Bismuth-based combination therapy exerts potent antimicrobial performance on NDM-1 superbugs

Combined use of CBS leads to 8-fold decrease in antibiotic MIC

“Wild”NDM-1 superbugs

Release Zn\(^{2+}\) ions

“tamed”NDM-1 superbugs

Free Zn\(^{2+}\) ions cannot enter

Treated with CBS

Enzyme activity \(> 90\%\); cannot be restored

Enzyme stability declines
And likely to be rapidly degraded by proteinase

Combined use of CBS leads to 8-fold decrease in antibiotic MIC
Bismuth-based combination therapy slows down resistance development and extends antibiotic lifecycles

Treatment over 20 passages

- NDM-1 expression decreased by 2.7-fold
- Resistance development slowed down by 4-fold

Treatment in mega dose

- Mutation frequency Decreased by 133-fold
Bismuth-based combination therapy extends the lifespan and raises survival rate of NDM-1 superbugs infected mice

Mouse model of acute peritonitis infection

1. NDM-1 superbugs is extremely dangerous to kill non-treated mice within 18 hours
2. In comparison to antibiotic monotherapy, CBS-based combination therapy significantly postpones the death of infected mice and raises survival rate by 25%