

# Can Antibiotics Alone Protect a Population Against an Anthrax Attack?

**Anthrax (*Bacillus anthracis*) can easily be made to resist every recommended antibiotic that is available by prescription or stored in the Strategic National Stockpile.<sup>7,8,9,10,11</sup> Antibiotics affected include:**

- ciprofloxacin (Cipro<sup>®</sup>)<sup>7,8,11</sup> and ofloxacin (Floxin<sup>®</sup>)<sup>7,9,11</sup>
- doxycycline<sup>8,9</sup> and tetracycline<sup>8,9</sup>
- penicillin G<sup>7</sup> and amoxicillin (Amoxil<sup>®</sup>)<sup>7</sup>
- ceftriaxone (Rocephin<sup>®</sup>)<sup>7</sup>
- vancomycin (Vancocin<sup>®</sup>)<sup>7</sup> and clindamycin (Cleocin<sup>®</sup>)<sup>7</sup>
- erythromycin<sup>7,8</sup> and azithromycin<sup>8</sup> (Zithromax<sup>®</sup>) and clarithromycin (Biaxin<sup>®</sup>)<sup>7,8</sup>

**Antibiotics have no effect on anthrax spores or the toxins produced by the organism.<sup>1</sup>**

- Spores can lay dormant in the host mammal for up to 60 days before germinating and attacking.<sup>2</sup>
- This persistent and lingering threat can outlast antibiotic regimens – anthrax spores can be detected in the lungs of monkeys (the best model for human disease) for at least 100 days after exposure.<sup>3</sup>

**Per researchers at Johns Hopkins, the 60 day antibiotic treatment regimen currently recommended for post-exposure may not be enough to prevent anthrax in some cases.<sup>4</sup>**

- The optimum duration of antibiotic prophylaxis depends critically on the exposure dose<sup>4</sup> and the rate of clearance of the spores from the lung by natural defense mechanisms<sup>5</sup>.
- It is likely that a course of 100 days of antibiotics is necessary to protect against infection induced by lingering spores that germinate later.

**Patient adherence to long term antibiotic regimens, as observed in the 2001 anthrax attacks, is poor.<sup>6</sup>**

- Compliance and persistency to the prescribed 60 day course of Cipro<sup>®</sup> ranged from 21% of persons exposed at the Morgan postal facility in New York City to 64% of persons exposed at the Brentwood postal facility in Washington, D.C.<sup>6</sup>

**Adverse events associated with antimicrobial prophylaxis in victims of the 2001 anthrax attacks were commonly reported.<sup>6</sup>**

- Of the 5,343 persons who reported taking at least one dose of antibiotic, 57% (n=3,032) reported adverse events during the first 60 days of the prescribed regimen.<sup>6</sup>
- At the post 60 day follow-up, 16% (n=842) of respondents who took at least one dose of antibiotic reported seeking medical care for adverse events caused by the antibiotic at some time in their 60 day course of treatment.<sup>6</sup>

**If not first used on civilians as a weapon, resistant anthrax strains may result from long term antibiotic regimens.**

- Long term antibiotic therapy, as recommended for the treatment of exposure to anthrax might induce antimicrobial resistance in *Bacillus anthracis* by the selection of resistant mutants.<sup>7,12</sup>

## References:

- <sup>1</sup> Spencer R. C., *Bacillus anthracis*. J Clin Pathol 2003;56:182-197
- <sup>2</sup> Friedlander A. M., Welkoss L., Pitt, M. L. M., et al. Postexposure prophylaxis against experimental inhalation anthrax. J Infect Dis 1993;167:1239-43.
- <sup>3</sup> Henderson D. W., Peacock, S., Belton, F.C. Observations on the prophylaxis of experimental pulmonary anthrax in the monkey. J Hyg (Lond). 1956 Mar;54(1):28-36.
- <sup>4</sup> Brookmeyer R., Johnson, E., Bollinger, R. Modeling the optimum duration of antibiotic prophylaxis in an anthrax outbreak. PNAS (2003) Vol. 100, No. 17; 10129-10132.
- <sup>5</sup> Brookmeyer R., Johnson E., Barry S. Modelling the incubation period of anthrax. Stat Med. 2005 Feb 28; 24(4):531-42.
- <sup>6</sup> Shepard CW, Soriano-Gabarro M, Zell ER, et al. Antimicrobial postexposure prophylaxis for anthrax: adverse events and adherence. Emerg Infect Dis 2002;10: 1124-1132.
- <sup>7</sup> Athamna et al. Selection of *Bacillus anthracis* isolates resistant to antibiotics. J Antimicrob Chemotherapy(2004) 54, 424-428.
- <sup>8</sup> Brook, I., Elliott, T. B., Pryor, H. I. et al. (2001). In vitro resistance of *Bacillus anthracis* Sterne to doxycycline, macrolides and quinolones. International Journal of Antimicrobial Agents 18, 559–62.
- <sup>9</sup> Pomerantsev, A. P., Shishkova, N. A. & Marinin, L. I. (1992). Comparison of therapeutic effects of antibiotics of the tetracycline group in the treatment of anthrax caused by a strain inheriting tet-gene of plasmid pBC16. Antibiotiki i Khimioterapiia 37, 31–4.
- <sup>10</sup> Price, L. B., Volger, A., Pearson, T. et al. (2003). In vitro selection and characterization of *Bacillus anthracis* mutants with high level resistance to ciprofloxacin. Antimicrobial Agents and Chemotherapy 47, 2362–5.
- <sup>11</sup> Choe, C. H., Bouhauuala, S., Brook, I. et al. (2000). In vitro development of resistance to ofloxacin and doxycycline in *Bacillus anthracis*. Antimicrobial Agents and Chemotherapy 44, 1766.
- <sup>12</sup> Levy, SB. The 2000 Garrod lecture. Factors impacting on the problem of antibiotic resistance. J Antimicrob Chemother. 2002 Jan;49(1):25-30.