Journal of Rural Social Sciences

Volume 36
Issue 1 Volume 36, Issue 1

5-17-2021

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This article is available in Journal of Rural Social Sciences: https://egrove.olemiss.edu/jrss/vol36/iss1/6
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ABSTRACT
The Amish are an endogamous rural population experiencing rapid growth; consequently, they have attracted the attention of population health researchers and service providers. With approximately one quarter of all Amish studies publications now devoted to population health (n=246), the time is ripe to review research trends. Using bibliometric measures, we map the genealogy, influence, and configuration of Amish health publications. Amish population health research has (1) a health culture-focused core with clusters representing social science and health practice, (2) peripheral clusters addressing health conditions—mental, physical, and injury/safety—and (3) several clusters straddling both. We identify fruitful interdisciplinary studies and recommend researchers investigating health culture and conditions seek ways to integrate their research agendas. This article represents a pivot-point for Amish population health research, for it provides a first-ever bibliometric mapping, allowing researchers to more easily locate their work within the literature and identify opportunities for interdisciplinary collaborations.

KEYWORDS
Bibliometric analysis, citation network analysis, ethnicity and population health, meta-review, religion and population health
INTRODUCTION
Among the 1,000+ peer reviewed, cross-disciplinary publications about the Old Amish (“Amish”) since 1942, nearly one-quarter address the population’s health culture and conditions (Anderson 2017a). The reasons for this interest vary. Population health researchers are exploring how Amish lifestyle patterns may increase or decrease the risk of certain illnesses. Geneticists are interested in identifying heritable causes for health conditions, and the Amish, as an endogamous group with strict sanctions against extramarital relations, provide an unparalleled opportunity (Francomano 2012). Healthcare service providers are seeking information about Amish culture in order to provide sensitive, informed care. The Amish population is growing exponentially (Colyer et al. 2017) and their health needs may be overlooked, as Amish fit awkwardly into common surveillance categories (e.g. ethnic minority, or underserved and at-risk population). Further, they are growing and relocating exclusively in rural North America, which is an area underserved by the modern medical infrastructure (Danis 2008; Hanlon and Kearns 2016; Morton 2003).

While for these reasons Amish health research is germane, as of yet, we have no meta-level map of Amish population health research trends and trajectories. A recent bibliometric mapping of all Amish research revealed a strong social scientific/humanities research core, but population health research stood out as one of two semi-autonomous knowledge bodies needing further analysis (Anderson 2017a). Several reviews brought clarity to specific health topics (Cross and Crosby 2008; Farrar, Kulig, and Sullivan-Wilson 2018; Gillum and Staffileno 2011; Hou et al. 2013; Strauss and Puffenberger 2009; Thomas et al. 2002) but did not analyze Amish health research patterns from a bird’s eye view. Consequently, the scholarly topography of Amish health research remains unmapped. To map a research area is to organize the literature by identifying key orientations and paradigms as well as central actors and publications (Greenhalgh et al. 2005). In this article, we use several bibliometric methods to map Amish population health research.

Reference mapping directly informs the work of researchers and service providers. With the passage of time and accumulation of publications, field researchers are less able to map the shifts in research focus or the trajectory of an idea, instead focusing on the latest findings or conveniently accessed literature. After all, in a single article, authors cannot cite all references contributing to an idea’s development (Garfield et al. 1964; Hargens 2000), and as research publications continue accumulating, authors face greater difficulty identifying all relevant
literature. A research area map grants researchers access to the full historic development of ideas. It supplements researchers’ literature reviews and grounds future projects in full consideration of an idea without needing to extensively review that idea. Further, researchers can back up if they think an earlier paradigm shift should be revisited (Kostoff 1998; Kuhn 1962).

Literature mapping is also necessary for effective evaluative reviews, which perform the additional important tasks of study evaluation, synthesis, and future research recommendations (Van Raan 2003; Wallin 2005). We offer two narrative reviews elsewhere (Anderson and Potts 2020; 2021), that relied on our present literature mapping in three ways. First, literature mapping helped us identify key paradigms, an important prerequisite for evaluating interdisciplinary approaches to similar subject matter (Greenhalgh et al. 2005). Second, it helped us frame cumulative knowledge as not just a product of findings but also of time-specific trends, the enabling power of funding agencies, the efforts of citation clubs, and power distributions across research-based institutions that de/legitimate certain knowledge bodies (Barth, Haustein, and Scheidt 2014, Bourdieu 1990, Gouldner 1962, Kostoff 1998, Kuhn 1962). Third, it helped us identify and underscore important work in narrow, but nevertheless important, research areas (Wallin 2005).

In this article, we first detail the methods employed to map Amish health research, then offer our findings. We next turn to discussing the topography of Amish health research. We find that Amish health research is organized around 13 topical clusters. Among these 13, two major topical preoccupations exist but are somewhat disconnected: (1) a central body of Amish health culture research (two clusters), and (2) a peripheral set of health conditions research, which encompasses three disconnected areas: mental health (two clusters), physical health (three clusters), and injury research (two clusters). Three clusters are located between these culture and conditions research; a small, thirteenth cluster is outlying. We also observe changes in research trends over time, especially noting the 1990s emergence of cultural competency research and its present stagnation. We conclude by identifying areas of research lapse and research gaps.

THE AMISH
The “Old Amish” are ethnically German-Swiss and trace their religious roots to the 16th century Anabaptist tradition of central Europe. They migrated to North America in the 1700s and 1800s, then followed the
American frontier. Today, they occupy rural areas across the North American mid-latitudes, with sizeable communities as far south as Tennessee and Missouri and north as Minnesota and upstate New York, but with the largest populations in Indiana, Ohio, and Pennsylvania (Anderson and Donnermeyer 2013; Crowley 1978; Lamme 2001). In a companion supplement publication, we provide a description of the Amish communities where the bulk of health studies—and other Amish research—has been conducted (Anderson 2021).

Due to their high birth rate and retention rates, Amish populations are growing. The 2010 U.S. Religion Census reported a nationwide population of 241,356 (Grammich et al. 2012). Their doubling time has been repeatedly calculated at around two decades (Cross 1976; Dewalt 2001; Donnermeyer 2015; Greksa 2002). Structurally and culturally, Amish maintain tightly integrated kinship and congregational networks (Škender 2020; Stein, Corcoran, and Colyer 2019); are engaged in market-oriented trades, industry, and agriculture (Jeong 2013; Lutz 2017); and maintain a nuanced symbolic world that both shapes and is shaped by social action (Anderson 2017b; Enninger 1982). Even as we are able to identify people-specific practices and ideologies, the Amish should not be dichotomized as “Amish” against an “outside world,” for “Amish” is neither individuals’ most self-conscious identity at all times nor a total identity (Anderson et al. 2019) but rather one of many variously nested identities in a larger landscape of socially oriented references (Wimmer 2013).

METHODS
To map out Amish population health knowledge, we were interested in three bibliometric results: topical clusters, citation centrality, and scholarship trends across time. Topical clusters allow us to identify sustained research foci and scholarly alliances/engagements. Citation centrality measures reveal the most influential references for knowledge production and synthesis. Time-passage trends provide insight into how knowledge accumulates or disintegrates and where focus shifts occur.

For this analysis, we employed an asymmetrical adjacency matrix consisting of cross-disciplinary Amish studies references and last updated in 2017. At the time, it had 983 references and 7,151 citations—see Anderson (2017a) for methodological details about this matrix’s development. We extracted the health-related references and then identified additional health-related references through February 2020. To define the Amish population health literature, we developed two straightforward criteria: research design focuses on “Amish” exclusively or
comparatively and the research addresses “health”, i.e. physical or mental well-being. Two protocols helped us identify the Amish health literature. First, using a snowball strategy, we consulted the bibliographies of all Amish-themed publications until they yielded no additional references; this method was used in the original 2017 matrix and the update to 2020. Second, the term “Amish” was searched in Google Scholar—a wide-spectrum research database—from 2010 to February 2020 until no new results emerged. We excluded (1) non-English publications, (2) dissertations and theses, (3) conference presentations, unless published as full papers in a peer-reviewed anthology, and (4) technical genetics studies, a literature more focused on genetics knowledge than Amish health. References from these categories rarely appeared in our literature body’s bibliographies, thus rendering their exclusion inconsequential for bibliometric analysis.

After identifying health-related references and completing the citation matrix, we made two adjustments. As main path analysis (discussed below) requires a strict publication chronology, we deleted citations creating circularity. For example, three publications in 1983 by the same authors all cite one another, creating a citation loop. We also deleted isolate references (i.e. without ties) and components (i.e. connected networks) separate from the main component. All network calculations derive from the main component.

**Topical Clusters**
We analyzed topical clustering in VOSViewer (“Visualization Of Similarities”), a bibliometric-focused analysis software that weights citations’ importance, identifies topical clusters, and visually maps citation-based relationships among references (van Eck and Waltman 2010). The resultant clusters reflect specific research paradigms, topical preoccupations, and long-term projects. For the optimal visualization of citation clusters, we used distance-based mapping, where node proximity to another node represents relative similarity and node size represents centrality. We then reviewed each cluster’s publications and assigned a label characterizing the dominant theme.

**Citation Centrality**
We used UCINet (Borgatti, Everett, and Freeman 2002) to calculate reference in-degree and out-degree (ego network measures), and hub and authority scores (total network measures). In-degree refers to the number of times a reference is cited while out-degree is the number of times it
cites others. Authorities and hubs are interrelated measures that identify influential works. Authorities are those references named by many high-ranking hubs, and hubs are those naming high-ranking authorities. A publication becomes a hub if it cites all high-ranking authorities, even if the hub is rarely cited itself, as with recent literature. An authority does not need to cite anyone else to score highly if it is named by the right hubs (Kleinberg 1999). The hubs and authorities measures assume citations represent cycles of prestige and popularity among publications. Such measures are used widely to rank journals and articles (Bollen, Rodriguez, and van de Sompel 2006).

**Time-Passage of Scholarship**

To analyze research trends over time, we first calculated and graphed citations per year. We then conducted a main path analysis using Pajek and visualized the path in yEd using the hierarchical layout algorithm. Main path analysis identifies a backbone of accumulating knowledge, where past findings are integrated into important new research. Paths are identified with traversal weights, that is, a measure of the frequency with which a given link is used on all possible paths between source references (with no citations to others) and sink references (having not been cited) (Calero-Medina and Noyons 2008; de Nooy, Mrvar, and Batagelj 2005; Lucio-Arias and Leydesdorff 2008). A basic main path analysis produces a single path. However, research trends are better conceptualized as a web of parallel and intersecting paths (Hummon and Doreian 1989). To broaden the scope of the main path, we graphed all links with traversal weights of 0.04 and greater, which, with one exception, was the minimal link weight along the main path. All literature links have a traversal weight score but scores vary; we decided on 0.04 as a meaningful cut-off point; 0.04 represented the threshold point between a limited number of high-ranking weights and scores representing the vast majority of links. To map the main path, we used yEd Graph Editor, which contains a catalog of visualization algorithms and works well for smaller networks.

**RESULTS**

Overall, 246 Amish health references were included in the Amish health research citation matrix. The 246 references had 917 citations to each other. Of the 246, for analysis, we deleted 16 isolate references and four references constituting two components separate from the main component. An additional six citations in the main component were deleted to eliminate circularity.
VOSViewer generated 13 reference clusters in the main component with its citation-based algorithm (Figure 1). After reviewing the citations in each cluster, we concluded that the algorithm has face validity, as we were able to provide topic-specific labels that captured each cluster’s emphasis. Most clusters had a topical focus, although two represented research collaborations. Several topics were also time-contingent trends or discipline-specific groups. For example, the topics “Health culture: practitioner” and “Health culture: social science” contain a similar topical foci but represent different research periods, with an average publication date of 2003 and 1987, respectively (Table 1). They also represent different research disciplines: health practice and social sciences. Similarly, we found two clusters of “Mental health…” research – “Diagnosis & culture” and “Deviance” – distinctive by average publication year (1993 and 2008, respectively) and preoccupations. Likewise, we found two clusters of physical health conditions research, but one specifically reflected an ongoing collaboration among University of Maryland and National Institutes of Health researchers. Overall, the network map shows a set of highly central references constituting several subareas. Additionally, three conglomerates of subareas are spatially distinct from the central references. The central subareas address culture while the three peripheral subareas address mental health, physical health, and injuries/treatments.

Our analysis of reference centrality is presented in Figure 2. “Authority” includes all references with an in-degree of nine or greater (i.e., references cited nine or more times), a cut-off point after which many more references would be included than would be meaningful. Thirty-one references met this in-degree threshold. The figure also includes authority scores set against in-degree scores. Two references are particularly worth noting. Adams and Leverland (1986), an early cultural competency piece in Nurse Practitioner, had authority and in-degree scores measured 1.27 times the scores of the next highest reference, suggesting all-around popularity. Campanella, Korbin, and Acheson (1993), a mixed methods Social Science & Medicine publication addressing pregnancy and birthing, ranks fifth in in-degree but second in authority score, suggesting citations to this work are disproportionately high among prestigious publications.
Figure 1: VOSViewer Citation Network Map of 243 Amish Health Publications

Colors correspond with topical clusters. Citation names are coded as: first three letters of first author’s last name, four-digit year of publication, first three letters of the publication title. This permits easy cross-reference with the bibliography.

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Table 1: Range and Mean Year of Cluster Publications

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Median</th>
<th>Mean</th>
<th>SD</th>
<th>Earliest</th>
<th>Latest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer, genetics, and screenings (olive)</td>
<td>2011</td>
<td>2002</td>
<td>18.63</td>
<td>1964</td>
<td>2019</td>
</tr>
<tr>
<td>Health culture- practitioner (red)</td>
<td>1999</td>
<td>2003</td>
<td>10.94</td>
<td>1984</td>
<td>2018</td>
</tr>
<tr>
<td>Physical being (BMI, body, birthing) (brown)</td>
<td>2006</td>
<td>2005</td>
<td>8.01</td>
<td>1993</td>
<td>2018</td>
</tr>
<tr>
<td>Heritability studies (U. of Md./NIH) (light blue)</td>
<td>2009</td>
<td>2007</td>
<td>9.02</td>
<td>1990</td>
<td>2017</td>
</tr>
<tr>
<td>Services (clinics, genetic tests, immunzs) (purple)</td>
<td>2009</td>
<td>2008</td>
<td>8.72</td>
<td>1992</td>
<td>2018</td>
</tr>
<tr>
<td>Mental health and deviance (aqua)</td>
<td>2010</td>
<td>2008</td>
<td>6.14</td>
<td>1997</td>
<td>2018</td>
</tr>
<tr>
<td>Technical studies of conditions (light pink)</td>
<td>2013</td>
<td>2012</td>
<td>6.71</td>
<td>2000</td>
<td>2020</td>
</tr>
<tr>
<td>Natural treatments/burns &amp; treatments (pink)</td>
<td>2012</td>
<td>2012</td>
<td>4.05</td>
<td>2002</td>
<td>2018</td>
</tr>
<tr>
<td>Overall</td>
<td>2005</td>
<td>2003</td>
<td>12.72</td>
<td>1958</td>
<td>2020</td>
</tr>
</tbody>
</table>

Also in Figure 2, “Hub” shows all references with an out-degree of nine or greater, which includes 25 qualifying references. Two references well exceed the scores of others: Farrar et al. (2018), an integrative review literature addressing elder care, and Weller (2017), a broad introduction for anesthesiologists to Amish cultural practices pertaining to health. The third- and fourth-ranking publications are also literature reviews and rank well above remaining publications: Colyer et al. (2017), a review of the demographic literature, and Gershenson and Levine (2016), who weigh the literature’s contributions to administering and interpreting neuropsychological assessments with the Amish.

Amish-themed health publications ranged from 1958 to our data collection’s conclusion (2020) with an average publication year of 2003 and standard deviation of 12.7 years, suggesting publications are heavily skewed toward recent years. The main path analysis (Figure 3) reveals a turning point at Fuchs et al. (1990) and Levinson et al. (1989), two studies with the same authors who use survey methods to analyze Amish health and behavioral risks. Prior to 1989, only 37 Amish health studies were published. Research was dominated by the clusters “Population health/demography” (blue) and “Health culture-social science” (orange). Though representing 50 percent of the timespan under consideration, pre-1990 publications account for only 16.5 percent of all references (Figure 4). Two growth periods thereafter sustained an increased publication
quota: the early 1990s and the early 2010s. Though the pre-1990 clusters maintained representation along main paths, the primary and proximate main paths were dominated by newer clusters, “Health culture-practitioner” (red), “Physical being (BMI, body, birthing)” (brown) and “Natural treatments/burns & treatments” (pink).

Through the 1990s-2000s, JMNH (Journal of Multicultural Nursing & Health, now defunct) ran two full special issues about the Amish, partly explaining the 1997 and 2002 spikes. A 2006 special half-issue yielded fewer publications. During the 2010s, JAPAS (Journal of Amish and Plain Anabaptist Studies), established in 2013, provided a continual source for health articles, publishing one to three articles each year except in 2019. Three high-ranking hubs were published in JAPAS – Colyer et al. (2017), Hess (2018), and Jolly (2017) (Figure 2). These hubs provided extensive literature reviews in demography, burns and injuries, and birthing, respectively. The 2006 special half-issue of JMNH published two pieces ranking highly as both hubs and authorities: Armer (2006) and Graham (2006) (Figure 2). Both JAPAS and JMNH rank well above other outlets in the quantity of Amish-themed health publications (Figure 4). While this verifies their importance to knowledge production, it also suggests that a vast number of outlets are hosting Amish health research, since only two outlets have more than a handful of publications.

DISCUSSION
We now use our findings to narratively trace Amish health research trends, knowledge trajectories, and institutional configurations. We organize our discussion chronologically, dividing research into a “longstanding” period (1958-1986), a “research shift” (1986-90), the aftermath of the research shift wherein important central research clusters emerged and defined Amish health research as a semi-autonomous area, and more recent research trends in other clusters.

Longstanding Studies (1958-1986) and Their Legacy
The pre-1990 “longstanding studies” are characterized by an attraction to unique properties of the Amish population—including lifestyle patterns and the closed genetic pool created through endogamy—that lend well to demographic and genetic research. These studies are represented in the dark blue cluster, “Population health and demography.” Elmer Lewis Smith’s (1960) groundbreaking demographic report, the sink in the main path (Figure 3), presented a prodigious amount of quantitative and qualitative data that characterized Amish population patterns. While Smith
Figure 2a: Top In-Degree / Authority Scores for Amish Health References

Colors correspond with topical clusters in Figure 1.
Figure 2b: Top Out-Degree / Hub Scores for Amish Health References

Colors correspond with topical clusters in Figure 1.
Figure 3: Main Path Analysis of Amish Health References

Paths and traversal weights calculated using search path link count with flow normalization. Colors correspond to citation clusters in the citation network map.
Figure 4: Amish Health Publications by Year (1958-2020) and by Journal Outlet

- American Journal of Medical Genetics
- Holistic Nursing Practice
- Internal & External Perspectives on Am. & Plain Anabaptist Studies
- Journal of Agricultural Safety and Health
- Journal of Amish and Plain Anabaptist Studies
- Journal of Multicultural Nursing and Health
- Journal of Rural Health
- Journal of Transcultural Nursing
- Medicine & Science in Sports & Exercise
- PLoS ONE

Publications per year
collected his own data using mixed methods, other early main path publications used large quantitative datasets generated from surveys and genealogical projects. Most demographic research focused on birth and death trends, while Amish genetic research—especially the work connected with Victor McKusick, e.g., represented in his 1978 edited volume—contributed broadly to the growing field of genetics by identifying inheritable properties of common medical disorders among the Amish. Demography and genetics overlapped due to their common data source: settlement-specific population rosters (“directories”), which several medical researchers helped compile.

Three highly cited studies in the blue cluster, third-, fourth-, and eighth-ranked for in-degree in Amish health research (Figure 2), include (1) Cross and McKusick (1970), whose extraordinary compilation of Holmes County, OH, Amish demographic data permitted a first-of-its-kind analysis of the Amish population structure; (2) McKusick (1978), whose edited volume of Amish genetic disorders represented at least 15 years of concerted field research with collaborators; and (3) Ericksen et al. (1979), who found that Lancaster County, PA, Amish birth rates remained high across twentieth century cohorts and identified several physical and social correlates affecting fertility. Though highly cited, these studies have a comparatively low authority score, evidencing their limited impact outside their citation cluster and time period.

Genetics research is addressed in newer clusters (Figure 1) – such as “Heritability studies” (light blue) and “Cancer, genetics, and screenings” (tan) – a consequence of geneticists turning from demographic data to genealogical and clinical data. Occasional, topic specific demographic studies still dot the 1990s and 2000s. Among these are Hewner’s (1997, 1998, 2001) studies of a Western New York Amish settlement’s population health; Dorsten’s (1994, 1999) analysis of childbirth and infant mortality indicators among Amish in Lancaster County, PA; and Greksa’s (2002) study of the population structure of Geauga County, OH, Amish. Yet, none of these studies earned a ranking on the hub/in-degree or authority/out-degree graphs. Evidencing current stagnation in Amish population research, Colyer et al. (2017), the third-ranked hub, recently called for a revival of demographic research.

A second research trend among longstanding 1958-86 studies is represented in the “Health culture-social science” cluster (orange) (Figure 1). This cluster represents a now-dated research emphasis, with an average publication date of 1987 and a range from 1958 to 2006 (Table 1). These studies typically analyze Amish health culture from a social
scientific perspective (e.g. sociological, anthropological, and/or psychological). These studies use qualitative methods, including ethnography, applied strategies, content analysis, the case study, and formal interviews, and examine health ideologies, cultural values, social roles, and social processes. The most recent study in this cluster, Armer and Radina (2006), is the seventh-ranked authority and twelfth-ranked hub (Figure 2). Armer and Radina used a novel set of mixed methods to identify (1) important concepts in Amish health beliefs, and (2) social contexts in which Amish make health decisions.

Research Shift (1986-1990) and Central Research Clusters
A major turning point in Amish health research is represented by Levinson et al. (1989) and Fuchs et al. (1990) – which were collaboratively authored by Janet Fuchs, Diane Jones, Richard Levinson, Maurice Mullet, and Ronald Stoddard – and the influential Adams and Leverland (1986) article. Adams and Leverland (1986) and Fuchs et al. (1990) are the first- and third-ranked authorities, while Levinson (1989) also receives a high authority score (Figure 2). All three represent a main path bottleneck between longstanding and recent studies (Figure 1). These three studies shifted the Amish health research core toward practitioner-focused analyses of culture.

Unlike most prior studies, Fuchs and colleagues were all affiliated with public health institutions and not universities. Their research provided empirical evidence of differences between Amish and non-Amish across a range of health practices and conditions. In a massive, successful survey of 600 Ohio Amishmen (100 percent response rate) and 773 non-Amish neighbors, they found that respondents self-report lower rates of tobacco use, alcohol consumption, salt use, dieting and deliberate weight loss, and hypertension, and higher rates of vitamin use, although respondents also self-reported higher rates of obesity and stress, especially among women. Importantly, the researchers offered cultural explanations for these differences, characterizing the Amish as a “unique societal subgroup” (1990 abstract), but their social theorizing went no further than the circular claim that Amish have differences because they are a unique group. Nevertheless, such a quantitative study suggesting distinct health outcomes caught the attention of practitioners eager for information about the Amish, a population that by 1990 had been rapidly growing for several decades. The health issues Levinson and colleagues addressed were quotidian and accessible.
Levinson et al. and Fuchs et al.'s publication pair initiated two topical precedents in Amish health research: (1) discussion of service provider work that equated service effectiveness with understanding and explaining Amish culture, and (2) focused, sub-topical investigations of specific health conditions. The culture literature is represented by the highly central “Health culture-practitioner” cluster (red). At the cluster’s center is Adams and Leverland (1986), a short, anecdotal, and seemingly modest contribution in a nursing practitioner journal that has never published another Amish-themed article. Yet, this article ranks above all other Amish health publications in authority and in-degree scores (Figure 2). The article, written to nurses, describes six Amish beliefs affecting healthcare. Why has this piece been so influential?: because the notion of distinct Amish healthcare was new, and because it provided an easily replicable article model for practitioners who just wanted to share a few insights about their Amish work. These practitioners are primarily nurses; 18 of the 35 publications in the “Health culture-practitioner” (red) cluster have the word “nursing” or “nurse” in the journal/compilation or article title. But other practitioners also occupy the cluster. Of the remaining publications, 11 have the word “care” in the title. Subjects address elder care, financing, and specific medical topics. Of the remaining six publications, four address ethical scenarios.

Despite its influence, Adams and Leverland’s (1986) publication is lean on theory and methods. This characterizes much of the “Health culture-practitioner” literature, which, though written by researchers with rich firsthand experience, often lacks the helpful grounding of theory and/or methods. Several studies in this cluster are important exceptions. Foremost, Anna Francis Wenger offered several lengthy, painstakingly nuanced ethnographies of the Amish cultural cosmos and its impact on health practices (Wenger 1991a; 1991b; 1993; 1994). Wenger built on Madeleine Leininger’s advances in transcultural nursing (Leininger 1978; 1988). In the health and culture literature, Wenger’s work has received some citations, though mostly superficial, as evidenced by the higher citation rate to her more descriptive pieces (Wenger 1994; Wenger and Wenger 1998). Yet, by offering theoretical context for cultural observations, Wenger’s research, were it more carefully considered in health and culture publications, could have rendered Adams and Leverland’s limited approach incidental.

Furthermore, inasmuch as the two health culture clusters (red and orange) are addressing related concepts – health culture/beliefs/practices – but are approaching the subject from separate disciplinary angles –
health practitioner work and the social sciences – much could be gained
were more cross-disciplinary collaborations initiated between these two
areas.

Since Adams and Leverland (1986), the culture-oriented literature
has dominated the main paths (Figure 3) and center of the citation
network graph, while health conditions research is located in smaller,
peripheral citation clusters (Figure 1). However, the themes of culture and
conditions can and do overlap, as demonstrated in Levinson et al.’s two
studies, and some clusters provide at least token disciplinary bridges –
notably “Services” (purple), “Cancer, genetics, and screenings” (tan), and
more recent publications in “Population health and demography” (blue),
which mostly focus on women’s natal health. However, few effective
collaborations exist. Such collaborations arguably once characterized the
now defunct “Health culture-social science” cluster, when social scientists
conducted work with quantitatively oriented population researchers and
medical scientists (Weaver-Zercher 2005). In the aftermath of the 1986-90
shift, medical scientists moved into peripheral clusters and social
scientists’ work became scattered across other clusters, suggesting some
fragmentation in what social scientists offer service providers:
psychologists studying Amish body image (Davidson et al. 2018)
categorized in “Physical being (BMI, body, birthing)” (brown); an
anthropologist studying an Amish-focused genetics clinic (King 2017)
categorized in “Services” (purple); a sociologist studying birthing practices
(Jolly 2017) categorized in “Physical being (BMI, body, birthing)” (brown);
and a rural sociologist studying horse and buggy safety symbols
(Anderson 2014) categorized in “Injury” (dark green). A research
collaboration meriting emulation consisted of medical anthropologists
working with mental health service providers to increase community
access (Miller-Fellows et al. 2018), a study categorized in “Mental health
and deviance” (aqua).

While the continued involvement of social scientists in health
research provides theoretically and methodologically sophisticated
analyses of culture – as represented by their more recent widespread
representation in specific clusters–their notable absence in the core
culture clusters after the 1986-90 turn suggests an opportunity for more
cross-pollination in health research, especially with both health
practitioners and medical researchers. Such collaborations would offer all
parties a holistic understanding of the Amish health universe.
Outer Research Cluster Groupings: Physical Conditions Research

From the citation network’s center (Figure 1), references stretch outwardly into three cluster groupings shaped like peninsulas: (1) “Injury” (dark green); (2) “Technical studies of conditions” (light pink) and “Heritability studies” (light blue); and (3) “Mental health diagnosis and culture” (brown), with related topical clusters located between these and the cultural core. “Dental” is a fourth cluster located outside Figure 1 and consists of only three references by the same lead author. These three cluster groupings are distant from the citation network’s center (Figure 1), do not occupy main paths (Figure 3), and rarely have publications highly ranked as hubs or authorities (Figure 2). These clusters are peripheral in the network because they prefer bridging copiously to non-Amish research about a condition, citing only the most immediately germane Amish health studies.

The two mental health clusters represent related but distinct research foci (Figure 1). As reported in Table 1, “Mental health diagnosis & culture” (light green) has an average publication date of 1993 and range of 1983-2012. “Mental health and deviance” (aqua) has an average publication date of 2008 and a range of 1997-2018, making the former the older literature. Neither mental health cluster has highly central references. “Mental health and deviance” includes four studies by Eastern Michigan University’s Denise Reiling (1997; 2002a; 2002b; 2002c) and five studies by practitioner James Cates and collaborators (2002; 2005; 2010; 2012; 2013). Both address substance abuse, narcotics, and the relationship between mental health conditions and deviance among Northern Indiana’s Amish. Reiling emphasized sociological theory, value neutrality, and researcher ethics, while Cates emphasized psychological practice and activist-oriented intervention. Additionally, four recent studies (Gershenson and Levine 2016; Knabb and Vogt 2011; Knabb, Vogt, and Newgren 2011; Kuehner et al. 2016) address measurement issues with psychological tests.

Clear across the network from the mental cluster area is a peninsula of “Injury” (dark green) articles (Figure 1). Representing the second largest cluster, at 26 publications, “Injury” publications largely focus on farm or road safety and are primarily conducted by agricultural extension researchers. These publications use interviews or secondary records to assess risk and then report on outreach efforts. Research collaborations led by Purdue’s Field and Jones (2002-13), Ohio State’s Jepsen (2009-15), and Penn State’s Fisher, Hupcey, and Rhodes (2000-02) have productively contributed to our understanding of farm injury risk in Indiana, Ohio, and Pennsylvania, all states with large Amish
populations. Concurrently, a series of studies addressing horse and buggy safety identified frequent crash variables and scenarios, primary injury types, and the efficacy of different buggy markings. While “Injury” studies focus on technical questions and outreach, they are distant from the network’s culture clusters. The only propinquitous cluster is “Natural treatments/burns & treatments” (pink), a cluster closer to cultural research. The distance of “Injury” from the network’s center suggests potential for “Injury” literature to both benefit from and contribute to health culture literature, especially as researchers implement safety recommendations through outreach.

Branching in a third direction in Figure 1 are two clusters addressing physical health conditions: “Heritability studies” (light blue) and “Technical Studies of Conditions” (light pink). Studies in these cluster areas often accumulate impressive amounts of data on conditions that provide novel field advances, evidenced by publications in the New England Journal of Medicine, PLoS ONE, and the American Journal of Medical Genetics. The “Heritability studies” cluster represents research from the University of Maryland (UM) and the National Institutes of Health (NIH). Not only do “Heritability” references cite each other frequently, they also contain several reoccurring co-authors, including Braxton Mitchell-UM (7), Alan Shuldiner-UM (6), Toni Pollin-UM (6), Patrick McArdle-UM (3), Alejandro Schäffer-NIH (3), Richard Agarwala-NIH (3), and Robert Reed-UM (3) (publication tallies include only those in this cluster). These studies use an Anabaptist genealogy database and a pool of recurring Amish participants in Lancaster County, PA, to analyze various medical conditions and behaviors.

The “Technical studies of conditions” cluster includes some of these same authors and research strategies, though these references are not as closely intra-citing, and they include work outside the UM/NIH collaborations. In this “Technical” cluster, health conditions analyzed have included physical activity and BMI, cardiovascular disease, diabetes, asthma, seasonal affective disorder, and sleep. Both Bassett, Schneider, and Huntington (2004) and Hsueh et al. (2000) have authority rankings among the top ten (Figure 2) – despite their peripheral location in the network map – due to important citations both within the cluster and to others in neighboring clusters. Furthermore, early on, these two references helped define the cluster area by utilizing substantial quantitative datasets and demonstrating substantial, significant differences between Amish and non-Amish people’s health conditions.
The physical health clusters’ emphasis on quantitative data and Amish/non-Amish comparisons traces its intellectual heritage to the main-path bottleneck of Fuchs et al. (1990) (Figure 3). Publications so heavily cite Fuchs et al. (1990) that this study was incidentally classified as “Heritability” – the only non-UM/NIH publication in this particular cluster. Despite the interesting differences between Amish and non-Amish identified in the “Heritability” and “Technical” clusters, these studies have but cursory analyses of cultural dynamics, which is peculiar given that Fuchs and collaborators also helped trigger the influx of health culture studies in the 1990s-2000s. Notwithstanding, the two health condition clusters represent several invested scholars and institutions, a productive structure for advancing debates and tests of empirical validity.

**Emerging Trends**

After over two decades of excitement – the 1990s and 2000s – the culture-health practitioner literature is stagnating. Two of the area’s more recent publications – Weller (2017) addressing anesthesiologists and Gershenson (2016) addressing psychologists – are highly ranked hubs, yet they reiterate the all-too-familiar, and somewhat problematic, cultural competency perspective on Amish-focused healthcare. Two responses to the limitations of this perspective are now discernible. For one, several publications call for re-evaluating the practitioner-oriented cultural competency paradigm (Anderson and Potts 2020), including Jolly (2017), Garneau et al. (2018), Farrar et al. (2018), and Benedict (2017) (Figure 2). Alternatively, several health researchers, practitioners, and Amish opinion leaders avoided generalized assessments of the Amish health culture (characteristic of cultural competency) and helpfully nuanced the perspective to an applied collaborative study on the Amish preference for and efficacy of the B&W salve/burdock leaves for burn therapy, e.g. Amish Burn Study Group et al. (2014), Trinkle (2016), and Hess (2018). The cluster “Natural treatments…,” in which these three studies exist, may represent an important refocus in practitioner-oriented culture work. The cluster’s mean and median publication year (2012) and standard deviation (4.05) (Table 1) suggest these developments are recent and concerted. Further, the emerging centrality of this cluster is evidenced in the most recent section of the main path (Figure 3).

**SUMMARY AND CONCLUSION**

Amish health research was sparse from 1958 to 1986 and primarily focused on population and genetic properties. The years 1986 to 1990
were a turning point due to a new cultural competency emphasis in Adams and Leverland (1986), Levinson et al. (1989), and Fuchs et al. (1990). In the first, readers valued a few cultural insights for their work with Amish, while in the latter twin studies, the extensive data collection effort coupled with an emphasis on culture intrigued researchers. In the years after, Amish health research publications surged and, as evidenced by the 13 clusters we identified from citation mapping, emphasized health culture or health conditions. Health culture research is at the center of the citation map and dominates the main paths. These studies represent distinct contributions from social scientists (earlier) and practitioners (more recently). Health conditions research forms three cluster areas – mental health, physical health, and injuries. These cluster areas are at the periphery of the citation network and are basically absent from the citation main paths, suggesting their limited influence across Amish health research. Several clusters are located between the culture and conditions cluster areas, suggesting attempts to integrate both approaches, but rarely do publications deeply integrate the two.

Unlike Amish studies research when taken as a whole (Anderson 2017a), our analysis of Amish health research does not suggest a disproportionately influential set of studies, authors, publishing venues, or institutions. Rather, Amish health research appears fairly level, with pockets of protracted projects, which is fertile ground for productive debates and incorporation of diverse vantage points. However, these strengths can only be harnessed as researchers meaningfully engage each other. This analysis has brought to our attention several areas of consideration for the structure and organization of Amish health research.

First, researchers and practitioners should consider more bridging, bridging across clusters, areas, institutional settings, and disciplines. Productive developments have arisen when social scientists and practitioners collaborate to study Amish health culture. For example, collaboration between Case Western Reserve University medical anthropologists and northeast Ohio public officials helped expand mental health services in an Ohio Amish settlement (Miller-Fellows et al. 2018). Further, as medical conditions research continues to discover interesting health condition patterns among Amish populations, and as culture-oriented practitioners continue to describe best practices for working with Amish people, these two camps must seek ways to collaborate. For example, medical conditions data risk misinterpretation without involving those deeply familiar with Amish culture while practitioners risk overgeneralizing differences in medical practice without strong datasets. A
natural burn treatment study led by Amish lay healthcare workers and plotted along the most recent segment of the main path represents one effective collaboration. The natural practice, at first deemed provincial and unfit for professional medical use, has now attracted more attention (Amish Burn Study Group et al. 2014; Hess 2018; Trinkle 2016).

Second, the age of some clusters suggests a decline in research, but the work is not finished. We are particularly concerned about declines in injury research and research on the relationship between Amish culture and psychological tests. Land grant universities – Purdue, Ohio State, and Penn State – have supported injury research and outreach, which should continue as the Amish population grows, while psychological testing research invites a set of extensive collaborations between clinical staff and social scientists yet to be forged. Additionally, recent social scientific studies of health practice and beliefs are spread across the citation graph. While this could represent integration with health conditions research, such research should also demonstrate interconnectivity with other social scientific health research.

Finally, we note several research questions that did not coalesce into clusters. We suggest more research in three areas. First, given that the Amish are a rural, theologically separation-oriented population, we see little discussion about whether or not the Amish are an underserved population, and if so, what services should be provided and how. Research addresses service competency but not rationale. Second, we have little deep cultural research about why Amish people are so predisposed to complementary and alternative health (CAM). While much discussion exists about CAM usage and specific CAM practices, we are missing deep analyses of cultural variables supporting CAM. Finally, relatively few syntheses of the Amish health literature exist. While we are addressing this gap in two overarching companion publications – one addressing the health culture (Anderson and Potts 2020) and the other addressing health conditions (Anderson and Potts 2021) – most clusters could justify individual in-depth review.

ACKNOWLEDGMENTS
We thank Rosanna Hess, Karlin High Alyssa LaFever, Molly Thal, and Alicia Wodika for their helpful comments on earlier drafts. Anderson acknowledges assistance provided by the Population Research Institute at Penn State University, which is supported by an infrastructure grant by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (P2CHD041025) and training grant on Social Environments.
and Population Health (T32HD007514); Potts acknowledges a Truman State University GIASR grant in support of her summer 2018 work.

DISCLOSURE STATEMENT
No potential conflict of interest was reported by the authors.

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APPENDIX: Amish Health Literature References—246 Studies from 1958 to Spring 2020


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