobin, Arterial POCT</td><td>13.8</td></tr> <tr><td>Lactate Arterial POCT</td><td>12.6 ></td></tr> <tr><td>Methemoglobin Arterial POCT</td><td>31.0</td></tr> </table>	pH Arterial POCT	7.20	pO2 Arterial POCT	283.0	Total Hemoglobin, Arterial POCT	13.8	Lactate Arterial POCT	12.6 >	Methemoglobin Arterial POCT	31.0
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Methemoglobin Arterial POCT	31.0										
0339 Methylene blue dose #1											
0340 Cardiac arrest	ROSC achieved in 7 minutes										
0401 Methylene blue dose #2											
0406 Second cardiac arrest	ROSC achieved in 5 minutes										
0430 Methylene blue dose #3											
0442 Methylene blue dose #4											
0545 Second ABG	<table border="1"> <tr><td>pH Arterial POCT</td><td>7.24</td></tr> <tr><td>pO2 Arterial POCT</td><td>473.0</td></tr> <tr><td>Total Hemoglobin, Arterial POCT</td><td>11.2</td></tr> <tr><td>Lactate Arterial POCT</td><td>8.9</td></tr> <tr><td>Methemoglobin Arterial POCT</td><td>1.4</td></tr> </table>	pH Arterial POCT	7.24	pO2 Arterial POCT	473.0	Total Hemoglobin, Arterial POCT	11.2	Lactate Arterial POCT	8.9	Methemoglobin Arterial POCT	1.4
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0609 Transfer to ICU											
Day 3 Brain Herniation											
Day 10 Brain death confirmed											

References



TREATMENT

- Methylene blue is first-line treatment
- Ascorbic acid
- Supportive care
- Exchange transfusion
- Hyperbaric oxygen therapy

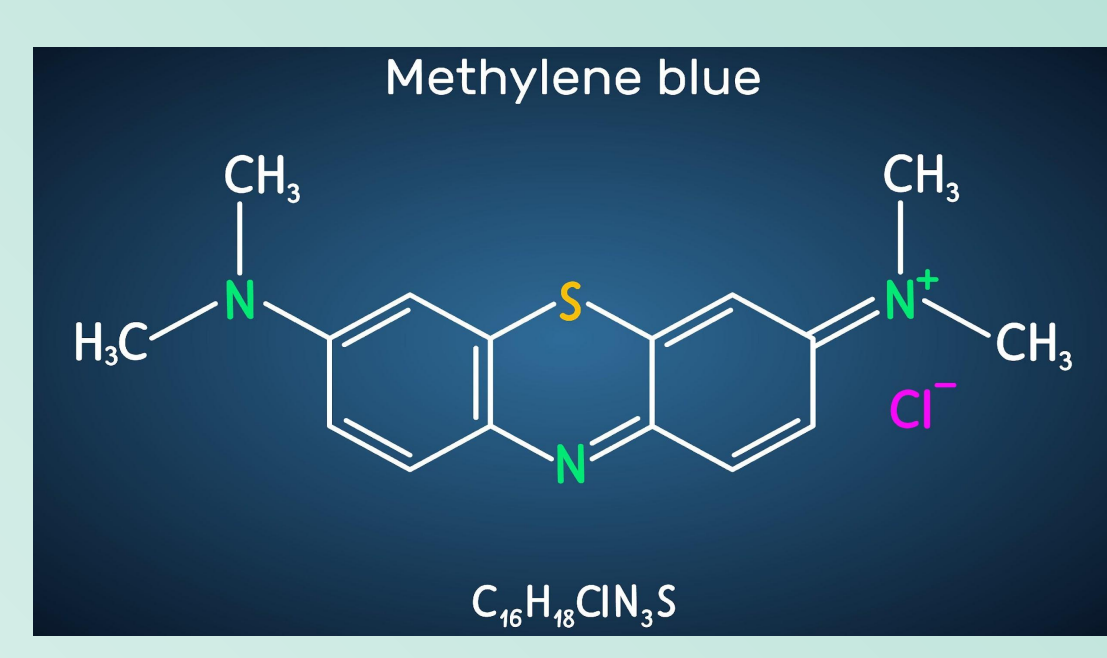


Figure 4. Chemical composition of methylene blue¹⁴

METHYLENE BLUE MECHANISM

Methemoglobin is reduced by the RBC enzyme cytochrome b5 reductase which adds an electron back to the heme molecule, converting iron Fe^{+3} into Fe^{+2} which delivers and exchanges O_2 normally.

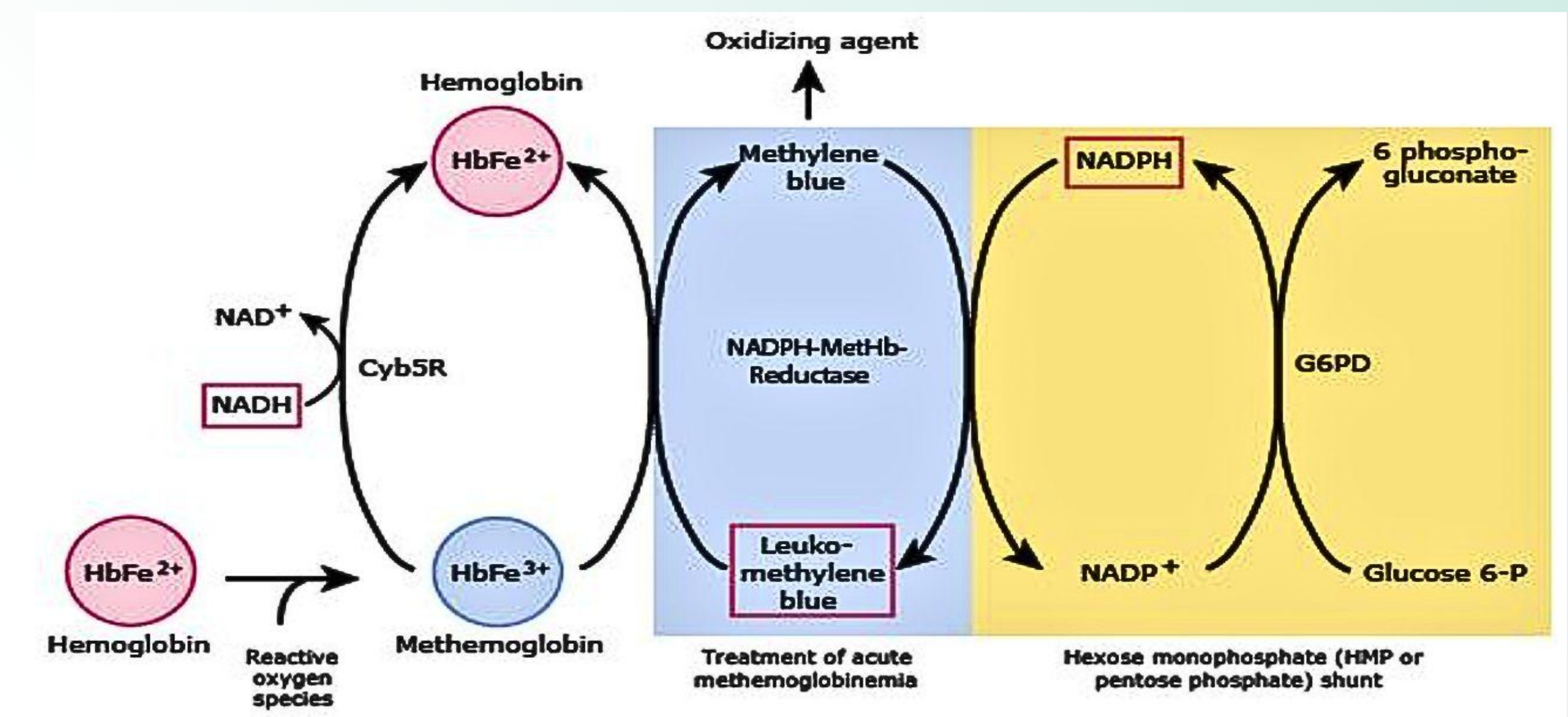


Figure 5. Mechanism of action of methylene blue¹⁵

LEARNING POINTS

- Use of sodium nitrite in suicide attempts is increasing due to easy access and its promotion on online suicide forums.
- Prompt administration of methylene blue is the definitive management for sodium nitrite toxicity.
- Delays in methylene blue administration can have catastrophic consequences.
- Methylene blue should be made available for immediate administration in the Emergency Department.
- Training for first responders and emergency department staff will help facilitate early recognition and treatment of methemoglobinemia.