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## Historical Environmental Racism, Structural Inequalities, and Dik'os Ntsaaígíí-19 (COVID-19) on Navajo Nation

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### Abstract

The Navajo Nation has been disproportionately affected by Dik'os Ntsaaígíí-19 (COVID-19), with the highest per capita COVID-19 rate in the United States. While some media attention has focused on the importance of structural inequalities in understanding the heightened experiences of COVID-19 for Navajo people, we draw from Indigenous knowledge and Indigenous research paradigm to bring the need to consider the lasting legacy of historical environmental racism on Indigenous lands to the center of the current public health dialogue. Specifically, we explore the potential lasting health implications of the historical environmental racism on Navajo people at the ecological level by describing the associations among abandoned uranium mines, structural inequalities (as measured by social conditions, lack of grocery stores and hospitals) and COVID-19 confirmed cases on the Navajo Nation by compiling unique dataset from the Navajo Department of Health, 2014-2018 American Community Survey 5-years estimates, and the Uranium Mines and Mills Location Database from the U.S. Environmental Protection Agency. We found that population and housing characteristics do not fully explain the different COVID-19 cases among 11 counties on Diné Bikéyah, and suggest that there is a need for the holistic approach is guided by Hózhó wisdom of Navajo people that emphasize the importance of interconnectedness and whole-system in understanding the impacts of Dik'os Ntsaaígíí-19.

Since the first confirmed case of Dik'os Ntsaaígíí-19 (COVID-19) on Diné Bikéyah<sup>1</sup>, the Navajo Nation, on March 17, 2020; the number of COVID-19 cases per capita started to grow at

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<sup>1</sup> In the Navajo language, Diné Bikéyah refers to the lands of the Navajo Nation, Navajoland. This article uses 'Diné Bikéyah' more generally when referencing the sovereign Tribe as an entity as well as the

an accelerated rate compared to other places in Arizona. By mid-May, it had the highest per capita COVID-19 rate in the United States, even surpassing the initial epicenters. Not only have Navajo people been experiencing the greater proportion of the population contracting COVID-19, but they are also seeing more severe health implications and higher probability of COVID-19 related death. At first glance, there is a paradox between the COVID-19 infection rate and population density because the Navajo Nation is a rural area of 27,000 square miles with very low population density of approximately seven people per square mile (Hu, Nigmatulina, & Eckhoff, 2013).

However, once we expand our scope to include structural inequalities generated by historically-embedded systemic racism, we can trace the architecture that exacerbated the spread of COVID-19 on Diné Bikéyah. Historical injustices such as forced assimilation and separation of families through Indian boarding schools (Lomawaima, 1995), environmental contamination due to resource extraction (E. Hoover et al., 2012) and institutional marginalization (Wilkins & Lomawaima, 2001) have manifested in the current social and health conditions. Diné Bikéyah is larger than 10 states in the United States, and yet to the best of our knowledge, there are only 13 grocery stores and 14 hospitals. These structural inequalities directly affect access to basic needs such as food, safe and clean water, and quality healthcare. Simultaneously, these experiences “get under the skin” over time (Taylor, Repetti, & Seeman, 1997) and contribute to health inequalities through weathering (i.e., physiological manifestations of accumulative stress from social inequalities) (Geronimus, 1992) and intergenerational transmissions (Brave Heart, 2003; Palacios & Portillo, 2009). In fact, American Indian, Alaska Native, and Pacific Islander Peoples are in a vulnerable position of experiencing more severe illness and complications from COVID-19 due to their disproportionate overrepresentation in underlying chronic medical conditions (Centers for Disease Control Prevention, 2020b, 2020c; Huysen, Rockell, Wilson, Manson, & O’Connell, 2020).

Although the pandemic is ongoing and ever-shifting in its nature, we observe that current efforts have been predominately focusing on only proximal factors of COVID-19 (e.g., individual-level pre-existing “risk” health condition factors and mitigating strategies like hand washing and wearing a mask) without critical attention to more distal factors such as social conditions from structural inequalities. We argue that individual-level interventions and mitigating strategies have

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geographic location of the Tribe’s reservation. For clarity, acts of Tribal governance are attributed to the sovereign government ‘Navajo Nation’.

little benefits; and interventions and mitigating strategies should be grounded in the social determinants of health framework (Marmot & Wilkinson, 2005) that explicitly account for larger social forces including social and health circumstances. More importantly, we argue that research and public policy efforts to ameliorate the disproportionate effects of COVID-19 on Indigenous Peoples and communities must be grounded in an Indigenous research paradigm (Hart, 2010) which centers on Indigenous knowledge and methodologies (Hart, 2010; Smith, 2013).

Towards that effort, we provide an ecological-level study that describes the associations among abandoned uranium mines (AUMs), structural inequalities (as measured by social conditions, lack of grocery stores and hospitals), and COVID-19 confirmed cases on the Navajo Nation. Indeed, the media has highlighted the structural inequalities on Diné Bikéyah, however, less attention has been given to the lingering effects of environmental contamination and its role in the spread and severity of COVID-19. Specifically, we assemble unique data from multiple sources to illustrate the links. By doing so, we highlight the ways systemic environmental racism—as measured by the number of AUMs—is a fundamental cause of health inequalities (Phelan & Link, 2015). Its lasting and ongoing health effects have exacerbated the COVID-19 pandemic and highlights the importance of accounting for historical injustices in understanding Indigenous health.

### **Diné Bikéyah: What's AUMs Got to Do with COVID-19?**

Diné Bikéyah occupies portions of northeastern Arizona, southeastern Utah, and northwestern New Mexico; it is the largest Indigenous Tribal lands in the United States. It is a home to 173,667 (52.3%) Navajo people residing on Diné Bikéyah as well as 158,462 (47.7%) Navajo people residing on surrounding border towns and metropolitan areas like Phoenix and Albuquerque as of 2010 (Navajo Division of Health, 2013).

Although Diné Bikéyah is an important place for the sovereign Navajo Nation, it is also a site where physical and environmental manifestations of historical and ongoing systematic racism have been taking place. Towards the end of World War 1, the largest uranium mining effort began on the Four Corners region (northeastern Arizona, southwest Colorado, northwestern New Mexico, and southern Utah); and mining accelerated from the 1940s through the 1960s (Voyles, 2015). It is estimated that there are over 500 AUMs on or near the Navajo Nation (U.S. Environmental Protection Agency, 2018). Beyond the occupational hazards (e.g., accidents at

worksite), deleterious health effects of uranium mining went unrecognized until the early 1960s when the first cases of lung cancer among Navajo miners surfaced, nearly two decades after the mining began (Brugge, Benally, & Yazzie-Lewis, 2007; Brugge & Goble, 2002). There is a wide array of health inequities among Navajo miners including higher rates of toxin exposure such as Radon (Gilliland, Hunt, Archer, & Saccomanno, 2000), lung cancer (Gottlieb & Husen, 1982), and elevated mortality ratios due to lung cancer, tuberculosis, pneumoconiosis and other respiratory diseases (Roscoe, Deddens, Salvan, & Schnorr, 1995). It took more than two decades of community activism and scientific research collaboration before the Radiation Exposure Compensation Act was passed in 1990 after the first legislative bill unsuccessfully filed in 1973 (Brugge & Goble, 2002; Panikkar & Brugge, 2007).

Gradually, research began to advocate for a more comprehensive understanding of destructive health effects of uranium mines and ongoing toxicant exposures not only for Navajo miners themselves, but also for their families and communities at large. This is an important extension of much needed investigation of health inequities among Navajo general public because AUMs are associated with elevated arsenic and uranium concentration in unregulated water sources (i.e. wells) on Diné Bikéyah (J. Hoover, Gonzales, Shuey, Barney, & Lewis, 2017) and poisoned land (Pasternak, 2011). Studies have found that residing close to AUMs are associated with various developmental and reproductive physiological damages (Brugge, deLemos, & Oldmixon, 2005; Harmon et al., 2017). For example, a study of 13,329 Navajos born at an Indian Health Service Hospital on the Navajo Nation found that mothers living near the mines were significantly more likely to experience birth defects, stillbirths and other adverse outcomes of pregnancy (Shields, Wiese, Skipper, Charley, & Banally, 1992). Chronic arsenic exposure is associated with adverse health outcomes such as hypertension, cardiovascular disease, and diabetes (J. Hoover et al., 2017; Kirkley et al., 2018; Moon, Guallar, & Navas-Acien, 2012).

AUMs continue to have lasting indirect spillover effects on the health and wellbeing of Navajo people and communities. Due to toxins in water, such as arsenic, AUMs directly impact people's access to safe, running water on Diné Bikéyah. Nearly one in three people on Diné Bikéyah do not have indoor plumbing (Rodriguez-Lonebear, Barceló, Akee, & Carroll, 2020); water security is necessary for health equities in Indigenous communities (Mitchell, 2019). Even discounting Indigenous Peoples' mistrust in the government and health entities from historical systemic racism and exploitations (Belcourt-Dittloff & Stewart, 2000), the Centers for Diseases

Control and Prevention's recommendation of "wash your hands often" becomes challenging without safe running water (Centers for Disease Control Prevention, 2020a). Furthermore, people who have been living near AUMs may have more underlying health conditions that can lead to experiencing more severe illness from COVID-19. Our central question is: *Are the abandoned uranium mines (AUMs) important for understanding the COVID-19 related inequities on the Navajoland?*

### **Data and Methods**

Data come from multiple sources. The COVID-19 data for the Navajo Nation comes from the May 8<sup>th</sup>, 2020 report of COVID-19 cases by county from the Navajo Department of Health (Navajo Department of Health, 2020). Since then the Navajo Nation has stopped publishing the COVID-19 statistics by county and started to report statistics by the Navajo service areas. Because we assembled the unique data pulling from multiple sources to simultaneously show the pre-existing structural inequalities, the number of AUMs, and COVID-19 cases; we used the county as the common geographic unit. Characteristics of structural inequalities come from the latest available 2014-2018 American Community Survey 5-years estimates.

Information on AUMs come from the Uranium Mines and Mills Location Database from the U.S. Environmental Protection Agency (U.S. Environmental Protection Agency, 2019). There was no list of addresses of mine locations, but only a geographically-referenced shapefile that was based on *Abandoned Uranium Mines Project Arizona, New Mexico, Utah – Navajo Lands Project Atlas, 1994-2000* (U.S. Environmental Protection Agency, 2019). To estimate how many AUMs exist in each county, we reverse-geocoded the locations from the shapefile, then aggregated the number of AUMs by county using R statistical software in a Geographic Information Science (GIS) framework. Lastly, we gathered information on 13 grocery stores and 14 hospitals, geocoded them, then aggregated up to the county.

### **COVID-19 Cases, Historical Environmental Racism, Structural Inequalities among 11 Counties on the Navajo Nation**

While a great deal of media news focused on the effects of COVID-19 on Navajo Nation overall, relatively little attention has been paid to heterogeneous experiences of COVID-19 across place and space on Diné Bikéyah. Table 1 shows the comprehensive overview of COVID-19 cases,

population and housing characteristics by 11 counties on the Navajo Nation. There are substantial variations in COVID-19 cases across counties. As of May 8<sup>th</sup>, 2020, Navajo County had the highest number of COVID-19 cases with 787 cases. Followed by Apache County (739 cases), Coconino County (609 cases), McKinley County (314 cases), and San Juan County (295 cases). These counties have greater total populations than counties with less COVID-19 cases although they have much lower population density at the same time.

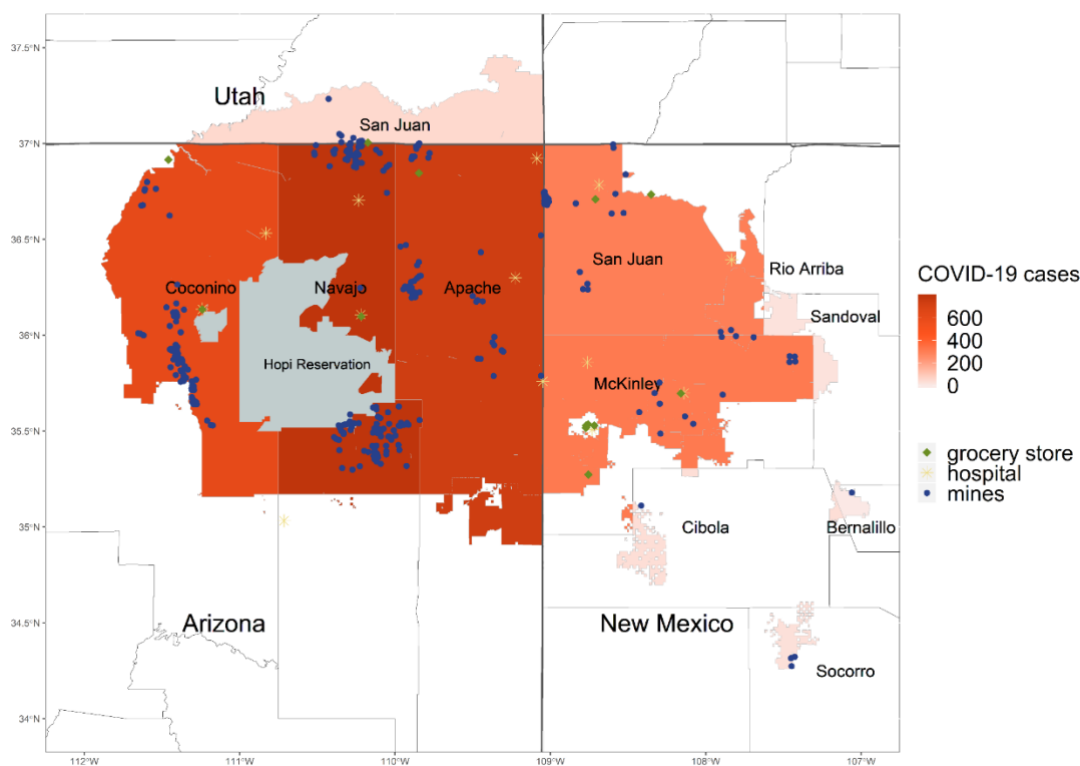
**Table 1.** A Comprehensive Overview of Population, Housing, and Social Condition Characteristics by 11 Partial Counties on the Navajoland

	Arizona	Total	Navajo County, AZ	Apache County, AZ	Coconino County, AZ	McKinley County, NM	San Juan County, NM	San Juan County, UT	Cibola County, NM	Socorro County, NM	Sandoval County, NM	Bernalillo County, AZ	Rio Arriba County, NM
<b>COVID-19 Cases (5/8)</b>													
Number of Cases			787	739	609	314	295	49	33	26	21	3	0
<b>COVID-19 Cases per 1,000</b>			<b>33.2</b>	<b>13.8</b>	<b>25.9</b>	<b>10.1</b>	<b>11.0</b>	<b>7.4</b>	<b>16.1</b>	<b>24.0</b>	<b>8.4</b>	<b>1.8</b>	<b>0.0</b>
<b>Interest Variables</b>													
Number of Abandoned Uranium Mines		<b>367</b>	<b>113</b>	<b>52</b>	<b>95</b>	<b>15</b>	<b>77</b>	<b>10</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>0</b>
Number of Grocery Stores		<b>6</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Number of Hospitals		<b>9</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Population Characteristics</b>													
Total Population	6,946,685	172,875	23,695	53,434	23,515	31,205	26,931	6,629	2,049	1,085	2,497	1,700	135
Population Density (Per Sq. Mile)	61.2	7.2	6.0	7.8	4.6	13.2	8.1	3.3	8.5	11.0	18.6	18.3	52.3
% Population (65 and Older)	16.7%	11.7%	12.3%	12.0%	10.9%	10.8%	13.0%	10.3%	11.8%	12.4%	12.5%	8.5%	28.9%
Median Household Income	\$56,213	\$27,502	\$24,121	\$25,154	\$38,764	\$25,744	\$32,346	\$26,875	\$23,259	\$13,274	\$15,647	\$28,897	N/A
% Families below Poverty Level	11.6%	34.9%	40.3%	36.3%	27.5%	36.5%	29.2%	35.9%	36.3%	52.0%	62.6%	38.6%	21.1%
Average Commute to Work (In Min)	25	32	33	29	29	31	35	37	32	47	47	43	23
No Health Insurance Coverage	10.9%	23.8%	16.7%	28.4%	18.7%	23.5%	23.8%	35.1%	12.9%	20.3%	24.4%	19.1%	20.7%
<b>Housing Characteristics</b>													
Housing Units	2,970,935	67,947	10,488	21,955	7,928	11,628	10,645	2,420	904	597	800	537	45
% in Mobile Home	10.5%	21.0%	14.5%	20.3%	26.5%	21.0%	24.0%	25.5%	13.7%	25.6%	23.0%	19.9%	42.2%
House Heating Fuel													
Gas (Utility, Bottled, Tank, or Lp Gas)	35.5%	18.3%	13.7%	14.8%	14.3%	20.1%	31.8%	12.4%	16.7%	19.1%	10.1%	25.6%	31.8%
Electricity	60.5%	12.6%	15.3%	15.5%	14.2%	8.0%	11.2%	5.8%	7.2%	3.0%	2.7%	17.1%	13.6%
% Complete Plumbing Facilities	98.2%	65.9%	63.6%	62.9%	71.3%	64.3%	73.2%	66.8%	66.8%	47.1%	60.0%	73.0%	46.7%
% Complete Kitchen Facilities	99.2%	86.7%	85.8%	86.5%	83.5%	86.0%	91.7%	89.3%	88.5%	93.3%	70.1%	86.6%	100.0%
% No Telephone Service Available	2.5%	14.1%	21.0%	14.6%	6.7%	17.7%	5.6%	28.9%	10.4%	40.8%	16.8%	7.2%	22.7%

Source: Navajo Department of Health (2020); Navajo Lands Project Atlas, 1994-2000 from the Environmental Protection Agency; and 2014-2018 American Community Survey 5-Year Estimates.

Figure 1 shows the spatial variation in COVID-19 and the numbers of mines by county. Our counts of AUMs show that these five counties also have the higher numbers of AUMs with Navajo County with the highest count of nearly 113 AUMs, followed by Coconino County (n=95) and San Juan County of Utah (n=77). This is consistent with early uranium mining during the period 1942 through 1944 in Navajo County and San Juan County of Utah (Chenoweth, 1985). Navajo County contains Kayenta, a city that in addition to heavy uranium mining was also a site of heavy coal mining. Chinle is another heavy uranium mining area that technically falls on Apache County, but most of the mines are located west of Chinle in Navajo County. Uranium was mined in this region between 1954 and 1968 (U.S. Army Corps of Engineers, 2007).

**Figure 1.** Map of Abandoned Uranium Mines (AUMs), Grocery Stores, Hospitals and COVID-19 Cases by 11 Counties on Navajoland



We initially gathered addresses of 13 grocery stores and 14 hospitals on Diné Bikéyah, but through mapping, we learned that only 7 grocery stores and 11 hospitals fall within the boundaries of the Navajo Nation. Unmapped 6 grocery stores are located in border towns (e.g., Gallup); three unmapped hospitals are in Gallup and on the Hopi reservation. Number of grocery stores and



hospitals did not differ much among the top six counties with larger total population, but it is troublesome that five out of 11 counties do not have a grocery store and six out of 11 counties do not have a hospital. Due to the lack of hospitals, many COVID-19 patients have been transferred to Albuquerque or Phoenix (e.g., from Pinon in Navajo County to Phoenix is 270 miles apart; from Window Rock in Apache County to Albuquerque is 165 miles apart) (Kovich, 2020). The housing condition characteristics show that compared to the percentage of households with complete plumbing facilities in Arizona (98.2%), only 65.9% of households on the Navajo Nation have complete plumbing facilities. While only 2.5% of household do not have telephone service available in Arizona, nearly 14.1% of household on the Navajo Nation do not have telephone service available.

### **Moving Forward**

We raised the question whether AUMs are important for understanding related inequities on the Navajo Nation as COVID-19 cases are not equally distributed spatially. We found that the areas with high numbers of AUMs are also areas with high number of COVID-19 cases despite lower population density and population size. For example, while Navajo County and Apache County has similar number of COVID-19 cases (787 and 739, respectively); once we account for the total population sizes of two counties (23,695 and 53,434, respectively), the Navajo County has much higher per 1,000 COVID-19 cases (33.2 versus 13.8). Population and housing characteristics of two counties do not differ much; in fact, Apache County has worse profiles including 28.4% of population without health insurance compared to 16.7% in Navajo County. Put differently, the high COVID-19 rate in Navajo County cannot be explained by population and housing characteristics.

Because a county is a large geographic unit, we were not able to empirically examine the *causal* relationship between number of AUMs and COVID-19 cases. Our exploration suggests that other factors are likely at work – e.g., Navajo County has the highest level of water contamination (Credo, Torkelson, Rock, & Ingram, 2019; J. Hoover et al., 2017). We used Indigenous knowledge and an innovative approach to assemble various existing secondary data to bring the importance of historically-embedded environmental racism on Diné Bikéyah to the center of the public health dialogue during the pandemic. COVID-19 related inequities within and outside of Diné Bikéyah are not only directly related to the poor social conditions stemming from structural inequalities;

but it is important to holistically consider the lasting implications of environmental racism in how health inequities are produced and exacerbated. This holistic approach is guided by Hózhó wisdom of Navajo people that emphasize the importance of interconnectedness and whole-system (Kahn-John & Koithan, 2015; Powell & Curley, 2008). Moving beyond the ecological exploration in this study, any future research investigating how COVID-19 has affected Navajo people must acknowledge Tribal sovereignty and rely on knowledge, methods, and methodologies that are Tribally-driven (Marley, 2019; Walter & Suina, 2019). Future studies should also consider investigating the specific mechanism in which AUMs continue to affect the people, livestock, and lands of Diné Bikéyah as well as ways lack of access to safe clean water is explicitly connected to AUMs.

Environmental racism and the legacy of uranium mining for Indigenous Peoples and communities is not unique to the Navajo Nation; these are also experiences of Indigenous Peoples in Australia, Canada and other places (Graetz, 2014). It is important to recognize the community-based movements and Indigenous resiliency that parallel the legacy of colonization and systemic racism. For Navajo people, community activism has been at the heart of decades of ongoing efforts to amplify Indigenous resiliency and advocacy (Powell & Curley, 2008). We urge that historically-embedded systemic racism must be considered a fundamental component of health inequities for Indigenous Peoples and communities, specifically in the midst of the current COVID-19 pandemic and moving forward.

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