Medical Policy

Blue Cross Blue Shield Blue Care Network of Michigan

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***Current Policy Effective Date: 5/1/22**
(See policy history boxes for previous effective dates)

Title: Intraoperative Fluorescence Imaging Systems

Description/Background

The fluorescence imaging is an intraoperative imaging technique that employs the fluorescence of indocyanine green (ICG) dye for visual assessment of vessels, blood flow, the lymphatic system, tissue perfusion, and/or related tissue transfer circulation before, during, and after vascular, gastrointestinal, organ transplant, plastic, micro-, reconstructive, and/or free flap surgeries. Examples of its use include autologous flap skin perfusion in breast reconstruction; tissue perfusion during organ transplant procedures; vascular surgeries involving grafted vessels during coronary artery bypass surgery, wounds or amputation; renal cancer surgeries; myocardial perfusion in cardiac and cardiovascular surgeries; gastrointestinal surgeries and parathyroid perfusion during endocrine surgery.

Once the graft vessels/tissues have been transplanted, the patient is injected with indocyanine green dye, which quickly binds to plasma proteins. A low intensity laser illuminates the dye as it passes through the grafts/tissues via the patient's bloodstream. The fluorescence imaging system consists of a video camera and a laser light source. The camera, positioned above the operative site, captures images of the fluorescent graft vessels/tissues and displays them on a monitor. If the images reveal a compromised graft, revisions can be performed immediately prior to completion of the surgical procedure.

Indocyanine green was originally FDA approved (NDA) in 1959 for retinal angiography.

Since the approval of indocyanine green, multiple devices which can be used with indocyanine green have been FDA approved.

Regulatory Status

Intraoperative fluorescence imaging has been approved by the FDA for use during coronary artery bypass, cardiovascular surgical procedures, plastic, micro- and reconstructive, gastrointestinal and organ transplant procedures. Products include: Fluoptics Fluobeam imaging, Pinpoint Endoscopic Fluorescence Imaging System, Novadaq SPY system, Hamamatsu PDE system, Quest Artemis and VisionSense VS3-IR-MMS system.

Medical Policy Statement

Assessment of vascular patency, tissue viability, or organ identification or perfusion by any technology (i.e. Artemis Handheld Imaging Systems, Fluobeam 800, Infrared 800, Leica FL800, PDE-Neo, SPY Fluorescent Imaging System, VS3 Iridium System) is considered an incidental part of the procedure when clinical utility has been demonstrated (e.g. breast reconstruction, choroid blood flow, parathyroid perfusion, to aid in sentinel lymph node biopsy) and is **NOT** separately reimbursable.

Inclusionary and Exclusionary Guidelines (Clinically based guidelines that may support individual consideration and pre-authorization decisions)

N/A

CPT/HCPCS Level II Codes *(Note: The inclusion of a code in this list is not a guarantee of coverage. Please refer to the medical policy statement to determine the status of a given procedure.)*

Established codes:

N/A

Other codes (investigational, not medically necessary, etc.):

76499

Rationale

The intention of intraoperative fluorescence imaging is to offer real-time visualization of blood flow to skin and soft tissue in a way that might help surgeons make decisions about closure or coverage of a surgical site based on blood flow, potentially avoiding soft tissue reconstruction while preventing skin necrosis or wound breakdown after primary closures.

Fluorescent angiography allows real-time assessment of blood flow and tissue perfusion in the preoperative, intra-operative and postoperative setting by injecting an intravenous dye that emits infrared energy upon excitation by a light source. As a result, it enables the assessment of blood flow and tissue perfusion..

DSouza et al (2016) discussed the growing interest of using fluorescence imaging instruments to guide surgery and the leading options for open-field imaging were reviewed. While the clinical fluorescence-guided surgery (FGS) field has been focused predominantly on indocyanine green (ICG) imaging, there is accelerated development of more specific molecular tracers. These agents should help advance new indications for which FGS presents a paradigm shift in how molecular information is provided for resection decisions. There has been a steady growth in commercially marketed FGS systems, each with their own differentiated performance characteristics and specifications. United States Food and Drug Administration 510(k) cleared commercial systems and some leading premarket FGS research systems were evaluated. There is no perfect imaging system, but the feature differences among them are important differentiators in their utility. Although new commercial research systems are regularly emerging, there is often an disconnect between the emergency technology and the surgeons need and flexibility. None of the reviews discussed provided direct guidance on how to choose the right imager based on objective criteria. System selection was found to be subjective and dependent on the end-user's preferences. Defining basic criteria for comparing imagers for specific applications can help the field of surgical-guidance mature in an organized manner. Despite the availability of these technologies, most surgeons still rely largely on visual and tactile cues combined with presurgical radiologic imaging to guide tissue resection.

Fluorescence Imaging and Coronary Artery Bypass

Coronary artery bypass graft (CABG) surgery is among the most frequently performed operations in the United States. Favorable patient outcomes are dependent on the success of the union and patency of the transplanted graft vessels. Approximately 4 to 12 percent of patients who undergo CABG surgery experience an occlusion in a transplanted graft vessel during the operation, placing them at increased risk for a heart attack post-operatively.

Currently, the gold standard for evaluating the patency of newly a transplanted coronary artery graft is via conventional x-ray angiography. However, cardiac angiography is not typically performed during course of a CABG, when it would be most ideal to detect a graft failure and would subsequently allow the surgeon to intervene before the patient leaves the operating room. The most widely used technique for intraoperative graft assessment is transit-time flowmetry (TTF). TTF uses the principles of ultrasound to detect coronary artery graft failures, and its ease of use intraoperatively is an advantage over coronary angiography.

Since intraoperative imaging has emerged as a practical approach for early assessment and identification of coronary artery graft failures, alternative technologies have been developed.

Ohmes et al (2017) quarried PubMed using the terms "transit time flowmetry", "graft assessment", "intraoperative fluorescence", "indocyanine green" (ICG) coupled, with "CABG", "imaging" and "patency." Relevant abstracts were reviewed and when found relevant the full article was examined. References from selected studies were cross-checked. The most important articles where included and in cases of disagreement an agreement was negotiated. Examination of different techniques for graft assessment along with their limitations led authors to recommend the use of transit-time flowmetry, especially in the setting of technically difficult cases such as off-pump multivessel sequential CABG. Authors concluded that intraoperative fluorescence coronary angiography (IFI) appears to be a promising modality for graft evaluation, however, limited data exists and we do not recommend its widespread adoption at

this time. More research is needed to delineate its diagnostic capacity. while IFI has been used for years in other surgical subspecialties, its use in determining coronary bypass patency has not been definitively proven. While several studies have shown promising results, continued research with long-term follow-up will help delineate IFI's role in coronary surgery.

Singh et al (2010) sought to establish whether intraoperative graft assessment with criteria for graft revision would decrease the proportion of patients with one or more graft occlusions or stenoses or major adverse cardiac events one year after CABG. In a single-center, single-blinded, controlled clinical trial, patients were randomized to one of two groups: intraoperative graft patency assessment using IFI angiography and TTF. Patients underwent follow-up angiography at one year. Between September 2005 and August 2008, 156 patients undergoing isolated CABG were enrolled (imaging, n = 78; control, n = 78). Angiography was performed at one year in 107 patients (imaging, 55 patients/160 grafts; control, 52 patients/152 grafts). The proportion of patients with one or more graft occlusions was comparable in the imaging (30.9%) and control (28.9%) groups, as were other graft patency end points. The researchers concluded that routine intraoperative graft assessment is safe but does not lead to a marked reduction in graft occlusion one year post-CABG.

Waseda et al (2009) conducted a study to evaluate the intraoperative fluorescence imaging system in the real-time assessment of graft patency during off-pump coronary artery bypass graft. Patients undergoing off-pump coronary artery bypass graft received IFI analysis, intraoperative TTF, and postoperative X-ray angiography. A total of 507 grafts in 137 patients received IFI analysis. Of all the IFI analyses, 379 (75%) grafts were visualized clearly up to the distal anastomosis. With regard to anastomosis location, anterior location was associated with a higher percentage of fully analyzable images (90%). More than 80% of images were analyzable, irrespective of graft type. Six grafts with acceptable TTF results were diagnosed with graft failure by IFI, which required on-site graft revision. All revised grafts' patency was confirmed by post-operative X-ray angiography. Conversely, 21 grafts with unsatisfactory TTF results demonstrated acceptable patency with IFI. Graft revision was considered unnecessary in these grafts, and 20 grafts (95%) were patent by post-operative X-ray angiography. The authors noted that "graft patency assessment using IFI was not in perfect agreement with those of postoperative angiography. Nine grafts were found to be occluded at the time of postoperative angiography, but the IFI system revealed acceptable intraoperative graft patency."

Desai et al (2006) compared the diagnostic accuracy of intraoperative IFI and TTF. Patients undergoing isolated coronary artery bypass grafting with no contraindications for postoperative angiography were enrolled in the study. Patients were randomly assigned to be evaluated with either IFI and then TTF *or* TTF and then IFI. Patients underwent x-ray angiography on postoperative day four. The primary end point of the trial was to determine the sensitivity and specificity of the two techniques versus reference standard x-ray angiography to detect graft occlusion or greater than 50% stenosis in the graft or perianastomotic area. A total of 106 patients were enrolled in this study and x-ray angiography was performed in 46 patients. In total, 139 grafts were reviewed with all three techniques and 12 grafts (8.2%) were demonstrated to have greater than 50% stenosis or occlusion by the reference standard. The sensitivity and specificity of IFI to detect greater than 50% stenosis or occlusion was 83.3% and 100%, respectively. The sensitivity and specificity of TTF to detect greater than 50% stenosis or occlusion was 25% and 98.4%, respectively. The researchers concluded that IFI provides better diagnostic accuracy for detecting clinically significant graft errors than does

TTF. Although the results support the idea that IFI is more accurate in identifying grafts with significant stenosis following CABG, there is no evidence that it is more effective in identifying completely occluded grafts. Additionally, there is no evidence that intraoperative revision of grafts based on IFI assessment leads to improved patient outcomes.

Balacumaraswami et al (2005) performed a prospective observational study to assess intraoperative graft patency in patients undergoing CABG by using an intraoperative fluorescence imaging system and TTF. Between 2003 and 2004, the researchers assessed the intraoperative patency of 266 grafts in 100 CABG patients. The results showed that IFI and TTF confirmed adequate flow in 241 (91%) grafts in 75 patients (75%). Transient poor flow was detected with both IFI and TTF in 7 (2.6%) grafts in 7 (7%) patients. Both IFI and TTF confirmed persistent poor flow in 8 (3%) grafts in 8 (8%) patients that necessitated graft revision. However, in a further 10 (3.8%) grafts in 10 (10%) patients, TTF indicated persistently poor flows on the basis of mean graft flow and pulsatility index values, whereas IFI demonstrated satisfactory flow. These grafts were not revised. The researchers concluded that both IFI and TTF are useful to confirm intraoperative graft patency. However, the researchers added that the "lack of angiographic follow-up precludes understanding the fate of the grafts with initial or persistent poor flow" and that "long-term angiographic patency data would be invaluable in determining the natural history of these grafts." Without appropriate controls in place, it is unclear if the graft revisions that were performed resulted in improved outcomes.

Summary: Fluorescence Imaging and Coronary Artery Bypass
Clinical studies indicate that fluorescence imaging is safe and correlates well with TTF, but there is no evidence to demonstrate that it is superior to TTF. Comparisons of fluorescence imaging to postoperative coronary angiography are less known. Additionally, there is no evidence to show that intraoperative coronary artery graft revisions based on the results of fluorescence imaging leads to improved clinical outcomes, which presents questions as to the diagnostic utility of this technique.

Other Uses of Fluorescence Imaging

Colorectal Surgery
Blanco-Colino et al (2018) discussed the intraoperative use of indocyanine green fluorescence imaging to reduce the risk of anastomotic leakage during colorectal surgery in a meta-analysis which compared fluorescence imaging with standard care. One thousand three hundred and two patients from five non-randomized studies were included. Fluorescence imaging significantly reduced the anastomotic leakage rate in patients undergoing surgery for colorectal cancer (OR 0.34; CI 0.16-0.74; p = 0.006). Low anastomotic leakage rates were shown in rectal cancer surgery (ICG 1.1% vs non-ICG 6.1%; p = 0.02). There was no significant decrease in the anastomotic leakage rate when colorectal procedures for benign and malignant disease were combined. To date, there are no published randomized control trials (RCTs) on this subject, though three ongoing RCTs were identified. Indocyanine green fluorescence imaging seems to reduce anastomotic leakage rates following colorectal surgery for cancer. However, the inherent bias of the non-randomized studies included, and their differences in anastomotic leakage definition and diagnosis could have influenced results. Large well-designed RCTs are needed to provide evidence for its routine use in colorectal surgery.

Endometrial Cancer and Sentinel Lymph Node Mapping

Lymph node sampling involves the removal of a limited number of nodes, which are suspicious for metastatic spread, based on palpitation and visual assessment of nodal size. Multiple tracers and techniques are used for sentinel lymph node (SLN) mapping. SLN mapping including near infrared imaging involves the use of an injectable tracer that identifies the pathway that leads to the SLN. The SLNs are the first lymph nodes that receive lymphatic drainage and hence where the migration of cancer cells may occur. If the SLN biopsy is cancer free, then is likely that the cancer has not spread to the remainder of the lymphatic system.

Namazov et al (2019) address the growing acceptance of intra-operative assessment of all patients in the management of endometrial cancer. Several techniques including blue dye, radioactive technetium-99 and indocyanine green for detection of SLN were discussed. The authors concluded that SLN mapping in endometrial and cervical cancers can easily be performed with high detection rates by using an indocyanine green or near infrared integrated conventional laparoscopic system. SLN procedures reduce the complications associated with lymph node dissection (LND). At the same time, the yield and accuracy are increased as the selected nodes undergo pathological ultra-staging allow detection of metastatic disease that otherwise would have gone undetected. This tailored treatment allows individualization of surgical and postoperative treatment or precision medicine.

Goebel et al (2019) evaluated the clinical significance of isolated tumor cells detected by ultra-staging. Four-hundred and seventy four SLNs from 155 patients with endometrial carcinoma and reported negative SLNs were subjected to an immunohistochemistry protocol which included staining slides with cytokeratin at 1, 10, 20, and 50 µm levels, to examine for ITCs. ITCs were detected in 5.7% (27/474) of SLNs and 13.5% (21/155) of patients with previously reported negative SLNs. In this patient cohort, 95.2% (20/21) had endometrioid histology, with the remaining case being carcinosarcoma. 38.1% (8/21) received adjuvant therapy (either brachytherapy alone (4/8) or chemotherapy and radiation (4/8)) based on other parameters, while 61.9% (13/21) had no adjuvant therapy. Of the patients who did not receive adjuvant therapy, all had endometrioid histology and 84.6% (11/13) were International Federation of Gynecology and Obstetrics (FIGO) stage IA. No patients (0/13) recurred after a median follow-up of 31.5 (range 2-84.4) months. In this study, 38.1% of patients with previously undetected ITCs had adjuvant treatment based on other high risk factors; as such, reporting ITCs would not have altered patient management for those who received adjuvant chemotherapy. To date, no patients with previously undetected ITCs without adjuvant treatment had a recurrence. Authors concluded that ITC detection may not be clinically relevant.

Breast Reconstruction

Griffiths et al (2016) reviewed literature spanning from 1950-2015 regarding the use of fluorescent angiography to assess blood flow, tissue perfusion and clinical utility with breast reconstruction procedures. Numerous commercial near infrared light detection devices can be used to derive quantitative data from the ICG-derived fluorescence, including SPY Elite (Novadaq, Canada), FLARE (Curadel LLC, USA), PDE-Neo (Hamamatsu Photonics, Japan), Fluobeam 800 (Fluoptics, France), and IC-View (Pulsion Medical Systems AG, Germany). In breast reconstruction, ICG has been established as a safer, more accurate tracer agent, in lieu of the traditional blue dyes, for detection of sentinel lymph nodes with radioactive isotopes ([99m]-Technetium). In prosthesis-based breast reconstruction, intraoperative assessment of the mastectomy skin flap to guide excision of hypo-perfused areas translates to improved clinical outcomes. Similarly, in autologous breast reconstructions, fluorescent angiography can

be utilized to detect poorly perfused areas of the free flap, evaluate microvascular anastomosis for patency, and assess superficial inferior epigastric artery vascular territory for use as an alternative free flap with minimal donor site morbidity. The authors concluded that ICG-based fluorescent angiography is a novel, useful tool for various applications in breast reconstruction. More studies with higher level of evidence are currently lacking to validate this technology.

Parathyroid Gland Preservation and Perfusion

Kim et al (2017) reported on the clinical utility of fluorescence angiography in identifying the parathyroid glands during a thyroidectomy. Surgeons have cited difficulties in identifying the parathyroid glands (PG) during thyroidectomy. Preventing or minimizing post-thyroidectomy complications such as recurrent laryngeal nerve injury or parathyroid gland hypofunction remains a challenge. Preservation of the parathyroid gland is critical to reducing postoperative complications in every thyroid surgery. Proper identification and careful dissection is crucial. Parathyroid glands are very small and embedded within paratracheal fat tissues, and have a color similar to surrounding tissues. Less experienced surgeons find it difficult to identify and preserve the gland. Even experienced surgeons sometimes find it challenging to locate all the parathyroid glands with visual inspection and palpation during surgery. Inadvertent parathyroid excision has been reported to be up to 15% of thyroidectomy cases in experienced surgeons. Predicting function of parathyroid glands after surgery was easier with indocyanine green uptake than with visual evaluation. Fluorescence angiography allows direct assessment of the parathyroid gland feeding vessels that are at risk of damage during surgery. It can guide decisions if the parathyroid needs auto transplantation. Authors concluded that indocyanine green will help surgeons determine the best approach to minimize parathyroid damage in thyroidectomies, thus reducing postoperative complications.

Ophthalmology

Stattin et al (2020) did a prospective explorative study to investigate 27 eyes of 17 patients with diabetes maculopathy by fluorescein/indocyanine green angiography (FA/ICGA; SPECTRALIS HRA-OCT, Heidelberg Engineering) and by swept source-optical coherence tomography angiography (SS-OCTA; DRI-OCT Triton Plus, Topcon) to identify clinically relevant microaneurysms. The SS-OCTA cubes were split into the superficial capillary plexus and the deep capillary plexus according to the automated segmentation. The images of all modalities were superimposed for alignment by an Early Treatment Diabetic Retinopathy Study grid overlay and compared to each other. In total, the mean number of microaneurysms in FA was 33.4 ± 22 (standard deviation) (median 27.5 [q1:21.75;q3:38.25]), in ICGA 24.9 ± 16.9 (17.5 [14;35]), in the superficial capillary plexus 6.5 ± 3.7 (5.5 [3.75;9.25]) and in the deep capillary plexus 18.1 ± 10.5 (18.5 [10.75;23.5]). Mixed effects models between ICGA and the deep capillary plexus were borderline significant ($p = 0.048$; 95% confidence interval 0.21 to 13.49), whereas all other imaging methods differed significantly. Quantitative analysis of microaneurysms in diabetes maculopathy showed a plausible agreement between ICGA and the deep capillary plexus in SS-OCTA. These findings contribute to the imaging methodology in diabetes maculopathy.

Campagnoli et al (2015) conducted a retrospective case series including five eyes of five patients with choroidal melanoma that were originally diagnosed and treated as choroidal hemangioma. Four men and 1 woman (26-61 years) were included. All patients were white and presented with nonspecific symptoms (visual field defect, decreased visual acuity, and metamorphopsia) and visual acuity ranging from 20/30 to 20/80. Four of the five tumors were yellow and/or orange and one was partially melanotic. All tumors were dome shaped (one

bilobed) and had associated subretinal fluid overlying the lesion. Two tumors had high internal reflectivity on standardized A-scan ultrasonography, whereas others had low internal reflectivity. Three tumors were hypofluorescent on early phases of indocyanine green and intrinsic vasculature was also observed in two of these three. Four of five patients who were initially treated by photodynamic therapy did not respond to treatment. However, they did respond to radiation therapy (after revised diagnosis), with documented regression and no evidence of detectable metastasis (mean follow-up 24.2 months). Authors concluded that differentiating between amelanotic melanoma and choroidal hemangioma can be challenging. Relying solely on ophthalmoscopic features can be misleading. Ancillary studies such as indocyanine green and standardized A-scan ultrasonography bring clarity in differentiating circumscribed choroidal hemangioma from choroidal melanoma. Although cytology or histopathology is the only definitive method of establishing the diagnosis, careful emphasis on key diagnostic features can obviate the need for diagnostic fine-needle aspiration biopsy in most cases.

Summary: Other Uses of Fluorescence Imaging

The clinical literature referencing intraoperative fluorescence imaging for use in plastic, micro- and reconstructive surgical procedures and tissue perfusion during gastrointestinal and organ transplants revealed small case studies and active clinical trials. Intraoperative fluorescence imaging for the use of SLN mapping resulted in mixed opinions regarding efficacy and clinical utility of the technology use. Larger prospective studies are needed to determine the long term clinical outcomes that result from this technology.

Ongoing and Unpublished Clinical Trials

Some currently unpublished trials that might influence this review are listed in Table 1.

Table 1. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
NCT03602677	Indocyanine Green Fluorescence Imaging in Prevention of Colorectal Anastomotic Leakage	1062	December 2022
NCT01042379	I-SPY Trial: Neoadjuvant and Personalized Adaptive Novel Agents to Treat Breast Cancer (I-SPY)	4000	December 2031
NCT03811704	Real-time Navigation for Laparoscope Liver Resections Using Fusion 3D Imaging and Indocyanine Green Fluorescence Imaging	50	December 2021 (results not posted)
NCT02997553	Fluorescence for Sentinel Lymph Node Identification in Cancer Surgery	774	March 2023

Supplemental Information

No evidence-based guidelines were identified regarding the intraoperative assessment of the integrity and patency of coronary artery bypass grafts. Standardized approaches to the intraoperative evaluation of graft patency are lacking.

National Comprehensive Cancer Network

The NCCNs (2022) principles of evaluation and surgical staging for endometrial cancer indicate the lymph node assessment may be performed by any surgical route, although the standard in those with apparent uterine-confined disease is to perform the procedure via a

minimally invasive approach. Intra-operative lymph node assessment includes evaluation of the nodal basins that drain the uterus, and often comprises a pelvic nodal dissection with or without para-aortic nodal dissection (assessment techniques are not discussed). Pelvic lymph nodes from the external iliac, internal iliac, obturator, and common iliac nodes are frequently removed for staging purposes. Sentinel lymph node mapping may be considered.

Government Regulations

National:

There is no National Coverage Determination (NCD) for fluorescence imaging systems.

Local:

There is no Local Coverage Determination (LCD) for fluorescence imaging systems.

(The above Medicare information is current as of the review date for this policy. However, the coverage issues and policies maintained by the Centers for Medicare & Medicare Services [CMS, formerly HCFA] are updated and/or revised periodically. Therefore, the most current CMS information may not be contained in this document. For the most current information, the reader should contact an official Medicare source.)

Related Policies

- Contrast-Enhanced Computed Tomography Angiography of the Heart and/or Coronary Arteries
- Myocardial Sympathetic Innervation Imaging

References

1. Accorsi, GS., Paiva, LL., et al. “Sentinel Lymph Node Mapping vs Systematic Lymphadenectomy for Endometrial Cancer: Surgical Morbidity and Lymphatic Complications,” *J minim Invasive Gynecol* 2019 Aug, 14. pii: S1553-4650(19)30374-7. PMID: 31421249
2. American Heart Association, “2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery: Executive Summary: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines,” *Circulation* 2011, 124:2610-2642.
3. Balacumaraswami, Lognathen, et al., “A Comparison of Transit-Time Flowmetry and Intraoperative Fluorescence Imaging for Assessing Coronary Artery Bypass Graft Patency,” *J Thorac Cardiovasc Surg* 2005; 130: 315-320.
4. Blanco-Colino, R., Espin-Basany, E. “Intraoperative use f ICG fluorescence imaging to reduce the risk of anastomotic leakage in colorectal surgery: a systematic review and meta-analysis”. *Tech Coloproctol.* 2018 Jan;22(1):15-23. PMID: 29230591
5. Campagnoli TR, Medina CA, Singh AD. “Choroidal melanoma initially treated as hemangioma: diagnostic and therapeutic considerations.” *Retin Cases Brief Rep*. 2016 Spring;10(2):175-82. PMID: 26448544.
6. Desai, Nimesh D. et al., “A Randomized Comparison of Intraoperative Indocyanine Green Angiography and Transit-Time Flow Measurement to Detect Technical Errors in Coronary Bypass Grafts,” *J Thorac Cardiovasc Surg* 2006; 132: 585-594.

7. DSouza AV, Lin H, et al. “Review of fluorescence guided surgery systems: identification of key performance capabilities beyond indocyanine green imaging.” *J Biomed Opt*. 2016 Aug 1;21(8):80901. doi: 10.1117/1.JBO.21.8.080901. PMID: 27533438.
8. Griffiths, M., Chae, M., et al. “Indocyanine green-based fluorescent angiography in breast reconstruction,*” Gland Surg.* 2016 Apr;5(2):133-49. PMID 27047782
9. *Hayes Clinical Research Response*, “SPY Elite Imaging System,” Lansdale, PA: HAYES, Inc., April 9, 2015.
10. *Hayes Technology Brief*, "SPY® Fluorescent Imaging System (Novadaq Technologies Inc.) for Intraoperative Evaluation of Graft Patency During Coronary Artery Bypass Surgery (CABG)," Lansdale, PA: HAYES, Inc., December 3, 2008. Archived January 2012.
11. *Hayes Technology Update*, "SPY® Fluorescent Imaging System (Novadaq Technologies Inc.) for Intraoperative Evaluation of Graft Patency During Coronary Artery Bypass Surgery (CABG)," Lansdale, PA: HAYES, Inc., January 5, 2010.
12. Kim, SW., Lee, HS., et al. “Intraoperative Real-Time Localization of Parathyroid Gland with Near Infrared Fluorescence Imaging,” Gland Surg 2017 Oct; 6(5): 516-524. PMID 29142843
13. Namazov, A., Volchok., V., et al. “Sentinel Node Detection with Near-infrared Imaging in Gynecological Cancer Patients: Ushering in an Era of Precision Medicine,” Isr Med Assoc J 2019 Jun; 21(6):390-393. PMID 31280507
14. National Comprehensive Cancer Network, “NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Uterine Neoplasms,” Version 1.2022. https://www.nccn.org/professionals/physician_gls/pdf/uterine.pdf. Accessed January 5, 2022.
15. National Institute for Clinical Excellence (NICE), “Intraoperative fluorescence angiography for the evaluation of coronary artery bypass graft patency”, Interventional procedure guidance 98. October 2004; http://www.nice.org.uk/guidance/ipg98. Accessed January 5, 2022.
16. Ohmes, LB., DiFranco, A., et al. “Techniques for intraoperative graft assessment in coronary artery bypass surgery,” *J Thorac Dis* 2017 Apr;9(suppl 4):S327-S332. PMID: 28540076
17. Singh, Steve K., MD et al., “The Graft Imaging to Improve Patency (GRIIP) clinical trial results,” *J Thorac Cardiovasc Surg* 2010;139:294-301.
18. Stattin M, Haas AM, et al. “Detection rate of diabetic macular microaneurysms comparing dye-based angiography and optical coherence tomography angiography.” *Sci Rep*. 2020 Oct 1;10(1):16274. PMID: 33005009
19. U.S. National Institutes of Health, “Fluorescent Evaluation of Colorectal Anastamoses,” *Clinical Trials,* Study NCT01424293, last updated August 2014.
20. U.S. National Institutes of Health, “SPY Intra-Operative Angiography & Skin Perfusion in Immediate Breast Reconstruction w/ Implants,” *Clinical Trials,* Study NCT01315119*,* last updated July 2014.
21. Waseda, K., Ako, J., et al., “Intraoperative fluorescence imaging system for on-site assessment of off-pump coronary artery bypass graft,” *JACC: Cardiovascular Imaging,* 2009;2(5):604-12.

The articles reviewed in this research include those obtained in an Internet based literature search for relevant medical references through 1/5/22, the date the research was completed.

Joint BCBSM/BCN Medical Policy History

Policy Effective Date	BCBSM Signature Date	BCN Signature Date	Comments
5/1/12	2/21/12	2/21/12	Joint policy established
11/1/13	8/20/13	9/3/13	Routine maintenance; no change in policy position.
3/1/15	12/12/14	12/29/14	Routine maintenance
7/1/16	4/19/16	4/19/16	• Routine maintenance, Updated references • no change in policy status • Added current clinical trials
7/1/17	4/18/17	4/18/17	• Routine maintenance
7/1/18	4/17/18	4/17/18	• Routine maintenance
5/1/19	2/19/19		• Routine maintenance
5/1/20	3/17/20		• Routine maintenance • Literature review of SPY Elite • C codes removed from policy MPS statement changed to not separately reimbursable statement • Changed to Mixed stance policy
5/1/21	2/16/21		• Routine maintenance
5/1/22	2/15/22		• Routine maintenance

Next Review Date: 1st Qtr, 2023

BLUE CARE NETWORK BENEFIT COVERAGE
POLICY: INTRAOPERATIVE FLUORESCENCE IMAGING SYSTEMS

I. Coverage Determination:

Commercial HMO (includes Self-Funded groups unless otherwise specified)	Not separately reimbursable
BCNA (Medicare Advantage)	Refer to the Medicare information under the Government Regulations section of this policy.
BCN65 (Medicare Complementary)	Coinsurance covered if primary Medicare covers the service.

II. Administrative Guidelines:

- The member's contract must be active at the time the service is rendered.
- Coverage is based on each member's certificate and is not guaranteed. Please consult the individual member's certificate for details. Additional information regarding coverage or benefits may also be obtained through customer or provider inquiry services at BCN.
- The service must be authorized by the member's PCP except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Services must be performed by a BCN-contracted provider, if available, except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Payment is based on BCN payment rules, individual certificate and certificate riders.
- Appropriate copayments will apply. Refer to certificate and applicable riders for detailed information.
- CPT - HCPCS codes are used for descriptive purposes only and are not a guarantee of coverage.