Anthem

Medical Policy

Subject: Electrical Impedance Scanning for Cancer Detection
Document #: MED.00139
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Description/Scope

This document addresses the use of electrical impedance scanning for cancer detection.

Note: This document does not address detection of skin cancer. Please see the following related document for additional information on skin cancer detection:

- MED.00004 Noninvasive Imaging Technologies for the Evaluation of Skin Lesions

Position Statement

Investigational and Not Medically Necessary:

Electrical impedance scanning for cancer detection is considered **investigational and not medically necessary** for all indications.

Rationale

Electrical impedance is a physical concept in which a body part's impedance (a calculated measure of electrical conductivity) to an applied alternating current can be measured in order to assess tissue composition. There is interest in the clinical application of electrical impedance technology as a non-invasive way to diagnose and manage malignancies. This approach is based on the notion that the electrical properties of bodily tissues change due to the presence of cancer. Although there is some understanding of this process, exactly how tissue electrical impedance changes with the development of a malignancy is not completely clear. It has been hypothesized that as a malignant pathological process progresses, the tissue's electrical impedance changes due to alterations in cell shape, size, membrane structure and fluid status. Recently, several electrical impedance devices have been developed that are proposed to detect lung, breast, prostate and other cancers using a low-voltage electrical current passed through the skin.

In 2020, Pathiraja and colleagues conducted a systematic review of clinical applications of electrical impedance technology in the detection of malignant neoplasms. A total of 51 studies were examined covering 16 cancer subtypes in 7035 individuals. The primary endpoint was defined as the ability to distinguish between malignant and normal tissue. Studies were categorized based on discriminative strengths determined by the area under the receiver operating characteristic curve (AUROC). Categories were "Good," AUROC > 0.7 or sensitivity and specificity both > 0.75; "Moderate," AUROC > 0.6 or Sensitivity > 0.7; or "Insufficient," not meeting the previous criteria or reporting insufficient data. Six studies examined in vivo breast tissue by measuring the electrical impedance of the overlying skin or lesion itself intra-operatively. Only 2 of the 6 studies were judged to have good or moderate discriminative strengths, the rest were insufficient. Two studies addressed lung cancer, although only 1 measured impedance in vivo and both studies were categorized as insufficient. Two studies examined prostate cancer in vivo, and both were judged to be insufficient. Altogether, in vivo electrical impedance studies were generally found to be non-invasive and painless, but with mixed results in terms of ability to discriminate between normal and malignant tissues. The authors concluded that more research and large-scale multi-center in vivo clinical trials are needed before electrical impedance technology can be reliably employed in the clinical detection of malignant tissue.

Andreasen and colleagues (2021) studied whether skin electrical resistance changes could serve as a diagnostic and therapeutic biomarker associated with physiological changes in individuals with malignant versus benign breast cancer lesions. A total of 48 women were enrolled in this study, 24 with malignant cancer and 23 with benign lesions. Skin electrical impedance measurements (a total of 47 per subject) were performed in lymphatic regions throughout the upper body. Impedance measurements from breast lymphatic points (n=4) and non-breast lymphatic points (n=43) were averaged by location and a ratio calculated between non-breast and breast lymphatic regions to generate individual data points for each subject. In 6 subjects who received therapy, additional longitudinal measurements were taken after 6 months to determine the effect of therapy. Significant differences were observed between subjects with malignant and benign breast lesions ($p<0.01$), and also pre- vs. post-treatment ($p<0.05$). A diagnostic machine learning classification algorithm was created by training a random forest model with impedance measurements and other subject parameters such as age, body mass index (BMI) and smoking status. Breast cancer was classified using this algorithm with an area under the curve of 0.68, sensitivity of 66.3%, specificity of 78.5%, positive predictive value 70.7% and negative predictive value 75.1%. The conclusion was that electrical impedance technology may be a useful diagnostic tool but is probably more suited as an adjunctive test to standard mammography screening rather than a replacement. Further studies are needed that include healthy controls and where operators are blinded as to subject type during electrical impedance measurements.

In 2022, Rezanejad Gatabi and colleagues published a systematic review and meta-analysis of the accuracy of electrical impedance tomography (EIT) for breast cancer detection. Twelve studies including 5487 individuals with breast cancer were analyzed. An overall sensitivity of 75.9% (range 26.4-94.6%) and specificity of 82.0% (range 49.0-98.9%) were reported. Significant heterogeneity was found between the studies (I^2=93.3%, $p<0.01$), as evidenced by the wide ranges in sensitivity and specificity, which may affect the quality of the meta-analysis. The heterogeneity was attributed to differences in protocol design, comparisons and methods between the studies. The authors concluded that although EIT is less effective than ultrasound or mammography due to its lower specificity, it may be a useful adjunct technology. However, further large-scale studies will be needed to support the clinical application of EIT.

The body of evidence regarding the analytical validity, clinical validity, and clinical utility of electrical impedance scanning (EIS) for cancer detection is sparse and of low quality. There are a few prospective studies that have assessed EIS technology in vivo for breast, lung and prostate cancer detection but most have reported either poor discriminative strength or insufficient data to properly evaluate. There are no studies identified in the peer-reviewed published literature that specifically evaluate the analytical validity, clinical validity, or the clinical utility of EIS devices. Use of EIS technology has not been proven to improve net health outcomes.

Background/Overview

According to the American Cancer Society (ACS), an estimated 1.9 million Americans will be diagnosed with some form of cancer in 2023. About 13% of women in the United States will develop breast cancer over the course of her lifetime. Lifetime risk of lung cancer

is about 6%, but it is the leading cause of cancer death among all Americans. Prostate cancer is the most common cancer in American men, other than skin cancer, with about 13% of men being diagnosed with prostate cancer during their lifetime. Survival rates are highest during the earliest stages of cancer, so technologies that facilitate early detection are of great interest and value.

EIS technology has been used for some time clinically in the measurement of fluid volumes as well as overall fluid status and body composition (Khalil, 2014). More recently, there has been interest in using EIS to detect pathological changes in tissue, specifically malignancies. It is thought that changes in cell composition and structure in malignant tissue alter the tissue's electrical conductivity which may be detected by EIS measurements. In particular, the ProLung Test and IONIQ Breast Test (both from IONIQ Sciences, Inc., Salt Lake City, UT) are proposed to use EIS technology to detect cancer in the early stages and accelerate diagnosis. At this time, these devices do not have United States Food and Drug Administration approval.

Definitions

Electrical impedance: Refers to a calculated measure of electrical conductivity.

Coding

The following codes for treatments and procedures applicable to this document are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement policy. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

When services are Investigational and Not Medically Necessary:
For the following procedure code, or when the code describes a procedure indicated in the Position Statement section as investigational and not medically necessary.

CPT

99199	Unlisted special service, procedure or report [when specified as an electrical impedance analysis to detect cancer]

ICD-10 Diagnosis

	All diagnoses

References

Peer Reviewed Publications:

1. Andreasen N, Crandall H, Brimhall O, et al. Skin electrical resistance as a diagnostic and therapeutic biomarker of breast cancer measuring lymphatic regions. IEEE Access. 2021; 9:152322-152332.
2. Khalil SF, Mohktar MS, Ibrahim, F. The theory and fundamentals of bioimpedance analysis in clinical status monitoring and diagnosis of diseases. Sensors. 2014; 14:10895-10928.
3. Pathiraja AA, Weerakkody RA, von Roon AC, et al. The clinical application of electrical impedance technology in the detection of malignant neoplasms: a systematic review. J Transl Med. 2020; 18(1):227.
4. Rezanejad Gatabi Z, Mirhoseini M, Khajeali N, et al. The accuracy of electrical impedance tomography for breast cancer detection: a systematic review and meta-analysis. Breast J. 2022; 2022:8565490.

Government Agency, Medical Society, and Other Authoritative Publications:

1. Fresh Medical Laboratories. Establish ProLung Test Measurement Collection Protocol for Future Studies. NLM Identifier: NCT04134520. Last updated on October 25, 2022. Available at: https://www.clinicaltrials.gov/ct2/show/NCT04134520?term=ProLung&draw=2&rank=1. Accessed on March 28, 2023.
2. Fresh Medical Laboratories. A Multi-Center Trial of the ProLung Test. NLM Identifier: NCT01566682. Last updated on September 4, 2019. Available at: https://www.clinicaltrials.gov/ct2/show/NCT01566682?term=ProLung&draw=2&rank=5. Accessed on March 28, 2023.

Websites for Additional Information

1. American Cancer Society (ACS). Cancer facts & figures. 2023. Available at:https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/2023-cancer-facts-figures.html. Accessed on March 28, 2023.

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ProLung Test
IONIQ Breast Test

The use of specific product names is illustrative only. It is not intended to be a recommendation of one product over another, and is not intended to represent a complete listing of all products available.

Document History

Status	Date	Action
Reviewed	05/11/2023	Medical Policy & Technology Assessment Committee (MPTAC) review. Updated Rationale, Background/Overview, References and Websites for Additional Information sections.
New	05/12/2022	MPTAC review. Initial document development.

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Federal and State law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage. The member's contract benefits in effect on

the date that services are rendered must be used. Medical Policy, which addresses medical efficacy, should be considered before utilizing medical opinion in adjudication. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.