Peptidoglycan is a major cell wall component of Gram-positive and Gram-negative bacteria involved in resisting turgor pressure and maintaining cell shape. Modification to peptidoglycan by many bacteria has been implicated in pathogenicity. Whilst simultaneously serving to control the activity of autolysins, one such modification, O-acetylation of the C-6 hydroxyl of N-acetylmuramic acid residues, renders bacteria resistant to lysozyme, a first defence enzyme of the host innate immune system. This modification contributes to the ability of bacteria to survive in the host and cause infection and occurs in many notable pathogens such as *Staphylococcus aureus, Streptococcus pneumoniae*, and *Neisseria gonorrhoeae*. O-Acetyltransferase A (OatA) has been identified as the enzyme responsible for peptidoglycan O-acetylation in Gram-positive bacteria. Loss of function of this enzyme results in lysozyme sensitivity and cell death. In light of the spread of antibiotic-resistant bacteria, there is a dire need for novel antibiotics to treat resistant infections. I hypothesize that OatA represents an excellent target for the development of novel antibiotics. I propose inhibition screens to further the search for enzymatic inhibitors of OatA as antibiotic leads. To facilitate inhibition studies, I also propose structural characterization of the enzyme in complex with ligands and of its membrane-imbedded domain. Insights gained from this work will allow a better understanding of the mechanism of OatA and will supplement future drug-discovery.