The growth of ^{68}Ga in PET

A rapid rise in the applications and use of gallium-68 (^{68}Ga) tracers has led to demand that has outstripped supply; and this demand is growing.

**^{68}Ga is a PET radionuclide with similar imaging properties to fluorine-18 (^{18}F).
It has a shorter half-life than ^{18}F, of 68 minutes, making centralised production more difficult.**

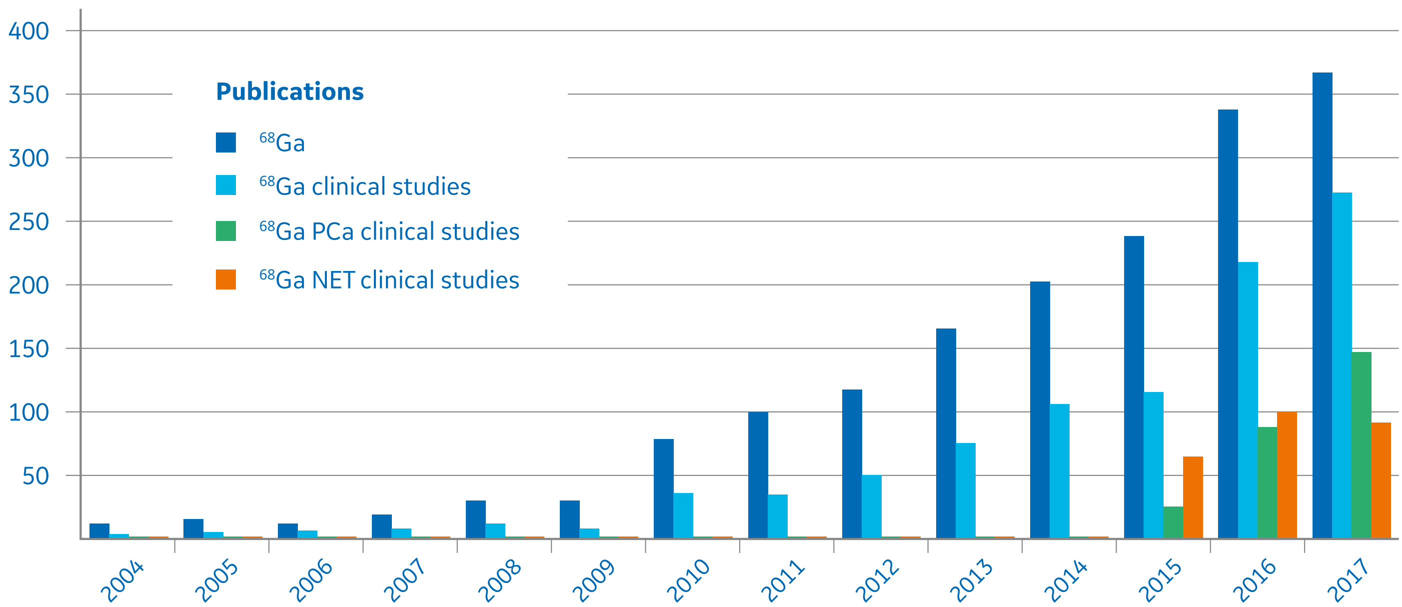
GE Healthcare is here to help.

^{68}Ga growth

The first modern ^{68}Ga generator became commercially available in 1996. Since then, the number of ^{68}Ga publications has grown rapidly, with a 100-fold increase in the last 15 years (Figure 1). The growing interest in ^{68}Ga has outstripped supply, and there is need for novel, cost-effective means of ^{68}Ga production.

The rapid rise in published clinical studies using ^{68}Ga is driven by the development of ^{68}Ga tracers for imaging of neuroendocrine tumor (NET) and prostate cancer (PCa), now the most common cancer in men. The approval in 2014 of a pharmaceutical grade ^{68}Ga generator helped to expand access to tracer supply. Marketing approval for two NET ^{68}Ga tracers, [^{68}Ga]Ga-DOTA-TATE and [^{68}Ga]Ga-DOTA-TOC, and the administration of [^{68}Ga]Ga-PSMA-11 for PCa imaging in more than 7,000 patients followed.

Figure 1 – Academic publications since 2004



^{68}Ga growth

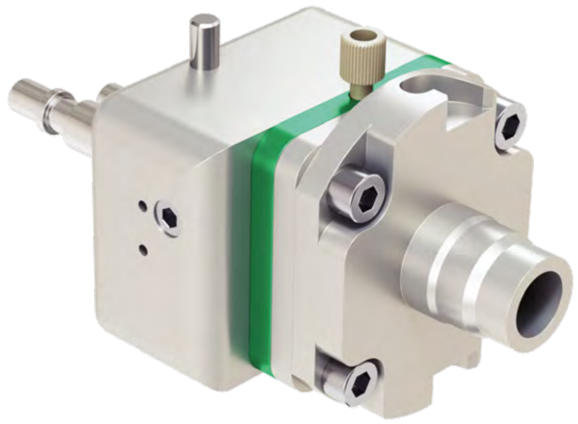
This growth in the use of ^{68}Ga PET radionuclide use will continue due to its adaptability in theranostics and peptide receptor radionuclide therapy (PRRT). Marketing authorisation for the first theranostic pair using ^{68}Ga was granted recently and PRRT has the potential to become widely used in patients whose disease is not suitable for surgery, focused radiation therapy, or where chemotherapy is not appropriate.[1,2]

In addition, there are currently dozens of Phase III and early clinical development trials for new tracer applications: in insulinoma, breast cancer, PCa, infection, renal cancer, rheumatoid arthritis, pulmonary fibrosis, stroke and coronary artery disease.

To help meet the soaring demand, GE Healthcare has developed exceptional cyclotron technology coupled with fully automated purification and synthesis solutions.

Cyclotron technology

GE Healthcare announced the availability of the ^{68}Ga liquid target on the PETtrace™ 800 series cyclotron in 2017, and is currently working on solid target options.



PETtrace 800 ^{68}Ga liquid target system performance summary

Isotope	Nuclear Reaction	Target Media
Gallium-68	^{68}Zn(p,n)^{68}Ga	[^{68}Zn]Zn nitrate salt solution in dilute nitric acid

Demonstrated performance yields

Output	Yield EOB	Irradiation Time
[^{68}Ga]Ga^{3+}	100 mCi / 3.7 GBq	60 min

Workflow & typical equipment

The liquid target workflow is summarised below.

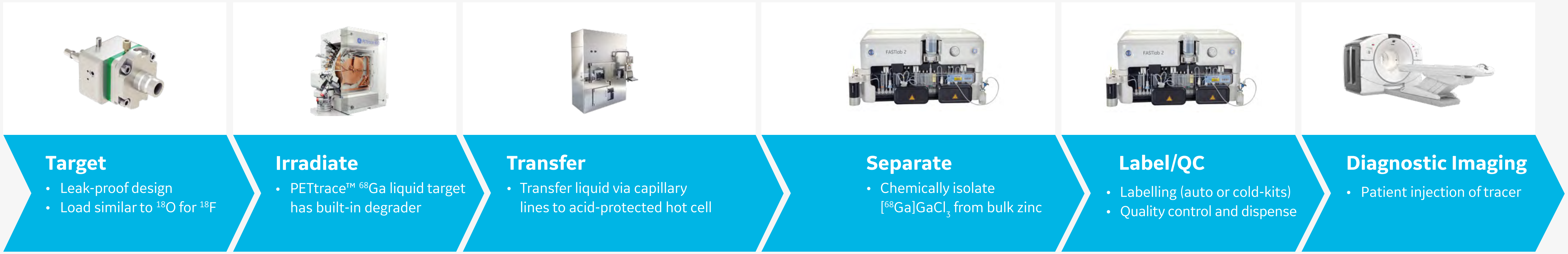


Figure 2 – High level workflow for cyclotron production. Images may not be representative.

FASTlab™ production of [^{68}Ga]$GaCl_3$

The FASTlab Developer platform isolates [^{68}Ga]$GaCl_3$ from the target solution by an efficient, fully-automated two step purification process. This provides pure [^{68}Ga]$GaCl_3$ in a form ready for further processing either within the FASTlab Developer cassette or via kit chemistry providing the desired tracer of choice.

Figure 3 – FASTlab 2 and FASTlab Developer

Example of initial results[4] from consecutive productions of [^{68}Ga]$GaCl_3$

Parameter/QC Test	Value
Irradiation conditions	14 MeV/60 min/30 μA
Total ^{68}Ga at EOB	4.4 GBq (120 mCi)
[^{68}Ga]$GaCl_3$ in hand @ 30 min post EOB	2.5 GBq (68 mCi)
Activity concentration @ 30 min post EOB	0.89 GBq/mL (24 mCi/mL)
RCP	99%

GE Healthcare offers an exceptional cyclotron system alongside fully automated purification and synthesis, and is committed to helping you to meet the growing demand.

Contact GE Healthcare today to learn more.

References:

1. Kwekkeboom DJ and Krenning EP. In: Peptide Receptor Imaging. Cook JR, Maisey MN, Britton KE, and Chengazi V (eds.). Clinical Nuclear Medicine 4th Edition, New York, Oxford University Press (2006).
2. Al-Nahhas A *et al.* Gallium-68 PET: A New Frontier in Receptor Cancer Imaging. Anticancer Research 2007; 27: 4087-7094.
3. Chakravarty R *et al.* Clinical ^{68}Ga-PET: Is radiosynthesis module an absolute necessity? Nuclear Medicine and Biology 2016; 46: 1-11.
4. Nair M *et al.* Cyclotron production and automated new 2-column processing of [^{68}Ga]$GaCl_3$. European Journal of Nuclear Medicine and Molecular Imaging 2017; 44: S119-S956.

GE Healthcare
3000 North Grandview Blvd, Waukesha, WI 53188, U.S.A.
www.gehealthcare.com

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