**Table 1. Potential role of *P. aeruginosa* virulence factors in UTIs**

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| **Virulence factor** | **Characteristics** | **Potential Role in UTIs** | **References** |
| LasA | Staphylolytic zinc metallopeptidase of the M23A family; has reduced elastolytic activity compared to LasB; enhances elastolytic activity of LasB; | Aid breakdown of host tissues (including elastin in the urinary tract) which could facilitate invasion and/or amino acid metabolism. | (Spencer et al. 2010)  (Cowell et al. 2003) |
| LasB | Zinc metalloprotease with the foremost elastolytic activity; necessary for activation of LasA | Biofilm formation; immunomodulation; Aid breakdown of host tissues (including elastin) and which could facilitate invasion and/or amino acid metabolism | (Cathcart et al. 2011)  (Yu et al. 2014)  (van der Plas et al. 2016)  (Cowell et al. 2003)  (Golovkine et al. 2014) |
| Phospholipase A | Has activity that releases fatty acids from phospholipid substrate whereas phospholipase C releases phosphate esters; found commonly in UTI isolates | Could be implicated in apoptosis of host cells; possible generation of ROS | (Steinbrueckner et al. 1995)  (Tielen et al. 2011)  (Kirschnek & Gulbins 2006) |
| Phospholipase C | Haemolytic (plcH) and non-hameolytic (plcN) versions; Both hydrolyze phosphatidylcholine; plcH hydrolyzes sphingomyelin and phosphatidylcholine; plcN hydrolyzes phosphatidylserine and phosphatidylcholine | Haemolytic activity could aid iron availability in the iron scarce urinary tract | (Ostroff et al. 1990) |
| Phospholipase D | Secreted by H2 Type VI system; implicated in bacterial competition, chronic infection and eukaryotic cell invasion | Could aid persistence and/or invasion in the urinary tract | (Russell et al. 2013)  (Wilderman et al. 2001)  (Jiang et al. 2014) |
| ExoS | Bi-functional type-III cytotoxin; almost never found in strains expressing ExoU; disrupts actin cytoskeleton; ADP-ribosylates broader range of host proteins than ExoT | Levels increase over time in UTIs, could aid persistence and immune evasion | (Barbieri & Sun 2004)  (Engel 2003)  (Engel & Balachandran 2009) |
| ExoT | Bi-functional type-III cytotoxin; induces mitochondrial apoptosis in host cells; disrupts actin cytoskeleton | Could aid immune evasion | (Barbieri & Sun 2004)  (Wood et al. 2015)  (Engel & Balachandran 2009) |
| ExoU | Type-III toxin; extremely cytotoxic phospholipase; almost never found in strains expressing ExoS | Some UTI isolates found with ExoU and low cytotoxicity; ExoU may serve other function or be a hindrance | (Engel 2003)  (Tielen et al. 2011)  (Engel & Balachandran 2009) |
| ExoY | Type-III toxin with adenylate cyclase disrupting actin cytoskeleton; enhances production of the second messengers cGMP and cUMP in host cells | Unclear | (Engel & Balachandran 2009)  (Beckert et al. 2014)  (Yahr et al. 1998) |
| Exotoxin A | Toxin Inhibits eukaryotic protein synthesis via ADP ribosylation of elongation factor 2 which can lead to cell lysis; stimulates inflammation and hepatotoxicity in animals; positively regulated by iron starvation and ToxR | Could aid immune evasion; stimulation of inflammation in the kidney could aid persistence | (Pastrana et al. 2005)  (Morimoto & Bonavida 1992)  (Chiu et al. 2009)  (Walker et al. 1994)  (Gaines et al. 2007) |
| Alkaline protease | Type I secreted zinc metalloprotease; degrades host immune complements C1q, C2, C3 and cytokines IFN-γ and TNF-α | Increase iron availability via breakdown of transferrin; enhance amino acid metabolism via protease activity; aid immune evasion | (Laarman et al. 2012)  (Shigematsu et al. 2001)  (Kim et al. 2006) |
| Pyoverdine and pyochelin (siderophores) | Main mechanisms for iron uptake and therefore survival in many environments. Pyoverdine displays high levels of diversity and the highest affinity for iron. Pyochelin has lower affinity but has been implicated in chronic infection and is association with pyocyanin | Urine, particularly in the bladder, is a low iron environment and siderophores would facilitate bacterial growth. | (Cornelis & Dingemans 2013) |
| Alginate | An *O*-acetylated linear polymer of d-mannuronate and l- guluronate residues (Evans and Linker 1973). Alginate overproduction (mucoidy) has been associated with chronic infection isolates from the CF lung. Alginate contributes to biofilm architecture but is not essential for biofilm formation (Stapper et al 2004). | Although alginate plays a role in biofilm formation, the contribution of alginate in the urinary tract is thought to be minimal. | (Evans & Linker 1973)  (Stapper et al. 2004) |
| Pyocyanin | Type-II secreted, redox-active zwitterion; cytotoxic; blue at physiological pH; | May impair ability of urothelial cells to repair and cause pain and urinary urgency in infection; induce inflammation | (Hall et al. 2016)  (McDermott et al. 2012)  (McDermott et al. 2013) |