interfere with the induction of this response, indicating that tungsten limits intestinal inflammation by manipulating the gut microbiota (Fig. 3a–c, Extended Data Fig. 2c, d). Tungstate had no observable effect on pro-inflammatory responses or cellular resistance to DSS injury in cultured cells (Extended Data Fig. 8b–d). Therapeutic administration of tungstate after the onset of inflammation was sufficient to inhibit molybdenum-cofactor-dependent processes in *E. coli* Nissle 1917 (Extended Data Fig. 8e, f), supporting the hypothesis that the effect of tungsten on microbial populations was not due to tungstate interfering with the induction of DSS-induced inflammation. Collectively, these data suggest that tungsten limits gut inflammation through manipulation of the mouse gut microbiota.

A subset of people with inflammatory bowel disease exhibit changes in the composition of their gut microbiota that include increased abundance of Enterobacteriaceae family members[1]. We humanized the gut of germ-free mice with gut microbiota from patients with active flares. To model intestinal inflammation, groups of mice were treated with either DSS alone or DSS and tungstate, and housed separately. Administration of tungstate reduced the intestinal Enterobacteriaceae load and decreased markers of mucosal inflammation (Extended Data Fig. 4i–m), thus providing evidence that the effect of tungsten is not unique to mouse microbiota.

An imbalance in the gut-associated microbial community may underlie many human diseases, but current approaches to treating dysbiosis lack the sophistication needed to restore a balanced community *in situ*. Administration of antibiotics broadly reduces numbers of many members of the gut microbiota without discriminating between beneficial and potentially harmful microbes. In some instances, removal of potentially harmful members of the community can lead to a beneficial outcome[14–16]. However, removal of beneficial microbes can lead to pathogen expansion[2,17] or increased bowel irritability[18], thereby adversely affecting the host. Commensal Enterobacteriaceae contribute to resistance to colonization by enteric pathogens by competing for critical nutrients[19,20]. Oral administration of probiotic *E. coli* Nissle 1917 is effective in maintaining remission in patients with ulcerative colitis[21], and microcins produced by *E. coli* Nissle 1917 suppress the growth of pathogenic bacteria[22]. Thus, it might be preferable to control the population size of commensal Enterobacteriaceae in the gut microbiome than to remove them entirely. In contrast to broad-spectrum antibiotics, tungstate treatment of the dysbiotic microbiota allows selective control of bacterial populations, such as Enterobacteriaceae, that rely on molybdenum-cofactor-dependent processes. Because these molybdenum-cofactor-dependent processes operate only during gut inflammation[11], tungsten treatment acts only on the enterobacterial population in the disease state, and does not eliminate Enterobacteriaceae from the ecosystem during homeostatic conditions. Our work identifies molybdenum-cofactor-dependent processes as a target for controlling disease-specific aspects of the microbiota composition. Furthermore, our results provide experimental evidence that this rationally designed microbiome editing approach can improve dysbiosis-associated mucosal inflammation.

Online Content Methods, along with any additional Extended Data display items and Source Data, are available in the online version of the paper; references unique to these sections appear only in the online paper.

Received 9 November 2015; accepted 24 November 2017.
Published online 3 January 2018.

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Supplementary Information is available in the online version of the paper.

Acknowledgements This work was supported by NIH grants AI112445 (A.J.B.), AI118807 (S.E.W.), AI128151 (S.E.W.), DK070855 (L.V.H.), DK102436 (B.A.D.) and 5K12HD-068369 (L.S.-D.), Welch Foundation grants I-1858 (S.E.W.) and I-1874 (L.V.H.), American Cancer Society Research Scholar Grant MPC-130347 (S.E.W.) and a Crohn's and Colitis Foundation of America postdoctoral fellowship no. 454921 (W.Z.). Work in the L.V.H. laboratory is supported by the Howard Hughes Medical Institute. The funders had no role in study design, data collection and interpretation, or the decision to submit the work for publication. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funders. We thank B. Sartor for the *E. coli* NC101 strain.

Author Contributions W.Z., M.G.W., L.S., L.B., E.d.L.R., R.P.W., E.R.H, C.A.L. and C.C.G. performed and analysed nitrate reductase activity, *in vitro* bacterial competitive growth, NF-κB induction, DSS cytotoxity experiments and experiments involving conventionally raised C57BL/6 mice. M.G.W., L.S. and E.R.H. performed *Il10*$^{-/-}$ mouse experiments. W.Z. and M.G.W. performed inflammation analysis. C.L.B., M.G.W., L.S. and W.Z. performed germ-free-mouse experiments. B.A.D. and W.Z. analysed 16S and metagenomic data. M.X.B. analysed the histopathology. L.S.-D. and K.H.-H. contributed to humanized mouse experiments. L.S. and S.E.W. performed metabolite quantification. W.Z., Ç.T., A.Y.K., E.B., L.V.H., A.J.B. and S.E.W. designed the experiments, interpreted the data and wrote the manuscript with contributions from all authors.

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Reviewer Information *Nature* thanks C. Elson, M. Fischbach and the other anonymous reviewer(s) for their contribution to the peer review of this work.