So we start with a random variable, recall that $\Gamma(\frac{1}{2}) = \sqrt{\pi}$

$$\phi(x) = \frac{1}{\sqrt{2}\Gamma(\frac{1}{2})} e^{-\frac{x^2}{2}}$$

So the same variable squared is:

$$\begin{aligned}
f(x) &= \frac{\delta}{\delta x} Pr(X^2 \leq x) = \frac{\delta}{\delta x} Pr(-\sqrt{x} \leq X \leq \sqrt{x}) \\
&= \frac{\delta}{\delta x} \frac{1}{\sqrt{2}\Gamma(\frac{1}{2})} \int_{-\sqrt{x}}^{\sqrt{x}} e^{-\frac{u^2}{2}} = \frac{\delta}{\delta x} \frac{2}{\sqrt{2}\Gamma(\frac{1}{2})} \int_{0}^{\sqrt{x}} e^{-\frac{u^2}{2}} \\
&= \frac{2}{\sqrt{2\pi}} e^{-\frac{\sqrt{x}^2}{2}} \frac{\delta}{\delta x} \sqrt{x} = \frac{2}{\sqrt{2\pi}} e^{-\frac{x}{2}} \frac{1}{2\sqrt{x}} \\
&= \frac{e^{-\frac{x}{2}}}{\sqrt{2\pi x}}
\end{aligned}$$

or using change of random variable formula

$$f_Y(y) = \Sigma_i f_X(g_i^{-1}(y)) \text{abs} \frac{\delta g_i^{-1}(y)}{\delta y}$$