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Decompression Illness in United States Air Force: High Risk Occupations

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High Risk Occupations

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Abstract

Introduction: Although the physics of decompression sickness (DCS) is well understood, an individual's unique response to the bubble formation places the United States Air Force's (USAF) Airmen and missions at risk. We identified 123 decompression sickness diagnoses in the USAF between the years 2005-2010. From these cases we attempted to identify an association between the disease and the two occupations that are routinely performing high-altitude duties, the U2 pilot and the hypobaric chamber technician. Methods: A Chi-squared analysis was performed to identify if DCS was associated with the high-altitude occupations, tobacco, or alcohol. Results: There association between DCS and U2 pilots or altitude chamber technicians was extremely statistically significant with a two-tailed p value less than 0.0000001, and an odds ratio of 150.6. There was no association between the DCS cases and tobacco or alcohol use. We identified 87 cases not connected to high-risk duties. Discussion: We expected the association between high-risk occupations and the diagnosis of DCS. We did not expect the high number of DSC cases in the low-risk group and the disproportionate number of cases chamber technicians had within the high-altitude occupations.

Keywords: Decompression Sickness, U2 pilot, hypobaric chamber technician, high altitude, hypobaric chamber

Decompression Illness in United States Air Force High Risk Occupations

As an Air Force flight surgeon, we are taught that decompression sickness is the occupational risk of high altitude pilots and hypobaric chamber technicians. We sought out to verify the statement with data derived from the billing codes recorded in the electronic medical record.

Purpose Statement

Our goal was to generate a factual statement on the association of DCS within high risk occupations in the USAF between the years 2006-2010.

Literature Review

Ever since James Eads first tried to span the Mississippi with a steel bridge, occupational exposure has been a known risk factor for decompression illness or death. Caissons gave workers the ability to set bridge piers in a dry environment, but the chamber required twice the atmospheric pressure to keep water out. After a day's work, workers would exit with joint pain and bent over. This was the birth of the term "the bends" (Diaz, 1996). Decompression sickness and decompression illness (DCI) are often used interchangeably, but this is incorrect. DCI is the all-encompassing definition of bubble formations in the circulatory system caused by a change in environmental pressure. DCI includes both arterial gas emboli (AGE) and DCS. AGE is defined by formation of gas bubbles within the arterial vascular system caused by pulmonary barotrauma. This type of barotrauma is typically seen in underwater divers ascending back to the surface with an excess of gas trapped within their alveoli; for example, a person holding his or her breath or an individual with pulmonary blebs (Mahon & Regis, 2014; Vann, Butler, Mitchell, & Moon, 2011). On the other hand, DCS is caused by the formation of extravascular and intravascular gas bubbles as the tension of the gas in the circulatory system exceeds the pressure of the local environment (Foster & Butler, 2009). U2 pilot and hypobaric chamber technicians are exposed to this type of high-altitude environment and are at an increased risk for DCS.

Unfortunately, simply understanding the physics of bubble formation within the circulatory system does not allow a flight surgeon to diagnosis DCS. There are individuals with a high concentration of bubbles who do not develop symptoms and others with no evidence of bubble formation who present with significant complaints (Conkin, Gernhardt, Abercromby, & Feiveson, 2013). An individual is constantly breathing in gases such as oxygen, carbon dioxide, nitrogen, and helium at ground level. The pressure exerted by the environment at ground level is sufficient to keep the gases within the liquid state of their vasculature. As the individual ascends in altitude, the environmental pressure decreases and the gases attempt to diffuse out. This point of supersaturation causes bubble formation (Foster & Butler, 2009). There are multiple physical interactions that need to occur for this event to happen, but two of the most important are Henry's law and Boyle's law. Henry's law states that gases dissolved in a liquid are directly impacted by the partial pressure of the gas on the solution (Davis, Johnson, Stepanek, & Fogarty, 2008).

$$yP = Hx$$

Where y is the mole fraction in the liquid phase, P is the pressure of all gasses within the solution; H is Henry's constant for a specific gas within a specific solution, and x is the mole fraction in the vapor phase (Mahon & Regis, 2014). A bottled soda is a classic example. Upon opening, the pressure inside the bottle is released and the liquid inside comes in contact with a less dense, lower pressure environment. Gas bubbles will form immediately within the liquid as it attempts to diffuse into the area of lower pressure (Davis et al., 2008).

Once the bubbles are formed they expand because of Boyle's law:

$$P1V1 = P2V2$$

Where P1 is the pressure of environment 1, V1 is the size of the gas bubble, P2 is the pressure of environment 2, and V2 is the gas bubble. As the environmental pressure decreases, the size of the bubble will increase, allowing more chance for tissue injury or blood flow occlusion.

Because gas bubbles can form in any section of the body, there are multiple symptoms associated with DCS. Traditional classification grouped pulmonary and neurological DCS as type II DCS because of their serious severity. Joint pain and skin symptoms were type I DCS because of their lower severity (Davis et al., 2008). This classification is confusing since symptoms can progress over class definitions. Also the vague definition did not adequately describe the patient's current status. Currently, a description of the symptoms is used to communicate the severity of the disease instead of a classification system.

Pulmonary DCS (historically labeled as the chokes) is caused by bubble formation within the patient's lungs. Patients will complain of chest pain, difficulty breathing, and a non-productive cough. Hyperbaric treatment in a chamber is the only known treatment option (Davis et al., 2008).

Neurological DCS can either be peripheral or central. Peripheral DCS presents with mild numbness in the extremities. Central DCS can be divided into spinal cord and brain, both generating significant risk to the patient. In spinal cord injuries, numbness and weakness begin in the lower extremities or abdominal region and slowly progress toward paralysis (Davis et al., 2008). Neuro DCS can cause ongoing symptoms ranging from a few months to permanent defects (Jersey, Jesinger, & Palka, 2013). Because of the potential for severe long-term impairment, the USAF has dedicated multiple studies on the effects of the hypobaric environment and the prognosis of neurological DCS (McGuire et al., 2012).

Joint pain DCS is the most common presentation of DCS, accounting for 80% of altitude-induced DCS (Balldin, Pilmanis, & Web, 2004). It typically occurs in the large joints of the body and resolves during the descent. Patients who present with joint pain as their only symptom have the option of the ground level oxygen (GLO) treatment. The GLO treatment requires two uninterrupted hours of breathing 100% oxygen through an aviator-type mask or U2 pressure suit (Krause & Pilmanis, 2000). GLO is only an option when dealing with joint pain or skin manifestations since any indication of pulmonary or neuro DCS requires immediate stabilization and hyperbaric treatment (Davis et al., 2008).

Cutaneous DCS symptoms are benign manifestations with no risk of progression to type II DCS when caused by altitude induced DCS. Cutis Marmorata is the typical marble skin lesion associated with bubble formation in the skin (Vann et al., 2011). In contrast, skin symptoms caused by diving can indicate a significant problem (Davis et al., 2008).

United States U2 pilots and hypobaric chamber technicians routinely perform duties in low pressures environments. We are interested in a possible association between their duties and the development of DCS. U2 pilot's mission flights can exceed 70,000 ft. (21,336 m) for 10-15 hours (Jersey et al., 2013). The USAF protects the U2 pilot with a redundant system, the aircraft's cabin and the pilot's full-pressure suit, to minimize the effects of the low-pressure environment. In 2013, the USAF completed a cabin altitude reduction effort (CARE) to increase the pressure within the U2 cabin from 29,500 ft. to 15,000 ft. (Cummings, 2013). If the cabin seal were to fail at high altitude, the U2 full-pressure suit can maintain the pilot at a pressure of 35,000 ft. (Jersey et al., 2013).

Physiological Support Squadron (PSPTS) hypobaric chamber technicians perform aircrew-training duties within a hypobaric chamber. They routinely enter a hypobaric chamber that simulates an altitude up to 35,000 ft. (United States Department of the Air Force, 2012). Although one would expect U2 pilots and aerospace physiologists to be at highest risk of DCS these occupations are highly screened and it is unknown whether there is an association between service in these occupations and clinical diagnoses of DCS as compared with service in other occupations in the Air Force. Furthermore, the total burden of DCS diagnoses in the Air Force is also not known.

Methods

The Wright State University Institutional Review Board (IRB) approved the study protocol (see Appendix A). The USAF IRB allowed for our research to fall under a previously approved protocol #FWRX0130117E (see Appendix B). A "Data Request, Agreement and Authorization" form was required to obtain the data from the USAF Aerospace School of Medicine. The data we obtained was originally derived from the billing codes recorded in the electronic medical record and subsequently archived. Using a case-control study design, we identified every active duty member diagnosed with DCS between 2006-2010 using the International Classification Disease (ICD-9) code 993.3. Each individual diagnosed with DCS was then matched to three active duty members by race, age, sex, and rank who served as controls because they were not diagnosed with DCS. There were two cases we were unable to match on race (one rare racial combination and one missing race) and so these two were matched on the other demographics. We also identified each subject's USAF occupation at the time of (their own or their matched case's) diagnosis. It was vital to label the individual's occupation specifically at the time of the diagnosis because of the possibility of retraining to a new occupation. We used a Chi-Square test to identify if an association existed between the development of DCS and those occupations identified as having hypobaric exposure. U2 pilots and hypobaric chamber technicians were the occupations we expected to have the highest risk. Using the same 2x2 table we calculated the odds ratio of the high-risk occupations developing DCS compared to the general Airmen in the USAF.

Tobacco use and alcohol use was also derived from annually collected survey data to evaluate for any possible association between their use and developing DCS. Cases between 2008-2010 had documented tobacco/alcohol while cases prior to 2008 did not. Information on drinking and tobacco habits were most likely collected prior to 2008, but in paper form in the medical record. DCS cases were reviewed for tobacco and alcohol on the date of the DCS event. If this information was not available, then their electronic medical records were reviewed up to three years prior or after the diagnosis. Our goal was to estimate the true amount of tobacco and alcohol use at the time of the event. The use of tobacco and alcohol from the control cases were taken from their yearly preventive health assessment. Because of the lack of tobacco and alcohol data prior to 2008, only 218 individual records of 492 contained the necessary information. We used a Chi-square test on this smaller subset to identify any association between the diagnosis of DCS and tobacco or alcohol use.

Statistical analysis was performed using SPSS and $p<0.05$ was considered significant.

Results

We reviewed a total of 492 individuals; 123 DCS cases matched 3:1 to 369 controls. There were 108 females; 27 were DCS cases and 81 were controls. Men totaled 384 with 96 DCS cases and 288 controls. The mean age was 28. The occupations of those diagnosed with DCS are listed in Table 1.

Table 1

Occupations and the Number of DCS Cases in the USAF 2006-2010

DESCRIPTION	DCS
Fighter Pilot (11FX)	8
Helicopter Pilot (11HX)	1
Trainer Pilot (11KX)	6
Mobility Pilot (11MX)	7
Recce/Surv/Elect Warfare Pilot (11RX)	8
Bomber Navigator, Bomber Combat Systems Officer (11BX)	2
Fighter Navigator, Fighter Combat Systems Officer (12FX)	1
Mobility Navigator, Mobility Combat Systems Officer (12MX)	2
Recce/Surv/Elect Warfare Officer (12RX)	2
Air Battle Manager (13BX)	2
Intelligence (14NX)	1
DESCRIPTION	**DCS**
Air Force Operations Staff Officer (16GX)	1
Force Support (38FX)	1
Aerospace Physiologist (43AX)	4
Acquisition Manager (63AX)	1
Heath Professions Scholarship Program Medical Student (92M0)	1
Student Officer Authorization (92S0)	1
Pilot Trainee (92T0)	9
In-Flight Refueling (1A0X1)	3
Flight Engineer (1A1X1)	2
Loadmaster, Aircraft Loadmaster (1A2X1)	5
Airborne Mission Systems (1A3X1)	3
Airborne Battle Management, Airborne Operations (1A4X1)	4
Aerial Gunner (1A7X1)	1
Airborne Cryptologic Linguist (1A8X1)	1
Aircrew Flight Equipment (1P0X1)	1
Aircrew Life Support (1T1X1)	2
Pararescue (1T2X1)	3
Survival Equipment (2A7X4)	1
Logistics Plans (2G0X1)	1
Materiel Management (2S0X1)	1
Vehicle and Vehicular Equipment Maintenance (2T3X1)	1
Munitions Systems (2W0X1)	1
Communication-Computer Systems Operations (3C0X1)	1
Fire Protection (3E7X1)	1
Security Forces (3P0X1)	1
Personnel (3S0X1)	1
Aerospace Physiology, Aerospace and Operational Physiology (4M0X1)	28
Technical Applications Specialist (9S100)	1
Basic Enlisted Airman (9T000)	1

Note: Air force specialty codes are in parenthesis.

There were 36 cases of DCS in our exposed group, eight U2 aviators and 28 hypobaric technicians. Only one control came from an “exposed” occupation. Of the non-exposed group, 87 Airmen were diagnosed with DCS and 368 were not. DCS cases had 150.6 odds of hypobaric occupation as compared to controls matched for age, sex, rank and race (OR=150.6; 95% CI 28.3-3131, $p<0.0000001$). The Chi-squared result was 111.5 with a two-tailed p value less than 0.0000001.

The data for tobacco use is listed in Table 2. The chi-squared equals 0.504 with 1 degree of freedom. The two-tailed p value equals 0.4776. There was no statistically significant association between tobacco use and DCS.

Table 2

Tobacco Use in the Cases and Controls of Decompression Sickness

	Decompression Sickness		**Total**	**p value**
Tobacco Use	-	+		
-	139	49	188	
+	24	6	30	
Total	163	55	218	0.4776

The data for alcohol use is listed in Table 3. The Fisher’s Exact test equals 1.727 with one degree of freedom. The two-tailed p value equals 0.651. There was no statistically significant association between alcohol use and DCS.

Table 3

Alcohol Use in the Cases and Controls of Decompression Sickness

	Decompression Sickness		**Total**	**p value**
Alcohol Use	-	+		
Never	26	8	34	
<= 4 times per month	111	36	147	
2-3 times per week	24	9	33	
>= 4 times per week	2	2	4	
Total	163	55	218	0.651

Discussion

As expected, the odds ratio for developing DCS of those working as U2 pilots or hypobaric technicians is extremely high at 150.6. These occupations are known to have hypobaric exposure and reducing risk with engineering or personal protective equipment is difficult. Those individuals dedicating their lives to the mission should be educated on the risks and given the education and tools to mitigate the risk as much as possible. We were not expecting the high percentage of hypobaric technicians when compared to the U2 pilots. Seventy-eight percent (78%) of the DCS cases in the high-risk cases were attributed to hypobaric technicians. U2 pilots are exposed to high altitude environments for longer periods of time, increased frequency, and they have the added stressors of heat fatigue and mission stress when deployed. Hypobaric chamber technicians do not perform altitude duties in deployed areas, so all of their exposure stems from their home station chamber units.

We expected no association of DCS with tobacco use or alcohol use. Though alcohol use can cause dehydration, which is a risk factor for DCS, we did not find a statistical difference between cases and controls in our study. Physiologically, tobacco use may have an impact on divers DCI due to an overall decreased lung function, but it was not expected to contribute to bubble formation in altitude induced DCS.

Finally, we did not expect the high number of DCS cases outside the high-risk USAF occupations. Fighter pilots had eight DCS incidents and pilot trainees had nine. Their risks are smaller because of their lower mission altitudes and their shorter flight times. Mobility pilots had seven documented DCS cases, just one fewer than U2 pilots. While DCS in fighter pilots and mobility pilots is rare, it can be explained by their limited exposure to altitudes near Armstrong's line, the point where total atmospheric pressure equals the body's vapor pressure

(63,000 ft.) (Davis et al., 2008). We could not identify the cause for the high number DCS in maintenance and support personnel without access to their individual medical records.

Strengths and Limitations

We concluded the high-risk occupation's association to DCS is not due to chance. Selection bias or information bias was controlled by performing an objective recording of occupational assignments and including all ICD-9 codes for every member of the USAF from 2006-2010. To remove possible confounders, individual cases were appropriately matched on relevant demographics. The resulting data provided insights to DCS occupational medicine currently not available elsewhere.

We were limited on the data describing alcohol use and tobacco use as 274 individuals did not have data to review. This was caused by the lack of information stored in the electronic database prior to 2008. Again, a review of the case's individual chart would be able to provide that information.

The prevalence of DCS is most likely underreported to the medical treatment facility. 75.5% of U2 pilots described at least one DCS event during their career on an anonymous survey (Muehlberger, Pilmanis, Webb, & Olson, 2004). The eight U2 cases we reported appear to be low in comparison. This is probably due to the flyer's fear of losing his or her aviator rating (McKeon, Persson, McGhee, & Quattlebuam, 2009). It is also likely that individuals feeling mild joint pain and fatigue are mistaking these symptoms as general wear and tear from prolonged sitting times and aircraft vibration.

Future Study

Our study is the foundation of a continued study to identify the cause of each individual DCS case documented by a medical facility in the USAF. We plan on performing chart reviews to verify the diagnosis and better define the cases. Among the cases, there were more individuals who were hypobaric technicians than U2 pilots. Finally, we plan to identify the cause of DCS within the occupations that do not appear to have occupational exposure to altered atmospheric pressure. DCS is a rare disease so it is unclear why these cases occurred or if they could be prevented. It is vital to research a possible unknown risk within the USAF.

Conclusion

The analyzed data validates a very significant association between DCS and high-risk occupations (U2 pilots and hypobaric chamber technicians). This was an expected finding that we sought to verify and in the process of doing so, we identified two areas of unexpected results. We were unsure on how to interpret the large number of DCS cases in the hypobaric chamber technician group and the 87 cases found in the low-risk cases. Could the larger number of cases be due to a higher frequency of mission exposures, more exposed personnel, or more risk? The answers to these questions will require further study into the population of each individual occupation.

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Appendix A – Wright State University IRB Approval

WRIGHT STATE UNIVERSITY

Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: June 23, 2015

TO: Jaime Rojas, M.D., Graduate Student
Master of Public Health
Michael Dohn, M.D., Faculty Advisor

FROM: Jodi Blacklidge
Program Facilitator, WSU-IRB

SUBJECT: SC# 5826
'Decompression Sickness in the United States Air Force, 2006-2010'

This memo is to verify the receipt and acceptance of your response to the conditions placed on the above referenced human subjects protocol/amendment.

These conditions were lifted on: 06/23/2015

This study/amendment now has full approval and you are free to begin the research project. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. If this is a MVH proposal, you must still receive a letter of approval from the Human Investigation and Research Committee (HIRC) prior to beginning the research project. This implies the following:

1. That this approval is for one year from the approval date shown on the Action Form and if it extends beyond this period a request for an extension is required. (Also see expiration date on the Action Form)

2. That a progress report must be submitted before an extension of the approved one-year period can be granted.

3. That any change in the protocol must be approved by the IRB; otherwise approval is terminated.

If you have any questions concerning the condition(s), please contact me at 775-3974.

Thank you!
Enclosure

RESEARCH INVOLVING HUMAN SUBJECTS

SC# 5826

ACTION OF THE WRIGHT STATE
UNIVERSITY
EXPEDITED REVIEW
Assurance Number: FWA00002427

Title: *'Decompression Sickness in the United States Air Force, 2006-2010'*

Principal Investigator: Jaime Rojas, M.D., Graduate Student
Michael Dohn, M.D., Faculty Advisor

Department: Master of Public Health

Expedited Category: 5

The Institutional Review Board has approved the use of human subjects on this proposed project with conditions previously noted. The conditions have now been removed.

REMINDER: FDA regulations require prompt reporting to the IRB of any changes in research activity, changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), and prompt reporting of any unanticipated problems (adverse events).

Jodi Blacklidge

Signed Program Facilitator, WSU-IRB

Expedited Review Date: March 20, 2015

IRB Meeting Date: July 20, 2015

This approval is effective only through: March 19, 2016

To continue the activities approved under this protocol you should receive the appropriate form(s) from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.

Appendix B – USAF IRB Approval

DEPARTMENT OF THE AIR FORCE
AIR FORCE RESEARCH LABORATORY
WRIGHT-PATTERSON AIR FORCE BASE OHIO 45433

23 September 2014

MEMORANDUM FOR USAFSAM/PHR (LT COL MONICA SELENT)

FROM: 711 HPW/IR (AFRL IRB)

SUBJECT: IRB approval for the use of human volunteers in research

1. Protocol title: Impact of Environment and Occupation on the health and Safety of Active Duty United States Air Force Personnel, Database Analysis 2006-2010

2. Protocol number: FWR20130117E

3. Protocol version: 1.04

4. Risk: N/A

5. Approval date: 23 September 2014

6. Expiration date: N/A

7. Scheduled renewal date: N/A

8. Type of review: Exempt

9. Assurance Number and Expiration Date: N/A

10. CITI Training: Completed

11. The above protocol has been reviewed and determined to be exempt from IRB oversight. The study seeks to explore the general hypothesis that environmental and occupational factors impact both health outcomes and risk-taking behavior of service members in certain high-risk career fields. The data being used will be taken from a unique fully de-identified database created in the practice of occupational/public health by a disinterested third party Mr. James Escobar. The investigators will not have access to any PII or PHI. **Amendment:** The investigator seeks to add additional AI, Stefani Ruiz, from STI Technologies. This amendment does not change the original AFRL IRB exempt determination to the study. This protocol therefore meets the criteria for exemption in accordance with 32 CFR 219.101 (b)(4) which exempts "Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects."

12. HIPAA authorization is not required, since no HIPAA protected information will be recorded in the execution of this protocol.

13. FDA regulations do not apply since no drugs, supplements, or unapproved medical devices will be used in this research.

14. This approval applies only to the requirements of 32 CFR 219, DoDD 3216.2, AFI 40-402, and related human research subject regulations. If this project is a survey, attitude or opinion poll, questionnaire or interview, consult AFI 38-501, AF Survey Program, for further guidance. Headquarters AFPC/DPSAS is the final approval authority for conducting attitude and opinion surveys within the Air Force. If the survey, attitude or opinion poll, questionnaire or interview is hosted on a .com server, consult AFI 33-129, Web Management and Effective Use of Internet-based Capabilities, for further guidance. If the study is being conducted under an Investigational New Drug (IND) or Device Exemption (IDE), a copy of the FDA IDE or IND approval letter must be submitted by the Principal Investigator to the IRB.

15. With this approval comes the expectation that the Principle Investigator has the funding to fully execute the protocol. Partial protocol funding, particularly with Greater than Minimal Risk studies, should prompt a re-examination of the protocol by both the Principle Investigator and the IRB with specific emphasis on the risk-benefit evaluation.

16. Any serious adverse event or issues resulting from this study should be reported immediately to the IRB. Amendments to protocols and/or revisions to informed consent documents must have IRB approval prior to implementation. Please retain both hard copy and electronic copy of the final approved protocol and informed consent document.

17. The IRB must be notified if there is any change to the design or procedures of the research to be conducted. Otherwise, no further action is required. All inquiries and correspondence concerning this protocol should include the protocol number and name of the primary investigator.

18. For questions or concerns, please contact the IRB administrator, Lt William Fergueson at william.fergueson@us.af.mil or (937) 904-8094. All inquiries and correspondence concerning this protocol should include the protocol number and name of the primary investigator.

lauren.mcginley@us.af.mil
Digitally signed by lauren.mcginley@us.af.mil
DN: cn=lauren.mcginley@us.af.mil
Date: 2014.09.23 15:01:01 -04'00'

LAUREN MCGINLEY, BSN, RN
Exempt Determination Official, AFRL IRB

Appendix C – List of Competencies Met in CE

Tier 1 Core Public Health Competencies

Domain #1: Analytic/Assessment Skills
Describes factors affecting the health of a community (e.g., equity, income, education, environment)
Identifies quantitative and qualitative data and information (e.g., vital statistics, electronic health records, transportation patterns, unemployment rates, community input, health equity impact assessments) that can be used for assessing the health of a community
Applies ethical principles in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
Uses information technology in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
Selects valid and reliable data
Identifies gaps in data
Collects valid and reliable quantitative and qualitative data
Describes public health applications of quantitative and qualitative data
Uses quantitative and qualitative data
Describes how evidence (e.g., data, findings reported in peer-reviewed literature) is used in decision making
Domain #2: Policy Development/Program Planning Skills
Identifies current trends (e.g., health, fiscal, social, political, environmental) affecting the health of a community
Gathers information that can inform options for policies, programs, and services (e.g., secondhand smoking policies, data use policies, HR policies, immunization programs, food safety programs
Domain #3: Communication Skills
Communicates in writing and orally with linguistic and cultural proficiency (e.g., using age-appropriate materials, incorporating images)
Conveys data and information to professionals and the public using a variety of approaches (e.g., reports, presentations, email, letters)
Domain #5: Community Dimensions of Practice Skills
Recognizes relationships that are affecting health in a community (e.g., relationships among health departments, hospitals, community health centers, primary care providers, schools, community-based organizations, and other types of organizations)
Domain #6:Public Health Sciences Skills
Describes the scientific foundation of the field of public health
Identifies prominent events in the history of public health (e.g., smallpox eradication, development of vaccinations, infectious disease control, safe drinking water, emphasis on hygiene and hand washing, access to health care for people with disabilities)
Retrieves evidence (e.g., research findings, case reports, community surveys) from print and electronic sources (e.g., PubMed, Journal of Public Health Management and Practice, Morbidity and Mortality Weekly Report, The World Health Report) to support decision making
Recognizes limitations of evidence (e.g., validity, reliability, sample size, bias, generalizability)
Describes evidence used in developing, implementing, evaluating, and improving policies, programs, and services
Describes the laws, regulations, policies, and procedures for the ethical conduct of research (e.g., patient confidentiality, protection of human subjects, Americans with Disabilities Act)
Contributes to the public health evidence base (e.g., participating in Public Health Practice-Based Research Networks, community-based participatory research, and academic health departments; authoring articles; making data available to researchers)
Domain #7: Financial Planning and Management Skills
Describes government agencies with authority to impact the health of a community
Adheres to organizational policies and procedures
Motivates colleagues for the purpose of achieving program and organizational goals (e.g., participating in teams, encouraging sharing of ideas, respecting different points of view)
Domain #8: Leadership and Systems Thinking Skills
Incorporates ethical standards of practice (e.g., Public Health Code of Ethics) into all interactions with individuals, organizations, and communities
Contributes to development of a vision for a healthy community (e.g., emphasis on prevention, health equity for all, excellence and innovation)
Describes ways to improve individual and program performance

Concentration Specific Competencies

Public Health Management
Be capable of applying communication and group dynamic strategies to individual and group interaction
Know effective communication strategies used by health service organizations
Have a knowledge of leadership principles
Be capable of applying decision-making processes
Have a knowledge of systems thinking principles
Know strategies for promoting teamwork for enhanced efficiency
Have an understanding of effective mentoring methods
Be able to use negotiation techniques
A knowledge of ethical principles relative to data collection, usage, and reporting results