Purpose: To explore alternative methods based upon light-ion beams to generate 99Mo and/or 99mTc, used in nuclear medicine imaging, due to a worldwide supply shortage of these materials from nuclear reactors.

Method and Materials: Fusion-evaporation statistical Monte Carlo code PACE4 was used to evaluate the excitation functions, i.e. cross-sections vs. energies, of nuclear reactions that may have a potential for the production of 99Mo or 99mTc. The calculated results were compared with the experimental data to validate the code and to estimate the scale-up or -down factors.

Results: For reactions involving evaporating neutrons, the calculation has the right trend but overestimates cross sections by about 7 times. The maximum calculated cross sections for 96Zr(7Li, 4n)99mTc, 96Zr(6Li, 3n)99mTc, and 94Zr(7Li, 2n)99mTc are 1130 mb, 801 mb, and 146 mb, respectively. The actual cross sections may be lower, but even the scaled down values of 161 mb (1130/7) and 114 mb (801/7) are still quite high and could be used to generate significant amount of 99mTc .

For those reactions with exiting charged particles besides neutrons, the code underestimates the cross sections by about 10 times. The maximum calculated cross sections for 96Zr(7Li, d2n)99Mo, 96Zr(6Li, dn)99Mo, and 94Zr(7Li, d)99Mo are 42.6 mb, 21.6 mb, and 8.51 mb. The actual cross sections could be higher. If scaled cross sections of 426 mb and 216 mb are realistic, it will be much easier to get 99Mo from 96Zr(7Li, d2n)99Mo and 96Zr(6Li, dn)99Mo, not to mention that the specific activity of 99Mo could be much higher under the optimized reaction conditions.

Conclusions: Specific activity and cross sections of nuclear reactions based on zirconium target using a light-ion beam of helium or lithium may be much higher than those based on molybdenum target. These reactions should be investigated experimentally.