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(54) **MULTIVALENT LIPOSOME FORMULATIONS**

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(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,591,448	A	1/1997	Tepic
2002/0102236	A1	8/2002	Taylor et al.
2010/0004195	A1	1/2010	Sasisekharan et al.
2013/0129636	A1 *	5/2013	Kamaly et al. 424/9.321

FOREIGN PATENT DOCUMENTS

WO WO-89/05633 A1 6/1989

OTHER PUBLICATIONS

http://en.wikipedia.org/wiki/Sialic_acid, "Sialic Acid", authors unknown, published online by Wikipedia Foundation, San Francisco, CA, downloaded Apr. 20, 2015 as a PDF version, 5 pages long.*

http://en.wikipedia.org/wiki/Virus, authors unknown, published online by Wikipedia Foundation, San Francisco, CA, downloaded Apr. 20, 2015 as a PDF version, 27 pages long.*

http://www.wisegeek.org/how-many-species-of-bacteria-are-there.htm, Author(s) unknown, Published by WiseGeek, Sparks, NV, downloaded Apr. 20, 2015, 4 pages long.*

Alford, et al., Fusion of Influenza Virus with Sialic Acid-Bearing Target Membranes, Biochemistry, vol. 33, No. 8, pp. 1977-1987 (1994).

Hendricks, et al., Sialylneolacto-N-tetraose c (LSTc)-bearing Liposomal Decoys Capture Influenza A Virus, Journal of Biological Chemistry. vol. 288, No. 12, pp. 8061-8073 (Jan. 28, 2013).

International Search Report and Written Opinion mailed Mar. 27, 2014 in PCT Application No. PCT/US2014/012577 (13 pages), John Tatjana.

* cited by examiner

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(57) **ABSTRACT**

This disclosure provides compositions, kits, and methods useful for treating or preventing viral and bacterial infection and reducing or preventing the effects of toxins. The methods comprise administering to a subject an effective amount of a liposomal composition.

17 Claims, 16 Drawing Sheets